# EMAN, and Protected Areas: Cooperating in Providing Information for Ecozone and Local Ecosystem Management

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## Abstract

*The Ecological Monitoring and Assessment Network's (EMAN) focus is the fostering of a scientifically sound, policy relevant ecosystem monitoring and research network based on a network of case-study sites operated by a variety of partners and developing a number of cooperative dispersed monitoring initiatives. These partnerships and initiatives will deliver unique and needed goods and services which include efficient and cost-effective timely reporting of status and trends to meet the requirements of adaptive management and responsive priority setting.*

*EMAN is developing a set of standardized measurements which can be carried out by interested sites, networks, and communities to establish whether and how local ecosystems are changing while at the same time contributing to timely status and trends reporting. These can serve as a basis for developing partnerships with a variety of protected areas. EMAN proposes cooperative development and implementation of a standard approach to ecosystem monitoring within such areas which includes cost-effective strategies, protocols, data management, interpretation and communication to meet the information needs of local managers, associated communities, relevant supporting agencies and Environment Canada.*

## Introduction

In 1994, Environment Canada created the Ecological Monitoring and Assessment Network Coordinating Office (EMAN CO) to augment Canada's ability to describe ecosystem changes, provide timely information to decision makers, and help inform the Canadian public. The EMAN CO facilitated the establishment of the Ecological Monitoring and Assessment Network (EMAN) which links the many groups and individuals involved in ecological monitoring in Canada in order to better detect, describe and report ecosystem changes. Essential elements of EMAN include numerous national and regional monitoring programs, over 80 long-term integrated ecosystem monitoring sites and a diversity of ecological monitoring initiatives conducted by numerous partners at all levels of government, by non-government organizations, and by volunteers. (Vaughan et al., 2001)

EMAN:

- Engages in cooperative projects to collect, collate, manage and interpret long-

term ecological science;
- Promotes collaborative multidisciplinary research and assessment of long-term ecological monitoring data to detect ecosystem changes;
- Identifies information gaps and priorities, and facilitates development of monitoring initiatives to address them;
- Promotes standardized electronic information catalogue systems (metadata);
- Provides a central access point for long-term integrated monitoring and assessment information;
- Develops and promotes needed ecological monitoring protocols, methods and standards, in cooperation with appropriate research institutes and agencies;
- Promotes and facilitates community and volunteer involvement;
- Delivers information and knowledge, including traditional knowledge; and
- Provides information for improved understanding about ecological changes to decision-makers and the pubic.

The EMAN web site (www.eman-rese.ca) provides examples and describes current initiatives pertaining to these activities.

Many parks and protected areas in Canada are EMAN partners. They include many relatively undisturbed ecosystems that provide an opportunity to collect information on large-scale stressors, such as global climate change, increased UV-B radiation, and long range transport of atmospheric pollutants. The information can then be compared with that from working landscapes subject to these and other more localized anthropogenic stressors such as land conversion, habitat fragmentation, transportation corridors, eutrophication and industrial effluents. Such comparisons can allow a better understanding of the potential ecological impacts of large-scale stressors, local stressors, and the synergistic effects of both on an ecosystem. Long-term monitoring in protected areas and in the working landscape will also facilitate the early detection and description of emerging environmental issues at national, ecozone and local scales providing timely information to facilitate adaptive management of science, development and policy.

The EMAN CO has been focusing on developing a set of standardized ecosystem monitoring protocols (EMPs) that will work together as a suite, to detect and track ecosystem changes over time, and which can be monitored in protected areas and working landscapes. A suite of about twenty EMPs have been selected that (Table 1):
- Will identify significant changes in ecosystems beyond normal ranges of fluctuations, so as to trigger and guide the design of future more rigorous investigations;
- Are suitable for measurement and comparison among a variety of sites;
- Are characterized by cost effective sampling methods; and, will easily fit into existing monitoring programs. (Environment Canada, 2000a)

The EMPs were distilled from 1770 monitoring variables assembled from a variety of sources including major environmental monitoring programs around the

Table 1. EMAN Suite of Ecosystem Monitoring Protocols

| Core Monitoring Variable | Derived Measures |
|---|---|
| Water quality – dissolved oxygen | |
| Water quality – water clarity | |
| Stream flow – stream flow rate | |
| Lake level – lake level fluctuation | |
| Air quality – lichen indicators | |
| Temperature mean – soil temperature/permafrost depth | |
| Snow/Ice phenology – lake ice out / ice in timing | |
| Lake sediment – sediment core analysis | |
| Species richness – amphibians | MS,RS,ES |
| Species richness – mammals | RS,ES |
| Species diversity – birds | RS,ES,SR |
| Species diversity – plants | RS,ES,SR |
| Species diversity – frogs and salamanders | MS,RS,ES |
| Species diversity – aquatic invertebrates / benthos | RS, ES, SR |
| Community biomas –benthos | |
| Indicator species group – fish Index of Biotic Integrity | MS, RS, ES, CB, CP, GP |
| Land cover change | |
| Plant phenolgy | |
| Community productivity – phytoplankton | |
| Community productivity – plants | CB |
| Soil health – earthworm species richness and soil decomposition | |
| Tree health – crown and bole condition | |

(Abbreviations used: MS – morphological symmetry, RS – rare species, ES – exotic species, SR – species richness, SD – species diversity, CB – community biomass, CP – community productivity,

globe. The variables were subjected to efficacy testing to ascertain their response to a variety of issues including:

1. Endocrine disrupters;
2. Invasive species;
3. Global carbon cycle changes/Global climate warming;
4. Increased Ultra Violet "B" (UV-B) radiation;
5. Habitat fragmentation;
6. Transportation corridors;
7. Acid rain;
8. DDT;
9. Eutrophication;
10. Ground-level ozone;
11. Pulp and paper mill effluent; and
12. Groundwater contamination. (Environment Canada, 2000b)

The majority of the selected variables are quite responsive to most of the stressors but redundancies and gaps were identified through this process and the suite was altered appropriately.

Several EMPs can provide multiple measures of ecosystem change. For instance, measuring species diversity of frogs also provides measures of morphological symmetry, species richness, and exotic species. The total number of field measure can therefore be reduced while retaining the capacity to measure different aspects of ecosystem change. There is general consensus among the EMAN partners that this suite is a suitable starting point for the tracking and early detection of ecosystem change. The suite will no doubt evolve, as pertinent new information on ecosystem changes becomes available.

An impediment to making comparisons at varying scales has been the lack of availability of comparable data: this can be addressed through development and implementation of standardized ecosystem monitoring protocols. EMAN is making a concerted effort to use, adapt and develop standardized monitoring methods for each of the EMPs and for other aspects of ecosystem monitoring as opportunities arise. National standardized monitoring methods are currently in use for several of the EMPs, particularly Stream Flow (Water Survey of Canada) and Ice Phenology (Meteorological Service of Canada). Anuran and earthworm distribution and abundance monitoring methods are currently being tested in all provinces and territories. However, for the majority of the EMPs the monitoring methods have been developed at local, regional and national levels, and although often similar, do not allow for direct comparisons at larger scales.

For instance, aquatic invertebrate monitoring programs have been implemented in the province of Ontario by the Ministry of Environment, the Ministry of Natural Resources, individual Conservation Authorities, Universities, and citizens groups, among others. The sampling frame, sample design, field methods, and data analysis, although similar, preclude regional and provincial comparisons. A workshop hosted by the National Water Research Institute and EMAN CO was held in the spring of 2001 and was attended by representatives from the aforementioned agencies. The representatives readily reached consensus to develop a standardized monitoring method that will contribute to local, provincial and national information needs. This attitude is proving typical for ecosystem monitoring practitioners, as there is a growing trend among the majority of agencies and non-governmental organizations to maximize monitoring efforts by sharing information and adopting common field collection methods, lab protocols, taxonomies and data management systems. Workshops are being planned to engage other agencies and organizations in developing pan-Canadian aquatic invertebrate monitoring methods. Similarly, initiatives are underway to develop pan-Canadian monitoring methods for lichen diversity, plant phenology, small-scale monitoring of bird diversity, and salamander diversity. A working draft: EMAN Monitoring Protocols (Environment Canada, 2001) has been published and EMAN CO is continuing to work with Network partners to define, describe and refine appropriate standardized monitoring protocols.

The proliferation of Environmental Non-governmental Organizations (ENGOs) during the past several decades points to a growing concern by Canadian citizens towards maintaining healthy ecosystems. Many of these groups have established local ecosystem monitoring programs and are using the results to influence policy and decision making at local, regional and national scales. Progressive ENGOs are seeking assistance to develop and implement comprehensive community-based and volunteer monitoring programs. EMAN, in partnership with the Canadian Nature Federation, has established a series of NatureWatch programs that are designed to collect reliable information that can contribute to local, regional and national monitoring programs. Sound scientific protocols are established with rel-

evant agencies and scientists. From these, succinct instructions are provided, informing volunteer observers how to collect reliable information. The NatureWatch programs are internet-based, but allow for hardcopy observation submissions. FrogWatch (www.frogwatch.ca) was launched in the spring of 2000 and collects information on the distribution and abundance of anurans across Canada. This program is supported by partnerships with anuran experts in each province and territory who check the submissions for accuracy and investigate outliers. WormWatch (www.wormwatch.ca) developed in partnership with Agriculture and AgriFood Canada collects information on the distribution and abundance of earthworms in Canada and was launched in the fall of 2001. IceWatch (www.icewatch.ca) developed in partnership with the Meteorological Service of Canada and Laval University collects information on lake and river ice phenology and was also launched in the fall of 2001. PlantWatch (www.plantwatch.ca) developed in partnership with plant phenology experts in each province and territory collects information on a suite of fifteen appropriate plants and will be launched in the spring of 2001. NatureWatch programs are also under development for lichen and aquatic invertebrate abundance and diversity, and tree health.

Community-based and volunteer monitoring benefits government agencies by increasing geographical coverage of observations and generating community support for ecosystem monitoring programs. Other benefits include the potential of reduced monitoring costs by engaging citizens in collecting complementary data and the potential to use citizens' data to locate suspected problem sites and assess the success of habitat restoration. Benefits are also accrued by the volunteers, such as: improving their environmental awareness; the opportunity to interact with government professionals; the opportunity to play and active role in safeguarding the environment; and, perhaps the most important, providing information for better decision making by the local community.

Volunteer monitoring programs have been criticized as being incapable of providing data of sufficient quality as they do not often address the QA/AC issues of sensitivity (recognition of species and individuals); reliability (reproducible results); and accuracy (lack of systematic bias). The NatureWatch programs provide training and reference materials which exceed requirements to address the issue of sensitivity; scientifically sound, tested and easily understood protocols to address the issue of reliability; and provide a multitude of independent observers and observations to address the issue of accuracy.

EMAN NatureWatch programs further define important but limited goals for the resulting data: goals that directly complement and augment professionally collected measurements and observations. NatureWatch programs are focused on providing coordinated and timely information on ecosystem changes so as to provide suitable input to policy development and priority setting. This is needed to augment the peer review process that often requires 10-15 years of routine data gathering to establish statistical certainty. Adaptive management of policy, science or

sustainability requires timely feedback which must as a result be openly based on risk or best judgement rather than certainty. Volunteer programs therefore achieve their maximum utility when their information is used to provide initial indications of a probable change in conditions that merits further scientific study or assessment. Well-designed volunteer programs are unique in their ability to extend line agencies' capacity to detect and respond to changes.

The establishment of the Ecological Monitoring and Assessment Network was a giant step towards implementing effective national, regional and local integrated monitoring programs that will meet the needs of decision makers and the public, and contribute to effective adaptive management programs at all scales. Protected area managers across Canada are implementing standardized ecosystem monitoring methods, developed with their colleagues in EMAN, that will meet their local management needs as well as contribute to ecozone and national management needs. Network resource constraints have been partially overcome by forming efficient and practical partnerships that meet the needs of the partners and of the Network, but much remains to be accomplished. However, the strength of EMAN is people – people who are working collaboratively and tirelessly to provide timely information on ecosystem change to the Canadian public, protected area managers, and decision makers. The future is bright!

## References

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