Engaging Ecological Monitoring in Atlantic Canada

Report prepared for:
Ecological Monitoring and Assessment Network Coordinating Office

Clean Annapolis River Project
Megan Beveridge, Consultation Coordinator

Table of Contents

Acknowledgements:

The productivity of the consultation process was the direct result of the contributions of the participants. The Clean Annapolis River Project acknowledges all those involved in the consultation for sharing their experiences, and for contributing their time and ideas. Representatives from the 14 Atlantic Coastal Action Plan sites, the Mersey-Tobeatic Research Institute, the Nova Scotia Department of Environment and Labour, the Centre for Sustainable Watersheds, and the Community-based Environmental Monitoring Network all participated in the process.

The Ecological Monitoring and Assessment Network Coordinating Office (EMAN CO) provided the necessary resources and funding for the consultation. The Coordinating Office also contributed staff time and resources for the consultation process itself, and helped to provide background on the issues at hand for the participants.

Executive Summary:

Monitoring practitioners from the Atlantic Coastal Action Program (ACAP), along with others involved in ecological monitoring in the Atlantic Region, came together for the first time as part of a consultation process to discuss common monitoring issues. This marks the first occasion that ACAP ecological monitoring staff had to share thoughts, ideas and concerns about monitoring programs. The Clean Annapolis River Project (CARP) served as the host organization for the consultation process, which was supported by the Ecological Monitoring and Assessment Network Coordinating Office (EMAN CO).

The consultation process aimed to find answers to common problems that monitoring practitioners face when trying to engage in the decision-making process, while at the same time forging a more solid network among ACAP monitoring practitioners. During the first half of the consultation process participants were introduced to and made familiar with the issues that were under consideration. Questions regarding the issues discussed were then answered based on each participant's experience. At the end of the consultation process, a final list of outcomes and action items was produced, outlining pertinent questions and tangible steps that could be taken.

Objectives:

The consultation process was intended to develop a stronger network among ACAP monitoring staff, as well as to answer questions on how to improve the effectiveness of ecological monitoring. The discussions centered on the following points:

- The standardization of monitoring protocols among ACAP groups
- Methods for sharing data and compiling data to determine regional trends
- The use of EMAN protocols in both long-term ecological monitoring and the generation of timely feedback on policies and choices
- Designing monitoring programs to better support the decision-making process
- Creating a stronger network among ACAP monitoring practitioners

Outcomes:

Outcomes for the consultation process centred around two major issues for monitoring practitioners in the Atlantic Region: how to maintain a strong network of monitoring practitioners; and how to increase the effectiveness of the monitoring work done in the region.

- The decision was made that performance measures will be created based on the impacts monitoring information has on decision-making (aligned with RMAF)
- Opportunities for standardizing monitoring protocols across ACAP were agreed upon, and steps were discussed on how to proceed
- Two areas were identified as being common stumbling blocks when trying to integrate ecological monitoring with the decision making process
    1) Obtaining feedback from decision-makers on what types of information and monitoring results would be beneficial to them
    2) Packaging and presenting ecological monitoring data to decision-makers in an effective way
- The benefits of maintaining a network among ACAP monitoring practitioners was recognized and a number of actions identified to help work towards this goal

Introduction:

Atlantic Coastal Action Program

The Atlantic Coastal Action Program (ACAP) was created in 1991, shortly after Environment Canada (EC) announced its new Green Plan in 1990. The program emerged from an initiative called the Atlantic Estuaries Cooperative Venture, established in 1988, which was initiated due to increasing concerns about the state of estuarine health in Atlantic Canada. This new venture was created based on the idea that communities, when provided with the right tools, could solve their own environmental problems (Daborn, 1992). To put this idea into action, 14 independently operated, community-based organizations were created throughout Atlantic Canada. The location of the sites was chosen based on the presence of sensitive ecosystems, and the current level of ecological degradation in the area. The boundaries of each ACAP site follow the catchment areas for their watersheds. There are currently two sites in both Newfoundland and PEI, and five each in Nova Scotia and New Brunswick (Figure 1) (Rousseau et al, 2005).

Figure 1. Location of ACAP sites in Atlantic Canada

There is as much variability between ACAP sites as there is between the communities in which they operate. There are ACAP sites located in cities such as Saint John, NB and St. John's, NF as well as smaller communities like Montague, PEI and Mahone Bay in NS. Besides varying in size, ACAP communities also have different socio-economic bases depending on whether they are reliant on tourism, natural resources, industry or commerce, as well as other complex measures such as age demographics. The site at Sable Island, which is inhabited only as a research station, is completely unique.

During Phase I of the program, EC provided funding for ACAP sites to develop their own Comprehensive Environmental Management Plans (CEMP) based on relevant environmental issues within their communities. While funding was also provided by EC for Phases II and III of the program, which focussed on projects under the headings of Knowledge Generation, Capacity Building, Direct Action and the Advancement of Science, ACAP sites also work to secure funding from outside sources. Funding and other contributions are secured from sources such as industry and local businesses, other levels of government, in-kind contributions and volunteer labour, and other non-profit organizations. Because projects undertaken by ACAP sites often involve multiple stakeholders, ACAP also helps to contribute to sustainability by promoting community partnerships (Rousseau et al, 2005).

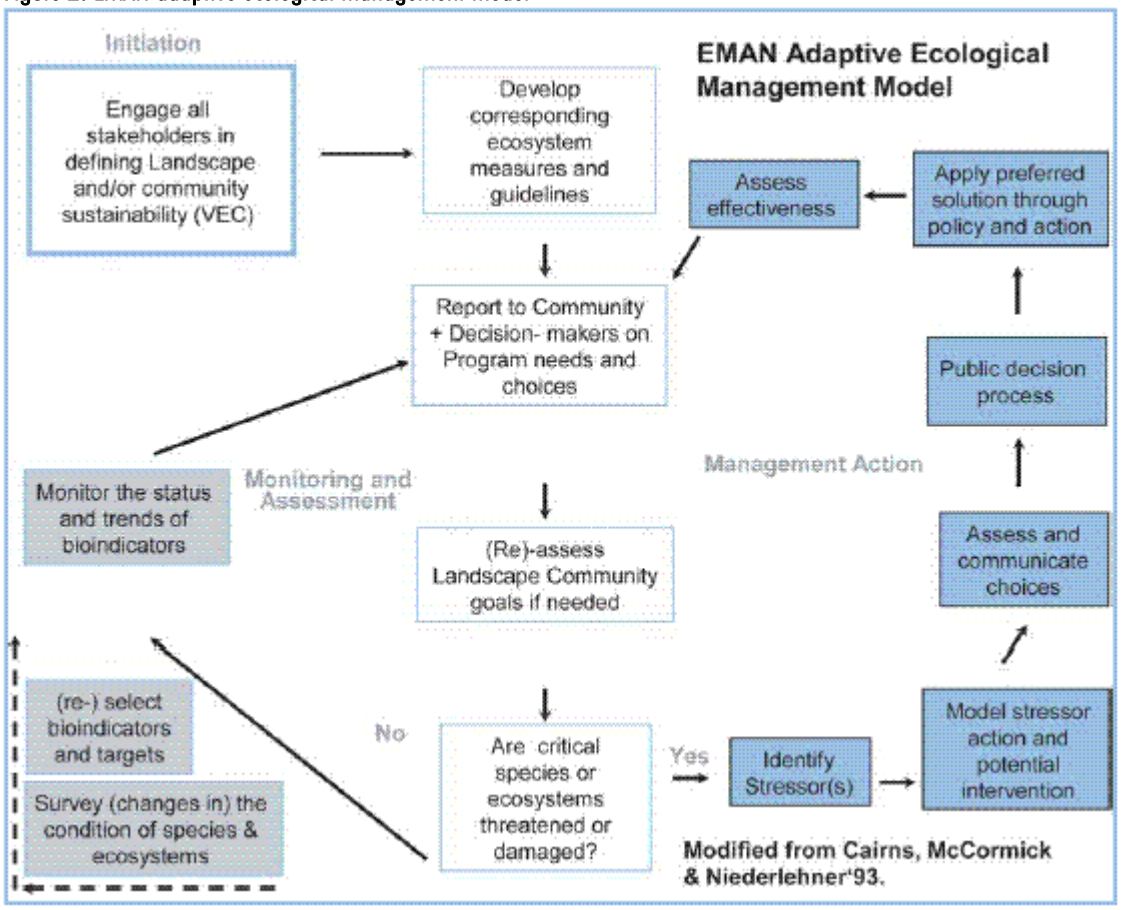
All 14 ACAP sites conduct some type of ecological monitoring, and several have participated in long-term programs (five years or more) resulting in large data sets that can provide detailed information about ecosystems over time. In a survey on monitoring activities within ACAP (Sullivan and Beveridge, 2005), it was also discovered that many of the ACAP sites monitor similar parameters, suggesting possibilities for standardization, and several make use of standard national protocols. As all fourteen sites are already connected under the umbrella of ACAP, the opportunities for cooperation on monitoring projects, including data standardization and sharing, are much stronger, opening the possibility of producing provincial and regional reports on the state of the environment.

Ecological Monitoring and Assessment Network

In 1994 Environment Canada created the Ecological Monitoring and Assessment Network Coordinating Office (EMAN CO). The Office serves to connect monitoring programs from across the country, creating a national network for ecological monitoring practitioners, and is working on creating standard monitoring protocols, including tiers of protocols that can be followed by volunteer citizen scientists. Studies done by EMAN have demonstrated that most monitoring programs are short term, lasting only one to three years, and that they monitor only a handful of parameters, with different projects using different protocols to measure similar variables. One of the mandates of the EMAN Coordinating Office has been to encourage the establishment of long-term monitoring sites and stations, to better document environmental changes over time. Linked with this is the initiative to develop suites of parameters that are tested using the same protocols, so that data can be pooled from over a larger geographical area. By its efforts, the EMAN Coordinating Office hopes to prevent monitoring programs from becoming isolated and their results from being under-utilized.

EMAN CO has also undertaken work to determine how to use monitoring data to help inform the decision-making process, so that data can be used to facilitate change. The concept of 'adaptive management' illustrates how monitoring information can be fed into the decision-making process and used to inform decisions at the community level (Figure 2). Linking ecological monitoring to decision-making is a process that serves the needs of both decision-makers and monitors. Decision-makers are able to make more informed decisions when provided with relevant and timely information on key issues within the community, while monitoring practitioners and volunteers are able to see positive results within their community as the information they provide is used to effect environmental change (EMAN CO and CNF, 2003). One of the network's main priorities is to increase the communication between ecological monitors and decision-makers, and it continues to work with monitoring practitioners to help them deliver their data in a more timely, integrated and non-confrontational manner, in order to better support adaptive management.

Figure 2. EMAN adaptive ecological management model



Atlantic Canada & EMAN

Groups involved in water quality monitoring in the Atlantic Region already measure many common parameters (Sharpe and Sullivan, 2003), but may use different protocols, which limits the ability of the data to be compiled and shared. Parameters that have been monitored include physical, such as temperature and Total Suspended Solids (TSS), biological (bacteria, benthic invertebrates) and chemical (Dissolved Oxygen (DO), pH). The five most commonly measured parameters were respectively: temperature, DO, fecal coliforms, pH and nitrogen. Even when considering one of these parameters, such as fecal coliforms, there are several methods that could be, and were, used for its measurement. The five least commonly measured parameters included secchi transparency, hydrocarbons, birds and other wildlife, chlorophyll and pesticides. Examining the range of parameters that were being monitored within Atlantic Canada, and the overlap between many monitoring programs has led to speculation on the possibility of standardization of protocols, either regionally or provincially.

A survey of monitoring programs undertaken within ACAP itself (Sullivan and Beveridge, 2005) noted a similar overlap between parameters being measured. The long-term presence that ACAP sites have had in Atlantic Canada make them an important source of information on the history of ecological monitoring in the region. The communication and interaction between the sites, as they operate together under ACAP, helps to form a mini-network that spans all four provinces and incorporates many ecologically sensitive areas within the region. The stability and experience represented by ACAP sites serve as a unique resource to inform others on, as well as to research trends within, ecological monitoring

in the Atlantic Region. As with other community monitoring groups, ACAP sites often measure similar sets of parameters, but there is little standardization in the methods used to collect monitoring data. Commonalities most often exist where national or regional protocols are being used, such as the CABIN (Canadian Aquatic Biomonitoring Network) protocol or the protocol used for New Brunswick's Water Classification Program. The survey also examined how the data collected through ACAP monitoring programs was reported and stored, and how effective the programs were at engaging decision-makers. The report discovered that only about half of the monitoring programs actively engaged decision-makers, and that thirty percent of those programs received feedback from decision-makers.

A recent survey undertaken by the Southeast Environmental Association (SEA) examined how data is currently stored, shared and obtained within ACAP, and described what survey participants found to be major barriers in data sharing. Among the problems to overcome are a lack of standardized templates for data entry, appropriate tools such as software, and insufficient time, funding and education for staff to enter and obtain data (Boyce and Judson, 2005). Greater communication between monitoring practitioners in the Atlantic Region may provide part of the answer in helping to integrate and standardize data that is collected. EMAN can play a major role in the process by helping to connect and develop a stronger regional network among ecological monitors, and at the same time provide technical information and monitoring strategies to help achieve common goals such as standardization of protocols and more effective data delivery.

One process being championed by the EMAN Coordinating Office, referred to as Community Based Monitoring (CBM), appears to be well aligned with the goals and outcomes of ACAP. A report compiled by EMAN CO and the Canadian Nature Federation (2003) defines Community Based Monitoring as a "process where concerned citizens, government agencies, industry, academia, community groups and local institutions collaborate to monitor, track and respond to issues of common community concern." Based on this definition, it can be argued that ACAP has been involved in CBM since its inception. The projects undertaken by ACAP sites often involve multiple stakeholders, and focus on issues that have been identified by their communities as areas of concern. EMAN has developed a suite of standardized protocols that can be used by citizen scientists to monitor a variety of environmental factors, the application of which has the added bonus of being able to compare data that was gathered at different sites over time. Some ACAP sites are already actively involved in administering the CBM protocols developed by EMAN and their partners, such as CABIN, PlantWatch (a component of NatureWatch), and EMAN's Terrestrial Biodiversity Monitoring Protocol (Sullivan and Beveridge, 2005).

A recent paper by Sharpe and Conrad (2005) deals with CBM in Nova Scotia, highlighting some of the challenges and opportunities involved in CBM. The authors identified the major issues within the province, including the lack of capacity to establish and design new monitoring programs, which impacts the ability of CBM groups to collect valid data; the difficulty in sharing data to conduct comparative analysis between watersheds; the scarcity of funding and resources to support ecological monitoring; and difficulty in engaging the public sector. Despite the problems that CBM groups face, the number of active groups within the province has continued to increase, partly because the monitoring responsibilities once undertaken by the government have been shifted to these stewardship groups. There has also been a corresponding increase in environmental concerns as the public becomes more aware of environmental problems in their region. Establishing a supportive network for CBM groups, as well as securing increased funding and mentoring support, in the form of scientific expertise and information management, and developing scientifically robust, standardized protocols to facilitate data sharing and to increase the compatibility of data sets were all recommendations made by the authors.

Creating Dialogue:

As the purpose of the consultation was to discover major trends and issues in ecological monitoring in the Atlantic Region, much of the consultation process involved direct discussion with practicing ecological monitors, although others whose focus was on metadata, data storage, and monitoring trends were also included. To gain additional perspective on how monitoring can be used to facilitate environmental change, in the form of policy and action, ACAP Executive Directors were also consulted. Participants in the consultation (Appendix A) contributed information on a variety of topics, which are listed below.

Consultation Background

EMAN consultation participants were briefed on the topics that would be discussed and the format of the consultation. Participants were introduced to each other and gave a brief background on where they were from and the types of monitoring their organizations have conducted. To ensure participants had sufficient background, the following topics were included in the introduction (Appendix B):

- The concept of 'data delivery' and the adaptive management model
- Providing concrete examples of successes in engaging decision-makers within ACAP
- Monitoring programs that were common among ACAP sites, and programs that were unique to specific sites
- Ideas for improving ecological monitoring and reporting

The role that EMAN has played in promoting community-based monitoring (Appendix C) was discussed, including:

- Common and problematic environmental issues
- Monitoring definitions
- A detailed review of EMAN's monitoring programs and protocols
- Indicators/Methods used for the early detection of ecological change
- Multi-party community based monitoring

EMAN's perspective on community-based monitoring (Appendix D) was emphasized, covering:

- The role of the EMAN Coordinating Office (EMANCO) and its focus on standardization, assessment, engagement and delivery in increasing the effectiveness of ecological monitoring
- The goals of environmental monitoring
- The different types of monitoring covered by the EMAN protocols, both biotic and abiotic
- How the goods and services provided by healthy ecosystems can be used to create an economic valuation demonstrating their worth
- The role of good scientific information in enhancing the sustainability of communities
- How community-based monitoring creates ownership of data

Monitoring Practitioners Consultation

Monitoring Trends

Following the above introduction, participants were asked a number of questions concerning their monitoring programs, including: the program objectives; how their data was stored, reported and analysed; who the information was communicated to; and if local decision-makers were included in the process. Definite trends appeared amongst the answers given, which seemed to vary based on the original intent and goals of the monitoring programs. Some monitoring programs were geared towards long-term surveillance of an area or issue, while others were short-term and sought to answer specific questions.

Common objectives of monitoring were:

- Documenting ecosystem changes over time

- Evaluating ecosystem health
- Compiling baseline data
- Educating and informing the public
- To inform Best Management Practices in industry
- To measure biodiversity
- To monitor effectiveness of Sewage Treatment Plants

Information was often reported back to:

- Volunteers participating in the programs
- Provincial governments (Department of Environment and Labour)
- Federal departments that were involved in the project (Department of Fisheries and Oceans, EC, Natural Resources Canada)
- To the public, via websites and newsletters
- Industries involved in the study
- To the Board of Directors

Data was often reported and stored:

- In the form of reports, posted on websites or held as hard copies
- Kept internally in databases and spreadsheets
- Sometimes posted to online databases (more likely if monitoring program long-term or supported nationally, like CABIN)
- In newspaper articles

Data was being used by decision-makers:

- When monitoring was conducted to ensure compliance with environmental standards, direct outcomes were reported to particular organizations
- Bacterial information collected in the Water Classification Program in New Brunswick was used by decision-makers
- Water Quality data was used in environmental prosecution

<u>Data Delivery</u>

After determining the general trends in monitoring programs in the Atlantic Region as suggested by the previous discussion, participants next provided input on strategies and major barriers in the delivery of monitoring information to decision-makers. Important examples and topics that emerged from the consultation have been grouped into the categories of Engaging Industry, Utilizing Data, Developing Relationships and Trust, and Tools for Moving Forward.

Engaging Industry

EMAN CO has suggested that industry is more resistant to sudden changes than other parts of society (decision-makers, general public). However, like other decision-makers they must be allowed to remain in charge of their own decisions, and not to be alienated by confrontation/usurped by those telling them what to do. In order to change industry practices, companies must want to engage in a process of continual improvement, whereby they move towards sustainability by continuously re-evaluating and improving their practices and policies. A case was brought forward by a researcher with the Mersey-Tobeatic Research Institute (MTRI) who had been working with the Bowater-Mersey Pulp and Paper company on creating guidelines for buffer zones along water courses. The study examined the effects of the

percentage of forest harvested within a catchment basin on water quality. Bowater-Mersey was willing to abide by the recommendations of the study and incorporate them into their Best Management Practices, as well as providing support and participating in dialogue on the study.

The willingness of this particular company to engage in and support ecological monitoring efforts led to the examination of unique features of the corporation. Bowater-Mersey currently has a large proportion of younger employees in management positions, which may make them more open to new practices and ideas. The company is also family-oriented, which could increase the environmental awareness of management as they are concerned about the future for their children. The company includes people from the community, and maintains a good relationship with others in the community, and therefore has an interest in showing that they care about protecting local resources. It was also noted that as long as 11 years ago Bowater-Mersey participated in monitoring and had representatives on the board of the Biosphere Reserve, an activity that may have led to increased knowledge of and concern over environmental issues. It was decided that these factors created an environment within the company that promoted the idea of continuous improvement, raising the question of how to encourage other corporations to become involved in similar activities.

Utilizing Data

One of the major issues in ecological monitoring is how to engage with decision-makers so that the information that is collected can be used in a meaningful way. Asking decision-makers what information they would like to see, and presenting it effectively, are the two components of data delivery, as advocated by EMAN, that monitoring practitioners often have the most difficulty in achieving. It was suggested that one method to find out what information decision-makers need would be to attend or organize a community visioning/planning session, which would highlight the local priorities and information needs. The idea of timeliness, when it comes to presenting information, was also underlined during the discussions. It was particularly stressed that the traditional approach, where decision-makers are approached directly before a decision needs to be made, is presenting information too late in the process, not allowing enough time for review and almost none for the information to be incorporated before the deadline. Approaching decision-makers when issues are emerging was advocated as a more effective approach to having monitoring information incorporated into the decision-making process. It was also mentioned that from a government perspective, the issue was in how to engage the community to determine its needs and opinions before making decisions. As a twist on the usual method of having community groups trying to engage decision-makers, it was suggested that an alternative may be to advertise how government can engage communities through community groups, shifting the onus onto them.

The issue of how to handle sensitive data was brought up by several participants. The decision of whether or not to publicize information can be a dilemma among groups, particularly if the information poses a risk to public safety or may stir up major controversy. One monitoring practitioner suggested doing a risk-based assessment on whether or not alienating local industry or decision-makers by publishing data may be worth it. With regards to discoveries that could be threatening to human health, such as improperly stored or dumped hazardous substances, government representatives participating in the consultation suggested turning the information directly over to the appropriate governing body.

It was noted that monitoring groups most often respond to specific issues and problems, and have difficulty determining how to take data to decision-makers. This problem is compounded when monitoring data reveals that there is no current environmental problem, identifying an area as one that should be preserved, instead of remediated. Healthy ecosystems are always sensitive to disruption, either from local factors, such as development, or from global issues such as climate change or acid rain. The question was raised on how to use monitoring data to maintain a state of good

ecosystem health, instead of to report a problem. One suggestion was to provide positive feedback to decision-makers, local authorities and the public on the good conditions existing in a certain area. If the health of an ecosystem is established in the public consciousness, it can become a point of pride within the community, and help to safeguard against future damage.

A point was made that there is no one formula or universal method for dealing with every community, and that those involved in environmental stewardship must always keep in mind the priorities of the communities that they are dealing with. One ACAP monitoring practitioner, whose ACAP site has been fighting to keep out a potentially harmful development in its area, illustrated this point by describing how they had approached representatives from two municipalities differently, to achieve the same result. With one community, where the local economy stood to lose by the development, they based their arguments on economics. With the other, where tradition and stability were higher priorities, the message was changed to illustrate how stopping the development would bring the community together. Using information in different, but effective ways, and developing strategies to do so, can be a key factor in making sure that the information that is presented successfully engages decision-makers.

Developing Relationships and Trust

The idea was brought up in the consultation that relationships between decision-makers and community members must be established in order for the voice of monitoring practitioners to be heard. The problem then, becomes one of how to first create and then maintain a relationship with community members. One method advocated by the EMAN Coordinating Office is to initiate a 'community visioning session', where community members decide what is important to them within their community, and create a plan to support their vision. This process can help to bring polarized communities together, as often many people can agree on what they do not want to give up in their community, regardless of the perspective they bring to the session. By having the community reach a consensus or agreement together, it brings everyone on board for future decisions made based on the outcomes of the visioning session.

In some cases relations were strained between town councils and community groups in particular, even when the community as a whole was not at odds. Many consultation participants questioned how to present information to town council members, after they have become alienated through past confrontations. It was put forward that it is important to first develop or heal a relationship with the council before results are presented to them, so that the information does not feel threatening. In small communities in particular, this was often achieved by paying attention to someone you know on the council, or in the case of one ACAP site to even have staff who sit on the town council to act as a window to their activities. It was stressed that it is important to develop any kind of relationship with local decision-makers, and to facilitate a process where round table discussions, and not direct questions or demands, provides the means of communication. It was also noted that it is important to recognize the contributions of communities and local authorities towards environmental projects. An example of this acknowledgement was found where one community group received an award for their work in bringing attention to an environmental issue, which was then remediated by local decision-makers. The community group invited the decision-makers to the awards ceremony in recognition of their contributions and the actions that they took.

The participation and cooperation of communities alone does not provide enough support for effective monitoring programs- there is also a need for government support. One example that was given involved a fledgling community group that had good relations within the community, and had worked hard to set up a meeting with government representatives to answer key questions that had been raised, but was disappointed by the process. The representatives who attended the meeting were poorly briefed on and inexperienced with the subject matter, and therefore could not

provide any useful information. This showed the community group members that their efforts were not important to the government, causing the movement to lose momentum as members lost enthusiasm. The above example illustrates the importance of support from many sources, both government and at the community level, to encouraging ecological monitoring programs. If community groups do not trust the government to be supportive of them and listen to their concerns and questions, it can be a strong disincentive for groups to form at all.

Tools for Moving Forward

The EMAN Coordinating Office has suggested developing guidelines on how to approach decision-makers and change monitoring programs to fit with their needs as a tool for those involved in ecological monitoring. It was recommended that information on conflict management and negotiation skills would be useful, as the sensitive nature of environmental issues can lead to confrontation. Advice on social marketing techniques with a focus on how to change behaviour and practices within a community would also be useful. It was also proposed that a 'story database' be compiled that features examples both of when decision-makers were successfully engaged and when they weren't, in order to examine what works in real situations. Different scenarios featured in the database may be able to be adapted to fit specific situations. The suggestion was made by the EMAN Coordinating Office that a new section on the Citizen Science website (citizenscience.ca) could be dedicated to this venture.

Monitoring practitioners agreed that it takes both good practices, taken from guidelines, and good people to achieve productive partnerships. Social capital, which takes time and people to attain, is an important but overlooked component to successful engagement with decision-makers. Positions to build social capital are often the first to get cut by governments, and there is a lack of funding for community groups to hire staff dedicated to this. It was thus recommended that there should be more resources devoted to building social capital, as many groups face problems of how to make contacts and build relationships when they are first starting out.

It was recognized during the discussions that it is often those who don't know about issues that are in charge of decisions. Many decision-makers do not respond well to structured and overly-detailed lectures on environmental issues, but are more interested in informal forums. One strategy put forward was to engage councils and boards by having education instalments on relevant issues, where simple presentations and discussions are held on topics of environmental interest to the council, a form of 'municipal education'. It was acknowledged that it is difficult for councils to get together, and that it is best to try to arrange talks as part of their regular meetings. By initiating these sessions, environmental educators may stop knowledge about certain issues from being concentrated among a few staff members, who can leave behind gaps in information when they leave the workplace.

Data Sharing

Consultation participants discussed the benefits and uses of RésEau in storing and sharing water quality monitoring data. The RésEau project allows water quality data and metadata to be shared on a common server, which helps to compile and compare water quality information from numerous sources. The work currently underway by Sarah Rosolen from the Centre for Sustainable Watersheds and Barry Judson from SEA (Southeast Environmental Association) on their Réseau projects was discussed (Appendices E-F). All who were present agreed that the program would be useful, but that problems may exist with a lack of funding and resources when it came to entering historical data collected from past years.

Standardization of Protocols

A discussion of the different protocols that are used by the various ACAP monitoring practitioners was also held. The dialogue focussed on the feasibility of standardizing certain types of monitoring activities. Main outcomes from the ideas that were exchanged were determinations of which monitoring protocols were being used by many of the sites, and what steps could be taken to help standardize them. The following monitoring programs and protocols were considered:

1. Benthic invertebrate monitoring
    - The CABIN protocol is already in use by several of the groups, making it a potential starting point for standardization across the organization
    - The protocol requires sorting to the Family level, which can be difficult for groups to achieve. Some groups have samples that are not being sorted because of lack of time, resources and expertise.
    - The Rapid Bioassessment Method requires less skill, as invertebrates are only sorted to Order with samples stored for possible detailed analysis later. Adopting this protocol may allow more sites to be incorporated into monitoring programs.
    - One potential problem with this is that EC may lack the capacity to support programs that are greatly expanded.
    - Some of the ACAP groups are already involved in developing a protocol for monitoring near-shore marine benthic invertebrates. As this protocol becomes developed, it could be used commonly among ACAP sites.

2. Bacterial monitoring
    - Methods currently used for detection include m-ColiBlue (2 sites), MPN for *E.coli* and MPN for fecal coliforms.
    - It was agreed that there may be opportunities to move towards standardization.

3. Quality Assurance/Quality Control measures
    - Duplicating samples
    - Using certified labs
    - Recognizing that accuracy comes from solid protocols, while precision comes from good teaching/execution of protocols
    - It is important to insure that study designs are scientifically sound, as community groups are under a lot of scrutiny, often more so than 'professionals'.

4. Water Chemistry
    - The importance of insuring that water chemistry instruments, such as probes, are properly calibrated was discussed. A suggested back-up/quality control measure for dissolved oxygen probes was using Winkler Titrations, which are a cost-effective and accurate method.
    - The Community Based Monitoring Network at St. Mary's University has an equipment bank for loaning instruments to community groups, including a DR890 Lamotte Colorimeter.
    - Parameters that can be measured to detect the presence of change within an ecosystem were discussed, such as sediment loadings (using sediment traps), E.coli, toxicity (using one or two key toxicity tests), and benthic invertebrates.
    - Types of instrumentation and tests being used are currently quite varied.

5. Water quality index

- Concerns were raised over the use of a water quality index being used among all sites. Some indexes, such as the one developed by the CCME (Canadian Council of Ministers of the Environment) recommend that parameters tested be directly relevant to the health of the river. The ACAP sites all cover widely differing water bodies, and so a common suite of parameters may not be applicable for all of the situations.
- Also discussed was the possibility of bias entering into the calculations by selecting parameters that would artificially raise or depress the index values.

6. Nature Watch
   - This program is based on participatory data from volunteers.
   - The program represents an easy and effective way for ACAP sites to monitor and/or map conditions generating useful and comparable data.
   - A standard method for monitoring pollinators is still in development at EMAN.
   - Physical river assessments are very subjective, and maybe shouldn't be left to volunteers, although the Rideau Valley Conservation Authority in Ontario has developed a methodology used in the Rideau Valley.

7. Fish surveys
   - Minnow traps were suggested as an alternative to electrofishing.
   - Catch-and-release programs with volunteer fishermen were suggested as another alternative. They involve people who enjoy fishing, and who are keen to monitor the state of local fish populations.

Forging a Stronger Monitoring Network

The importance of, and possible ways of maintaining, a network among ACAP monitoring practitioners were considered to be valuable outcomes by all participants. Those involved in the consultation proposed steps that could be taken to build and reinforce a network, and also highlighted the important role that it would play in the monitoring community.

- Barry Judson (SEA) suggested the establishment of a mailing list of ACAP monitoring practitioners
- Official sanction should be sought for regular annual meetings of the monitoring practitioners
- Lists of experts who may be able to provide insight into unusual situations encountered by monitors could be shared
- There is a need for a central place where articles and useful websites can be shared, such as a web portal
- That while continuity in monitoring programs is important, positions are rarely occupied for the long-term, making a continuous network important

ACAP Executive Directors

ACAP has been operating in the Atlantic region for fifteen years, and has promoted positive environmental action in its communities using a variety of tools. When the Executive Directors of the ACAP sites, some of whom have been involved in the organization for over a decade, were asked to describe common issues with ecological monitoring, they were able to provide advice and examples based on their extensive real-world experience. Major topics from the discussions have been listed below, with important outcomes being:

- Concrete examples of community groups engaging community members and decision-makers in effecting environmental change;
- The need for guidelines on defusing hostile situations with decision-makers/stakeholders while campaigning and how to heal a breach after the fact;
- The need for Environment Canada to develop national standards for common pollutants;
- A recognition of potential difficulties in aligning ACAP's community-based objectives with national initiatives;

- The need to enforce regulations in order for monitoring to be effective.

Economic-based Reporting:

Many of the participants in the consultation believed in the value of making science activities economically based. Economic reporting was described as using the 'ultimate laymen's terms' because it is what laypeople operate with on a daily basis, economics being a universal language. Two ACAP sites have made use of shellfish monitoring programs to demonstrate the costs of environmental degradation, as harvesting areas were closed, and the benefits of environmental remediation in re-opening clam and oyster beds. In both cases environmental clean-ups allowed shellfish beds to be reopened, making a significant contribution to the local economies. It was noted that economists and decision-makers may not understand monitoring variables such as coliforms, but even if they do the information must be related back to a budget, which is where economic reporting can help to make monitoring results relevant.

As a proviso to this, one ACAP site had little success with its own economic resource valuation, which demonstrated that there would be significant economic impacts for the community if raw sewage were no longer dumped directly into the harbour. Local authorities, however, disregarded the report, as they knew they would not be forced to change their practices. It was therefore advised that economic investment packages may only work if stakeholders are open to change, and regulations are enforced. Monitoring can make a difference when environmental regulations are put in place, and are accompanied by adequate enforcement.

Standards

It was suggested by participants that standards are a useful tool for environmental reporting, as they provide a 'yardstick' by which the public can measure results. The lack of Canadian standards for some pollutants is seen as a setback to effective reporting, as standards borrowed from other countries do not have the same stamp of credibility lent by those that have been endorsed by our own government. Conversely, it was also noted that communities need not be limited either by a lack of standards, or by standards that may exceed their own measures of environmental health. One ACAP site polled their community and set their own emission standards for a local pulp mill, which ended up being much lower than the legally allowable limits previously set. This method may help to foster sustainability and community involvement, as the standards are based on what the community feels to be acceptable, and therefore empowers them to choose conditions based on their own needs and values.

Use of Media

Several ACAP sites make use of the press because of the ability of headlines to grab the public's attention, as they present facts succinctly and in an understandable format. Newspapers are also a form of media that is widely read and distributed, thereby reaching a large and diverse audience, making messages accessible and hard to ignore. Articles can provide a summary for lay-people and explain what monitoring results mean. The media can also be used to politicize an issue, such as harbour clean-up. Publicity put forward by the ACAP site in St. John's, NL on the results of bacteria studies from St. John's Harbour prompted DFO to officially close the harbour for fishing. Another ACAP site located in Saint John, NB, stirred up controversy prior to their provincial by-election by publishing an article including facts about pollution in the harbour. The timing of the article made it a major issue in the political campaigns for the candidates, and was used as an opportunity to increase awareness and to stimulate action on the issue of untreated sewage discharges to the Saint John Harbour.

Avoiding and Using Confrontation

The media can be an effective tool to publicize results from monitoring programs, and to educate the public in informing a confrontation, but may not be constructive over the long run. Making issues confrontational is not sustainable as it polarizes factions, and makes people less open to engagement and less willing to provide feedback, all factors that work against the adaptive management model. Still, many groups face the frustration that their opinions are not heard or taken seriously unless they apply political pressure by swaying public opinion. Ironically, after decision-makers have been pressured into action on an issue, it ends up being beneficial to their own image, although relations with community groups may still be strained. It was requested by many consultation participants that materials be made available to address healing such breaches so that more productive communication can continue.

Some ACAP sites have developed strategies for avoiding confrontation. One group suggested that avoiding harmful confrontation depends not just on the data that is presented and reported, but on the process of data collection and project development. By inviting all stakeholders to the table before the data is collected, so that they can set the rules of data management and action beforehand, you can determine what they want out of the data and how you can use the information, while allowing for greater buy-in and ownership of results. If one of the partners feels threatened, the next step can be to back up and examine the process, to try to figure out what went wrong and how to fix it, making it non-confrontational. Having solid, 'bullet-proof' data that cannot be refuted is another strategy used to avoid confrontation. When creating an air quality monitoring program one ACAP site was challenged with legal action by local industry if they attempted to bring forward data that was not scientifically defensible. To comply with the standards imposed on the program by industry, they chose not to have data collected by volunteers, and sacrificed 'timeliness' with their data for greater certainty. As part of a risk-based assessment they had determined that if data is very solid it is more damaging for industry to deny a problem and take no action for remediation, than it is for them to simply attempt to refute the study. Orchestrating regular and informal meetings with local decision-makers is also an effective technique for facilitating discussion, as it creates a low-pressure situation in which to discuss sensitive issues.

Barriers to Data-sharing

One barrier to sharing monitoring data that was identified was that of data ownership, where information collected by a community group might be owned by an outside source. Data that was gathered from Nova Scotia Power as part of an air quality monitoring program could not be publicized because of concerns over its sensitivity, and the corporation had ultimate control over how the information was used. Even if information is collected and owned by the community group there can be potential repercussions when handling sensitive data. A survey of nitrates in ground water supplies (well water) was conducted by an ACAP site in PEI, but due to implications with property values, the information was shared only with participants in the study, and is not widely known.

There was also a general consensus that there is a lack of capacity to enter historical data into online databases. The costs are mainly associated with staff time, as some monitoring programs have extensive data sets, and may exist only in paper format, requiring reorganization before they could be entered. It was believed, however, that the use of online databases would facilitate data sharing, and that it would be a useful endeavour if funding and technical resources could be found. Another major barrier that was mentioned was the use of different methodologies in collecting data on similar parameters. This can restrict comparability between data sources, and before data can be shared it is important to understand the effect that different protocols can have on the data collected.

Local Needs vs. National Objectives

It was pointed out that the priorities of ACAP sites are determined by their communities, and that their first responsibility is to monitor problems that have been identified by their communities as issues of concern. There may be a lack of capacity and even will within communities to implement national protocols and monitoring programs in addition to the monitoring of local environmental concerns. Given the scarcity of funding for long-term monitoring programs, as well as the pressure by communities to deal with more immediate problems, it can be difficult for ACAP sites to balance their local needs and the national objectives set forth by Environment Canada. Although the benefits of long-term or surveillance monitoring may not be seen for many years, it was still recognized as being of value by providing baseline data on ecosystems. An ACAP site in the Miramichi monitored water quality for 13 years, and produced an extensive data set that was used by engineers to help design a sewage treatment plant. This is an example of how surveillance monitoring can be used in ways that were not originally foreseen, and can be adapted as conditions and concerns change over time. The other type of monitoring undertaken by ACAP sites is characterized as having a clear time frame, defined parameters and actions to be taken with specific outcomes. These projects are often shorter term, and are initiated in response to local environmental issues.

Recommended Actions:

The following actions will be used to implement recommendations and ideas from the consultations into the ecological monitoring community.

Issue: This meeting represented the first opportunity that monitoring practitioners from across the ACAP community had to meet and discuss common challenges and opportunities. Participants felt that there would be considerable benefit from the regular meeting of this group. It was pointed out that because of the frequent turnover of staff with ACAP groups, newly hired monitoring practitioners frequently waste valuable time in researching and developing monitoring programs. Through the establishment of an ACAP monitoring community of practice, new and existing employees would have access to a considerable body of knowledge and experience.

1. **Action:** The creation of a mailing list of ACAP Monitoring Practitioners, to facilitate sharing of ideas and good practice.

   Benefits:
   - A mailing list will help to keep monitoring practitioners in touch with one another
   - Information can be more readily shared among all of the sites
   - Updates in monitoring programs can be shared

2. **Action**: Each monitoring practitioner has connections with a network of experts or professionals who may provide advice on monitoring programs. The email discussion group (identified above) will be used to aid monitoring practitioners in identifying relevant technical experts.

   Benefits:
   - Access to a wider range of technical experts would help to increase ACAP's academic resources
   - Advice from professionals lends greater credibility to the science conducted by monitoring practitioners
   - Experts can help to cut down on research time by directing monitoring practitioners to the most helpful and current resources in a particular field

3. **Action**: Investigate development of a Monitoring Practitioners Web Portal that could host user mailing lists, a download page, archives, blogs and a discussion board. A functioning example can be found on www.coalition-sgsl.ca.
   Benefits:
   - A web portal would provide a centralized location for relevant information and contacts to be shared among monitoring practitioners
   - It would function as a useful tool in helping to achieve Actions 1 and 2
   - Other community groups may also be able to benefit from a web portal, which could increase partnership opportunities in the region
   - Having such information hosted on a web site may help to increase ACAP's profile in Atlantic Canada

4. **Action**: That a meeting of the ACAP monitoring practitioners be held on an annual basis to facilitate the maintenance of this important community of practice. The scheduling of this meeting in conjunction with the annual ACAP Workshop would allow significant savings in terms of transportation. Sanction from Environment Canada officials as well as a commitment to provide the additional funding will be sought.
   Benefits:
   - Due to the frequent turnover in monitoring staff, much time is currently wasted researching and developing monitoring programs. Annual meetings would provide a resource for new and existing employees to discover and share ideas for improving monitoring across ACAP.
   - The establishment of a monitoring community within ACAP would be helpful in creating continuity in monitoring programs throughout ACAP
   - The development of the monitoring practitioner community of practice would provide a forum for agreeing and sharing common protocols
   - By discussing issues among the group as a whole, monitoring practitioners would be able to see themselves as part of a network of people that faced similar problems, helping to lessen discouragement in dealing with common issues

Issue: As Environment Canada restructures its reporting system, ACAP sites must begin to align their own reporting and performance measures with the new system.

1. **Action**: Participants agreed on the value of developing performance measures based on impacts of monitoring activities on decision-makers. Reporting of performance measures would be based on the Results-based Management and Accountability Framework (RMAF) system. Andy Sharpe will work with Tara Martin from ACAP Humber Arm to facilitate sharing of electronic versions of RMAF material.
   Benefits:
   - There would be considerable value in sharing Performance Indicators for Immediate, Intermediate and Long-term outcomes, as many of these would be common across ACAP groups.
   - By basing indicators on the RMAF system, reporting on ACAP monitoring programs would become better aligned with Environment Canada's objectives

2. **Action**: Bedeque Bay Environmental Management Association (BBEMA) will shortly be involved in an exercise on setting Performance Indicators through its Agriculture Canada project. Paul McInnis from BBEMA agreed to share the lessons learned from this with the other ACAP sites.

Benefits:

- Lessons learned from the workshop can help sites to begin setting performance indicators for their monitoring programs, making reporting more straightforward
- Determining best practices for setting performance indicators would be a timely activity, as ACAP sites are attempting to redesign their reporting to fit in with the CESF and RMAF

Issue: While ACAP sites monitor many common parameters, the use of different protocols to do so can restrict the number of possible applications for the data. One hurtful repercussion from this is the inability to directly compare data sets collected using different protocols, even when the same parameter is being monitored. Due to differences in priorities among the various ACAP communities it is unreasonable, however, to standardize all ecological monitoring.

1. **Action**: It was agreed that there were opportunities for moving towards protocol standardization across ACAP. Many groups already make use of the CABIN protocol for freshwater benthic macroinvertebrate monitoring.
   Benefits:
   - The identification of a common protocol may encourage other sites to utilize this method when using macroinvertebrates to evaluate stream health

2. **Action**: Additional areas were identified which had promise for standardization, such as nearshore (intertidal) benthic invertebrates, microbiology (*E.coli*; fecal coliform), water quality instrumentation and calibration, and Quality Assurance/Quality Control measures. CARP will share its Quality Assurance/Quality Control document with other ACAP sites, to be used as an example.
   Benefits:
   - Through identifying areas of monitoring that were common to most or all sites, the group was able to agree upon monitoring programs that had potential for standardization.
   - If data is collected using common protocols, it can be compiled and analysed as a whole over the Atlantic Region. This may help to provide a better picture of the ecological health of the region as a whole.
   - By ensuring that Quality Assurance/Quality Control measures are held to a standard across the ACAP community the quality and accountability of the data will be increased.

Issue: A recurring theme throughout the discussions was the difficulty of integrating ecological monitoring with decision-making. It was suggested that particular thought could be given to recommendations on managing hostile situations.

1. **Action**: Two areas were identified as being common stumbling blocks for monitoring practitioners: (1) How best to ask decision-makers what types of information and monitoring results would be beneficial; and (2) How best to package and present ecological monitoring data to decision-makers. As these topics have national relevance, the EMAN Coordinating Office was requested to consider developing guidance material.
   Benefits:
   -
   - Once major barriers to effective communication have been identified, it becomes easier to directly address the problem
   - A compilation of suggested strategies for engaging decision-makers can provide a reference point for monitoring practitioners to begin to work with local governments and industries

- By having access to a list that contains strategies that do and do not work, it will become easier for monitoring practitioners to involve themselves in the decision making process
- Guides can be added to and adapted for varying situations, and feedback on the usefulness of the material can help in refining future publications

References:

1. Boyce, D. and B. Judson. 2006. 2005 ACAP Data Sharing Survey. Southeast Environmental Association.

2. Daborn, G. 1992. ACAP and "The Brain of Pooh". ACAP Conference, July 1992, keynote address.

3. Ecological Monitoring and Assessment Network Coordinating Office and Canadian Nature Federation.2003. *Improving Local Decision-Making through Community Based Monitoring: Toward a Canadian Community Monitoring Network*. Ottawa: Environment Canada. 22pp. http://www.ccmn.ca/english/library/ccmn.pdf

4. Roussea, F., C. McNeil, L. Hildebrand. 2005. *Partnerships in Community-based Approaches to Achieving Sustainability: the Atlantic Coastal Action Program*. In M. Doyle and M. Lynch (Ed.) Linking Ecological Monitoring to Decision-Making at Community and Landscape Scales. Ottawa: Environment Canada. http://eman-rese.ca/eman/reports/publications/2005/camesa/page4.html

5. Sharpe, A. and C. Conrad. 2005. *Community Based Ecological Monitoring in Nova Scotia: Challenges and Opportunities*. Environmental Monitoring and Assessment (in press).

6. Sharpe, A. and D. Sullivan. 2003. Community Science in Atlantic Canada: A survey of water quality monitoring programs. Clean Annapolis River Project.

7. Sullivan, D. and M. Beveridge. 2005. Ecological Monitoring and Reporting: A Survey of the Atlantic Coastal Action Program. Clean Annapolis River Project.

Appendix A

Name	Organization	Title
Craig Power	ACAP Cape Breton	MP
Valerie O'Grady	ACAP Cape Breton	ED
Wayne Williams	ACAP Cape Breton	MP
Tim Vickers	ACAP St John	ED
Brenda Penak	Bedeque Bay Environmental Management Association	ED
Paul McInnis	Bedeque Bay Environmental Management Association	MP
Brooke Cook	Bluenose Coastal Action Foundation	ED
Reg Madden	Bluenose Coastal Action Foundation	MP
Andy Sharpe	Clean Annapolis River Project	MP
Stephen Hawboldt	Clean Annapolis River Project	ED
Denise Sullivan	Clean Annapolis River Project	MP
Megan Beveridge	Clean Annapolis River Project	MP
Sarah Rosolen	Centre for Sustainable Watersheds	ED
Susan Farquharson	Eastern Charlotte Waterways	ED
Brian Craig	Ecological Monitoring and Assessment Network	NSA
Vaughan, Hague	Ecological Monitoring and Assessment Network	ED
Tara Martin	Humber Arm ACAP	MP
Pierre Martel	Mersey-Tobeatic Research Institute	MP
Harry Collins	Miramichi River Environmental Assessment Committee	ED
Beni Malone	Northeast Avalon ACAP	ED
Diana Baird	Northeast Avalon ACAP	ED
Dan Ficken	Northeast Avalon ACAP	MP
Janet MacKinnon	NS Department of Environment and Labour	ADM
Bob Petrie	NS Department of Environment and Labour	AWRM
Robert Christie	Pictou Harbour Environmental Protection Project	ED
Art MacKay	St. Croix Estuary Project	ED
Kim Reeder	St. Croix Estuary Project	MP
David Boyce	Southeast Environmental Association	ED
Barry Judson	Southeast Environmental Association	Technician
Karen Wilson	Southeast Environmental Association	MP
Gisele LeBlanc	Sable Island Preservation Trust	ED
Cathy Conrad	Community-based Environmental Monitoring Network, St. Mary's University	ED
Tyson Daosut	Community-based Environmental Monitoring Network, St. Mary's University	

ED- Executive Director
MP- Monitoring Practitioner
NSA- Network Science Advisor
ADM- Acting District Manager
AWRM- Acting Western Regional Manager

Appendix B

Ecological Monitoring and Reporting:
A survey of the Atlantic Coastal Action Program

Denise Sullivan
Clean Annapolis River Project

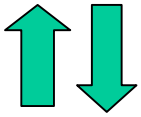
Purpose of survey:

- Resource for ACAP sites
- RMAF
- Assess effectiveness of data delivery
- Feasibility of SOE report

Methods:

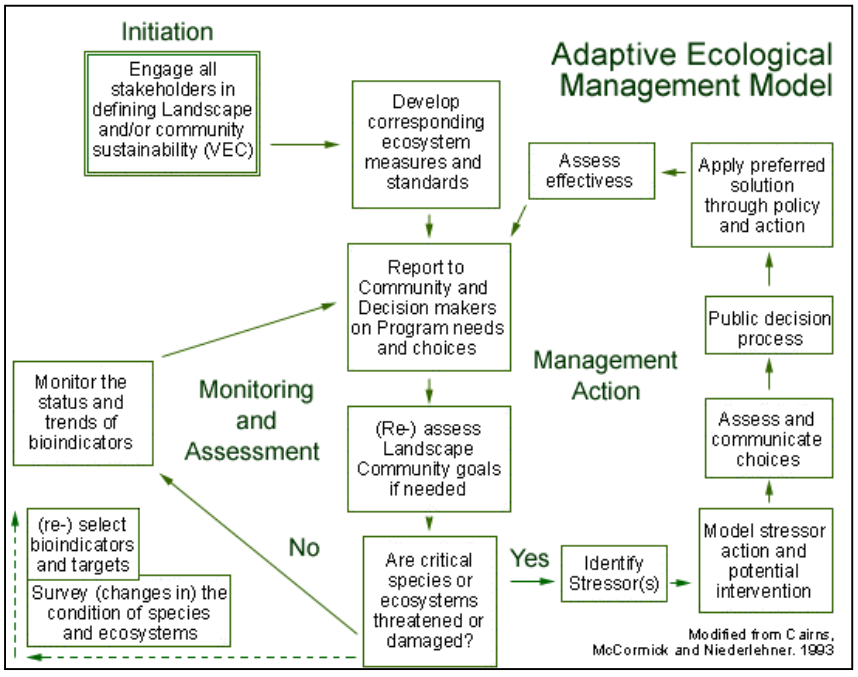
- Compiled metadata on monitoring programs of the last 5 years
- Readily accessible information
- Telephone and e-mail survey

Monitoring Practitioners/ACAP Groups



Decision and Policy Makers

Effective Monitoring



Results

Several examples of success:

- Water Classification Program – SARMLT
- Community Lake Monitoring Program – ECW
- Agriculture Bacteria Study –SEA

- Sanitary Shellfish Program – MREAC

1/3 received constructive feedback
Solutions were action-oriented, based on individual cases, rather than changes to written policy
~2/3 of programs surveyed received no feedback; either because data was not shared or there was insufficient interest to provide feedback

Common Monitoring

National / Regional Programs	Water Quality Parameters
CABIN	Fecal Coliforms
Estuary Monitoring	Dissolved Oxygen
CAMP	Water Temperature
	pH, metals, air temperature, turbidity

Unique Monitoring

- Plant Watch – EMAN protocol
- Terrestrial Biodiversity Monitoring – EMAN protocol
- Pesticide monitoring
- Airborne mercury monitoring
- Ground-level ozone monitoring

How can ecological monitoring and reporting be improved?

Next Steps

- Distribution
- Updating survey
- Standardization
- Do's and Don'ts
- SOE Reporting

Acknowledgements

Atlantic Coastal Action Program
National Indicators and Reporting Office
Ecological Monitoring and Assessment Network

Appendix C

EMAN-RESE: National Network

Canada needs a functional long term Ecological Monitoring and Assessment Network

- To address international, national, regional and local issues – climate change, ecological integrity, species at risk, species invasions, watershed management
- To deliver monitoring information in an integrated manner at all scales
- Beyond capacity of any one government agency, or organization

Monitoring Definitions

Monitoring (Observation):

Monitoring means maintaining regular surveillance by making measurements at regular time intervals over an indefinite, but usually long period of time

Environmental Monitoring:

Environmental Monitoring is defined as the repetitive measurement of indicators which will enable one to anticipate and provide a better understanding of spatial and temporal changes in environmental quality

Ecological Monitoring:

an integrated, interdisciplinary, and cooperative approach to monitoring complex issues
Contributes to integrated assessment

Types of Monitoring:

- Simple Monitoring (Observation)
- Proxy or Surrogate Monitoring
- Survey Monitoring
- Integrated Monitoring

Simple Monitoring (Observation):

Simple monitoring records the values of a single variable at one (or many) geographical point over time

- Air temperatures, water levels, carbon dioxide, etc.

Proxy or Surrogate Monitoring:

In this approach, data are obtained from information "stored" in the environment that relates to the desired variable.

- Information stored in Arctic ice cores has been used to infer air temperatures over very long periods of time – 250 000 years
- Coring trees and analyzing the growth rings can inform on past growth rates

Survey Monitoring:

The monitoring survey is designed to include areas that are affected and areas not affected by the observed problem. The affected areas are assumed to have had similar environmental characteristics as the unaffected areas at some unknown time in history

- Eutrophication of Lake Erie

Integrated Monitoring:

Simple, Survey and Surrogate, while providing valuable information cannot answer the question "Why"

- A much more detailed set of ecological information is needed to establish cause and effect relationships

Integrated Ecological Monitoring:

Four specific Objectives:

- to establish cause and effect relationships
- to derive scientifically defensible pollution control or resource management programs
- to measure the environmental response to the control measures
- and to provide early warnings of new problems

EMAN

Ecological Monitoring and Assessment Network

Through mutually beneficial partnerships, to augment Environment Canada and Canada's capacity to collect, access, integrate, manage, interpret, apply and communicate sound data and information on ecosystem status and trendS

STANDARDIZATION of Monitoring Measures is essential if data and information is to be compared across scales

LONG-TERM Monitoring is essential to provide appropriate data

Created in 1994

Objective - to provide a mechanism to bring Canadian federal, provincial, regional, and local agencies, and Environmental Non-governmental Organizations together for better coordinated and functional ecological monitoring and assessment at national, provincial, regional and local scales

EMAN: Partnerships!

- National ecological monitoring network
- Long-term multi-disciplinary research and monitoring study sites across Canada
- National Parks; National Wildlife Areas; Provincial Agencies – DNR - Oakfield Park – DEL; Biosphere Reserves – SWNBR, Universities – Dalhousie, St.Marys, Cape Breton, COGS,
- 400 + partners – Nature Canada, NS Museum of Natural History, Clean Annapolis River Project, NS ACAP sites, Pictou Harbour, FBWHT

EMAN Objectives

Long-term monitoring is essential to meet these objectives

Duration of All Observational and Experimental Studies:

- Eighty percent of studies in the ecological literature last less than three years
- Over 75 percent of studies reported in the literature look at only 1 or 2 species.

Indicators / Measures for the early detection of ecological change

Developing Measures for the Early Detection of Ecological Change

To select about 25 Core Monitoring Variables, that will work together as a suite, to detect and track change within the environment

- Monitoring variables are intended to identify changes in ecosystems to trigger more detailed investigations
- Monitoring Variables must be suitable for a range of terrestrial and aquatic sites in ecosystems across Canada
- Monitoring Variables must be cost effective to implement
- Monitoring Variables are preferably a part of and compatible with existing monitoring programs

Summary of Resources

Selecting Environmental Indicators (EPA 1997)

http://www.epa.gov/1. Selecting Core Variables for Tracking Ecosystem Change

2. Case Study to Test the Efficacy for EMAN Core Monitoring Variables EMAN 2000

3. EMAN Ecosystem Monitoring Protocols: Field Methods Manual – Version 2.0

http://eman-rese/eman/reports/publications/

EMAN Ecosystem Monitoring Protocols:

ABIOTIC

Water Quality - WQI parameters DO, P, NH_4^+, Ca, NO_3^- NO_2^-

Stream Flow

Lake Levels

Air Quality

Soil Temperature

Permafrost depth

Snow-Ice Phenology

Lake Sediments

BIOTIC

Species Richness and Diversity (amphibians, worms, mammals, birds, plants, benthos)

Indicator Species Group
Community Biomass
Community Productivity
Plant Phenology

CULTURAL

Land Cover Change

Process for Protocol Development

- Authors are experts in their field of study
- Extensive consultation with North American experts and Ecological Monitoring and Assessment Network partners
- Methods also incorporate study design methodologies, and data management and analytical tools
- Network database for information sharing

Plant Species Richness and Diversity

EMAN Terrestrial Vegetation Monitoring Protocols - Patricia Roberts-Pichette and Lynn Gillespie

- extensive review by Biodiversity Science Board
- Plot based monitoring techniques
- 20m quadrats and one hectare plots associated with SI/MAB program

Tree Health

Measure the change of tree crown condition (vigour) and bole condition (defects) as an indicator of tree health

- Bob Sajan of the Canadian Forest Service
- North American Maple Project (NAMP)
- Acid Rain National Early Warning System (ARNEWS)
- Niagara Escarpment BR

Terrestrial Salamander

Monitor presence/absence and changes in the abundance of terrestrial salamanders

- March 2002 Workshop hosted by Parks Canada and EMAN CO attended by North American salamander monitoring experts. Protocol completed being marked up for website.
- Long Point BR, Bruce Peninsula NP, Kejimkujik NP pilot projects
- Atlantic RCA-participating ACAP and other groups

Aquatic Macro-Invertebrates

Monitor benthic organisms as an indicator of aquatic ecosystem health

- Plethora of similar yet different protocols
- Ontario Benthos Biomonitoring Network - OMOE, OMNR, Conservation Authorities, Parks Canada, Environment Canada, ENGO's
- Tiered Approach – (1) Educational (2) Rapid Bioassessment – OMOE (3) CABIN – NWRI (4) Biodiversity

Lichens

Monitor presence/absence and changes in the abundance of specific arboreal lichen species as an indicator of air quality

- March 2003 workshop with Drs. David Richardson, Irwin Brodo, Dan McCarthy, Tom Hutchinson, George Sorger, Fred Rhoades, and John Innes to finalize protocols
- Citizens' Environment Watch pilot project

EMAN Lichen Monitoring Protocols

- Use suites of lichens - 15 to 20 species ranging from very tolerant to intolerant:
- Mixed Hardwood Forest
- Boreal Forest
- Temperate Rain Forest

EMAN Lichen Monitoring Protocols

1. Inventory - presence / absence of lichen suite at monitoring site

$$IAP = \sum_{N}^{1} \frac{(Q \times f)}{10}$$

N = number of species at a site
Q = Ecological Index of a species : It is the no. of species found with that species at a site added to the average for all sites where the species was present.
(Q x f) is divided by 10 to produce a smaller number
f = frequency coverage value

2. Diversity - Track changes in diversity over time using ladders placed on cardinal points of a tree.
   - Excel spreadsheet for analysis developed by Parks Canada

Soil Temperature and Health

- Monitor soil temperature at a single depth using inexpensive data-loggers, Dr. Don MacIver and Heather Auld, MSC
- Monitor the annual decay rates (decomposition) of aspen chopsticks, Dr. Tony Trofymow, Canadian Forest Service
- Monitor the presence/absence of earthworms as indicators of changes in soil health www.wormwatch.ca, Dr. Jill Clapperton, Agriculture and Agri-food Canada - Launched fall 2001 with CN F

Exotic Plants

Monitor presence/absence of exotic plant species using direction provided in the Guide to Monitoring Exotic and Invasive Plants - Haber, E. 1997 (EMAN website)

- establishing survey routes (y) list included in protocol
- Seedling and Shrub Regeneration
  - ➢ Monitor seedling and shrub regeneration over time using a slightly modified Canadian Forest Service protocol developed for the ARNEWS program
  - ➢ Implemented in conjunction with many Forest monitoring plots

Mammal Species Richness

Monitor the presence/absence of mammal species at sites

- Opportunistic surveys annually and every five years a comprehensive review

Anuran Species Richness

Monitor the presence/absence of amphibians using protocols established by Frogwatch Canada and the Canadian Wildlife Service

- Frogwatch Canada protocols developed in consultation with CARCNET and researchers - Launched with the Canadian Nature Federation (CNF) spring 2000 www.frogwatch.ca

Plant Phenology

Monitor the flowering times for indicator plant species - response to climate change and weather variability

- Elisabeth Beaubien, Alberta Devonian Botanical Garden, Dr. Liette Vasseur, St. Mary's University
- Plant Phenology Canada - Canadian Species List and protocols
- Launched with CNF spring 2002 www.plantwatch.ca

Dandelion Watch

- Monitor phenology of one of Canada's most common "weeds"
- Developed in cooperation with the Ontario Science Centre and TV Ontario
- Targeted towards primary/junior grades, launch in spring of 2004 www.dandelionwatch.ca

Ice Phenology

Monitor the date of ice freeze-up and break-up

- Protocol developed with Ted Yuzyk, MSC, and Claude Dugay, Laval University
- Majority of MSC monitoring sites lost during program review
- Launch with CNF fall 2001 www.icewatch.ca

Historical Trends in Lake and River Ice Cover in the Northern Hemisphere, Science - September 8, 2000

- "The results of the study", said Magnuson, "are not calculations", which are subject to bias and instrument error, but "direct human observations of a 150-year trend of ice freeze and thaw" that are difficult to refute. "It is clearly getting warmer in the Northern Hemisphere," he said. "This is very strong evidence of a general warming from 1945 to 1995 in areas where there is ice cover." Toronto Star, September 9, 2000

Current Initiatives

Pollinators

- Pollination an important ecosystem service
- Working with experts
- Currently testing and refining

Wetlands

- Working with Parks Canada to develop a suite of indicators and concomitant measures for wetland monitoring
- Workshop next week to finalize indicators and measures

Multi-Party Community Based Monitoring

Linking Community-Based Ecosystem Monitoring to Local Decision Making and Policy Development on Sustainability

Project Goals

1. Develop, test and enhance a conceptual framework to guide Community Based Monitoring in support of sustainability
2. Synthesize the successes and lessons learned in community involvement and capacity building

Methodology

Literature Review- little has been recorded in the literature on how to establish and coordinate CBM groups and networks

Case Studies

Atlantic Coastal Action Plan, Remedial Action Program, Model Forest, Local Agenda 21, Ontario Environmental Advisory Committees, Canadian Parks Partnership, Carolinian Canada, Biosphere Reserves,

Conceptual Model

An Emerging Solution

In communities across Canada and beyond, an effective approach is emerging to connect individuals and groups with each other and with their environment to achieve a common goal - **local sustainability.**

This approach is called **Community Based Monitoring**

Community Based Monitoring

Community Based Monitoring is a process where concerned citizens, government agencies, industry, academia, community groups and local institutions collaborate to monitor, track, and respond to issues of common community concern

Benefits of CBM:

- Partnerships between different groups, sectors, and jurisdictions to identify common concerns and possible solutions
- meaningful collaboration between citizens and government - improving public involvement
- enhance local governance structures by putting the creativity, skills and resources of many individuals and groups, toward solving a problem
- Increase knowledge about their environment by generating locally relevant monitoring information
- use of standardized methods will allow comparisons and integration of information within landscapes
- provides local decision-makers with the information and tools to make informed policy choices and management plans which are adaptive and responsive
- Builds social capital in participating communities. Increased social capital improves the community capacity to deal with the many complex issues and choices associated with sustainability
- provides decision-makers with early warnings of environmental issues before they become environmental catastrophes
- proactive vs reactive

Take Home Points

- Define objectives of monitoring program
- Develop questions, components, indicators, targets, techniques
- Develop partnerships
- Standardize measures
- Effectively manage and share data
- Link to decision making at all levels
- Engage your community!

The Value of Life: Biological Diversity and Human Society

Negativistic - fear, aversion, alienation from nature
Dominionistic - mastery, physical control, dominance of nature
Utilitarian - practical and material exploitation of nature
Ecologistic/Scientific - study of structure and function
Naturalistic - experience and exploration of nature
Aesthetic - physical appeal and beauty of nature
Symbolic - use of nature for language and thought
Humanistic - emotional attachment and love for nature
Moralistic - spiritual reverence and ethical concern

How Do We Acquire Appropriate Values?
A mentor - parents, teacher, friend, an ACAP Ecosystem Monitoring Practitioner
The opportunity to experience a natural environment
Citizen Scientist Monitoring Programs

- involve participants in authentic hands-on experiences collecting data using scientifically valid and reliable methods
- reconnect citizens with their natural environments
- provides information for better decision making by local communities

Points to Ponder

Information and education - to instill appropriate values – which drives **behaviours** – is essential if we are to become sustainable!

Appendix D
Citizen Science as a Catalyst in the Effective Delivery of Environmental Information to Decision-making

Hague Vaughan
EMAN Coordinating Office
Environment Canada

Enhancing the effectiveness of ecosystem research & monitoring programs by building complimentary localized capacity in communities to collect, share and use ecological information for informed decision-making and the adaptive management of sustainability

EMAN CO: Through the development and maintenance of **partnerships**, enhance EC's/Canada's capacity to collect, access, integrate, manage, interpret, apply and deliver sound data and information on ecosystem changes

Focus: Enhancing the Effectiveness of Ecosystem Monitoring through

- Standardization
- Engagement
- Assessment
- Delivery

Environmental Monitoring Goals

Characterization of baseline conditions

- Surveillance and Detection of change
- Description of recent and historical **status and trends**
- Long-term understanding or prediction of **processes, linkages & relationships**

Mandated obligations at inter-jurisdictional sites, on federal lands and in relation to species of national concern

Resource management including effluent effects, environmental effects monitoring, compliance, emergency measures, and establishing the need for, probable effects or success of interventions

- Delivering effective **feedback** on the adequacy of policies and programs and on the effects of development patterns or trends
- Providing **timely** identification of emerging environmental problems
- Providing policy-makers with a sound **basis for effective action**

Delivering information effectively to decision-makers including the public, stakeholders, research personnel, and managers so informed decisions and choices can be made

EMAN and the Enhancement of Ecological Monitoring Effectiveness

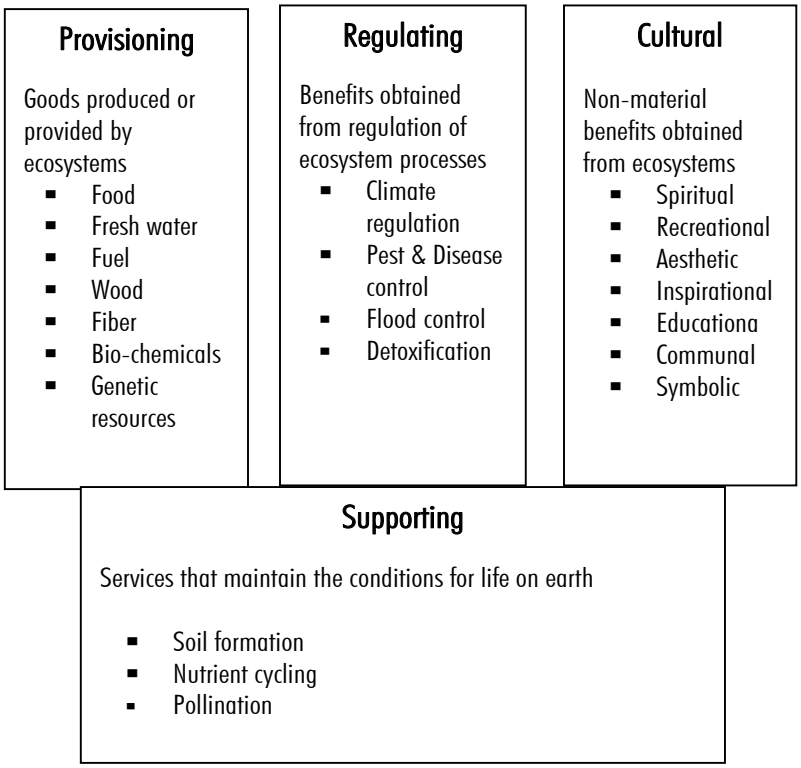
Investigations and pilots:

How to better integrate & communicate science
The assumption of responsibility to do so
How to better deliver info that is specifically tailored to the needs of policy and decision-makers
How to develop the public capacity to generate and use that information

Community Ecosystem Monitoring Toolkit

Biota: Frogs, Salamanders, Pollinators
Climate: ice, plant phenology
Soil: worms, chopstick decomposition
Vegetation: tree health, seedling survival and biodiversity plots
Air: lichens
Water: benthic invertebrates
Other: water levels, secchi, anecdotal reports, local/traditional knowledge, social & economic indicators, valued attributes
Methods, data quality, data mgmt, mapping, interpretation, delivery

Ecosystem Goods & Services



Opportunities & Challenges

- Role for Community Groups
- Need for effective delivery of environmental status, trends as feedback:
- 3 Pillars
- 5 Capitals
- Continuous Improvement
- Triple Bottom Line
- Marketing and education
- Approaching planners, decision-makers, officials

Lessons Learned: Linear Themes

Initial Context	Potential Catalysts	Potential Outcomes	Broader Outcomes
Existing Capacity **Timing & Readiness** **Political will** **Partnerships** **Environment-al Values**	**Coordination** **Inciting Issues** **Articulated Planning Needs** **Multi-stakeholder Dialogue** **Vision for Sustainability**	**Ecological Monitoring** **Volunteers & Champions** **Adaptive Management** **Political Influence** **Measurement of Indicators**	**Knowledge** **Social Networks** **Improved Governance** **Demand-driven Science** **Sustainability Models**

Contributing to Community Sustainability

• **Inform local decisions,** facilitate adaptive management, initiate links to science, create Social Capital
• **Local definition** of sustainability
• **Can Community Monitoring Network, CitizenScience** and other ongoing initiatives • **Limited experiment:** basis for proposed EC program + repeat at multi-community and –sector watershed scale
• **Initial mapping**: status, priorities and ownership: **Ice, Lichens**

Nature and characteristics of info to influence policy process/people

Relevant to problems and players;
Useable in form and for a specific context;
Targeted, accessible and understandable to its audience;
Integrated, and suggest a course of action;
Timely;
Allow **decision-makers** to weigh choices, trade-offs and consequences
Ensure those involved continue to be in **control** of the problem
Tailor these through dialogue

Hamilton Arboreal Lichens Response

EC-Hamilton-Env Hamilton MOU
Vision 2020 Reporting
HEIA CAP
HEIA Annual Meeting and McMaster Environment & Health Institute
EC/MOE Data
Follow-up & Refining/ Extending the Methods

Application in Other Regimes/Domains: Watersheds, Landscapes, Seascapes

Governance Issues: multi-community, multi-sectoral and multi-functional
- Layer cake of licensing & governance

Optimization
Water qual/quant management, best practices, optimal yields, economic diversity, cultural values
Health, security, sustainability
Biodiversity, habitat, sequestration
Ecological Goods/Services and Resilience
Criteria, Standards and Effective Delivery

Ecosystem Goods and Services

- Dependency for human welfare and economic competitiveness: non-substitutable
- Link ecosystem dynamics (Structure, Functions) to societal dynamics
- Currency of exchange between science and decision-makers
- Link to biodiversity, natural capital and resilience
- Focus of MEA

Ecosystem goal: sustainable provision of the full suite of goods and services (rather than ecosystem health, integrity, intactness, etc)

- Can address at Landscape, watershed and seascape scales as well as roll up standardized results to Regional, National, International and Global
- Can We Develop Landscape/Watershed Specifications (e.g Indicators + Thresholds) to Ensure Sustainable Provision?
  - E.g. Impermeable Surfaces
  - Pollination, Water Quality and Quantity, Soil health, Habitat, Fragmentation, Land use and conversion, Air quality, Industrial emissions
  - % roads, % protected areas; accessible parks; conservation areas, trails and public greenspaces; water access,
  - Disturbance of slopes; Riparian zones; Key Biodiversity measures; Nutrient loss; Soil loss; Hypolimnetic oxygen; % healthy river km;

- Invasives monitoring/management

Citizen engagement → Timely customized ecological information → Iterative adaptive management decisions and actions

Mechanism to enable watershed scale decisions

From Millennium Ecosystem Assessment: Projected improvements in services to 2050

Three of the four scenarios show that significant changes in policy can partially mitigate the negative consequences of growing pressures on ecosystems, although the changes required are large and not currently under way

Ecosystem Goods and Services

Landscape thresholds → Tradable environmental allowances

Basis: Research on ecosystem structure, functions & resilience linked to sustainable provision of full suite of goods and services: indicators, thresholds, predictive models

EMAN Opportunity:

Collaborative research along gradients of disturbance (Watersheds, Biosphere Reserves, Conservation Authorities)

Delivery of information effectively to support choices, trade-offs and policies

WHY: Societal requirements, expectations and under-filled needs

Inform the process of sustainability and adaptive management:

- Timely, useful feedback
- Place-based
- Timeliness vs certainty

Inform decisions and choices of others: individuals, processes and forums

Characterize needs, design to deliver

Support appropriate inclusion of environmental info:

- Triple Bottom Line, 5 Capitals, Continuous Improvement, Natural Step
- Engage industry, planners, engineers
- Deliver useful info to conserve or enhance **ecosystem functions and services**

Status, change, criteria and resilience

- Relate to human health, welfare, competitiveness, environmental health
- Meet requirements for **sound, responsive, relevant policy**
- Support **integrated management** at multi-community, multi-use, multi-stakeholder watershed/airshed/landscape/ seascape scales
- Develop **social capital** and **community engagement** in inclusive processes
- **Include Outcomes** as program performance measures

Opportunities and Directions

Partnerships and Relationships

Citizen science monitoring coordination and support

Stakeholder engagement

Engage decision-makers → Demand-driven monitoring and delivery

Outcomes as a measure of performance

Watershed/Landscape research: services, habitat, BMPs, resilience, governance

EMAN: the Power of Networks

Appendix E
Data of Atlantic Community Aquatic Projects

Bulk data-sharing

- Facilitate data access/sharing
- Ease demand on gov't

Shared infrastructure

- Provide central locations for community to input data (including historic, metadata)

Canadian Geospatial Data Infrastructure

- Provides standards and protocols to facilitate on-line data sharing
- ACAP Reseau enables community representation for the CGDI
- Facilitates integration of different data sets regardless of software
- • Reduces the requirement for data sharing agreements
- • Improves access and usability of community collected data
- • No need to hold data
- • No need for GIS software

Key components of the CGDI

Standards and specifications

- CGDI is based on geospatial standards that are created and accepted at national and international levels with the focus on interoperability

Metadata

- Data about data such as, content, quality and condition
- Allows for searching and comparing of data from different sources

Technology

- Integrating technology where global hardware and software systems work seamlessly together

Discovery mechanisms

- Online services allowing discovery, evaluation, and access to geospatial data, services and organizations
- Purpose to bring providers and users together

Framework data

- CGDI publishes base layers – elevations, transportation systems, water bodies & etc

Partnerships

- Partnerships are at the core of the CGDI: they reduce duplication and costs, leveraging national and international technology and skills.

Portal Integration: Five Key Components

- Tools
- Web Services
- Web Pages
- Data
- Content

Tools

Reseau's developed tools are transferable to other projects and partners.
Encourage the use of existing tools and encourage partners to exchange ideas on how existing tools should be modified and how new tools should be developed.

Web Services (Map, Feature and Coverage)

Web services must meet OGC (Open Geospatial Consortium) standards and be registered on the GeoConnections Discovery Portal
Metadata for each service must be completed and the abstract must provide a detailed description of the layer or layers.

Web Pages

Sampling locations should all be described using the station profile database provided by Environment Canada. A data entry tool and database are available to facilitate this process.
Funded applicants will be required to acknowledge the contribution of ResEau resources on their web site or pages if applicable.

Data

Data must be credible and verifiable by the data owner. QA/QC protocols must exist to support the data.
Data or resulting interpreted products must be publicly accessible.

Content and Context

The provision of explanatory text to describe all data is required. Text should be used to accompany graphs and layers, explain sampling procedures, explain scientific observations and conclusions, and describe background project information.

Limitations of use and applicability should accompany all provided data and interpreted products.

Interoperability Example: Web Mapping
Web Feature Services

Collection Level Metadata

Station Level Metadata
SensorML Standard - http://vast.uah.edu/SensorML/

EC provided templates for easy creation of XML file
Free Software – Altova Authentic
Microsoft Access

Next Steps
Please send to me:
Chemistry Data
Lats and Longs for sites. . . .Important!
Site descriptions as per station profile metadata requirements
Collection Level MetaData Information
Any QA/QC protocols associated with the sampling procedures should be sent to me
Site photographs and final reports for projects will be available with the data online
Bilingual Content?
Did I forget Anything?

Contact Info
Barry Judson
Phone: 902-838-3351
Fax: 902-838-0610
Email: judsonb@seapei.ca FTP: ftp://ftp.seapei.ca

Appendix F
Centre for Sustainable Watersheds

www.watersheds.ca
(613) 272-5136

Sarah Rosolen, Executive Director
rosolen@watersheds.ca

Shawn Barnes, Techie
barnes@watersheds.ca

OGC compliant FGDC WMS WFS SensorML Metadata MapServer Chameleon

Webmapping allows us to share data AND information

Minimizes the need for individual GIS expertise

Facilitates reporting to our communities and partners

Makes community collected data valuable

Watersheds InfoXchange

On-line web mapping application to facilitate data sharing of water quality data in Ontario

GeoConnections funding helped us build the infrastructure and ResEau funding this year helped us get data into it

Huge number of partners, and comprehensive consultation process – 67 community and government bodies

Where we are now…

- 10,000 volunteer water quality data sites through partnership with MOE Lake Partner Program
- working on additional 200 lakes (~1000 sites) through ResEau
- Municipalities, conservation authorities, lake associations other watershed stewardship groups
- Access to base data through Ontario Ministry of Natural Resources
- Provides water quality monitoring protocols
- Allows community organizations to input and manage water quality data and share it with resource managers and decision-makers
- We've also built an Organization Directory - Discover who is protecting watersheds in Ontario

Stats

- Stats (not including project developers)
  - 2110 unique visitors
  - 175 registered users
  - 21000 pages served (90% maps)
  - Average 7 users/day

- Location of users
  - 55% Canada
  - 26% USA
  - 18% Unknown (most likely Can/US)
  - 1% rest of world

Open Source Technologies

MapServer, Chameleon, PostgreSQL, PostGIS

No licensing fees
Reduces costs for on-going maintenance
Easier to replicate/share application with other community groups
Continual development available to all partners
Sharing environment