Building on the ONE Monitoring Program: Integrating Monitoring Programs in Protected Areas on the Central Niagara Escarpment

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Abstract

The management of protected areas requires an integrated strategy that successfully builds on the research and monitoring efforts of many groups including government agencies, academics, and non-governmental organizations. This requires a greater coordination of data acquisition and exchange of information than has occurred in the past. This paper will examine the integration of complementary projects within the framework of Ontario's Niagara Escarpment (ONE) monitoring program. The focus will be on the central region of the Escarpment where a number of concurrent research and monitoring programs have been initiated. The successful integration of these projects will aid in developing strategies that facilitate ecosystem planning and conservation of the parks and protected areas of this region of the Biosphere Reserve. Specific projects on biodiversity and ecosystem dynamics will be reviewed including the seasonal pattern and dynamics of bird populations and habitats on the central Niagara Escarpment. Other related projects that overlap with the goals as well as the spatial extent of the ONE monitoring program will be addressed including terrestrial monitoring and ecological land classification in the Credit Valley Watershed and the Forest Bird Monitoring and Forest Bird Productivity Programs.

Introduction

The growing awareness of large scale impacts on the components and functions of many global ecosystems has emphasized the need for a better understanding of the long term, temporal and spatial alterations to these systems. Consequently, this has led to the establishment of monitoring programs of varying focus, protocol and duration (e.g. Newton 1995). Often monitoring information has restricted use, fulfilling either research or management priorities. One of the shortcomings of many monitoring programs has been that research and management actions are not integrated with each other or with continued monitoring. As DeSante and Rosenberg (1998) emphasize, the interaction of monitoring, research, and management must be structured into an interactive loop for adaptive decision making.

Ontario's Niagara Escarpment (ONE) Monitoring Program addresses this problem of integration. The program was initiated to bring together monitoring information and to coordinate existing and future research directives to aid in assessing the cumulative effects of landscape change on the Niagara Escarpment. This will assist future decisions on land use management and policy directives.

Since its inception, other concurrent programs have been established that complement the ONE program. These programs have been initiated by a variety of groups, including government agencies, environmental groups and academic institutions. A "meta database" was created to track all monitoring and research activities along the Escarpment including those implemented through the ONE monitoring program and activities undertaken by the aforementioned organization. This meta data can be used to examine gaps in monitoring and assess the ONE monitoring program and related land use policy.

This paper will review the ONE monitoring program and its importance for land use management of the Niagara Escarpment Biosphere Reserve and assessment of the Niagara Escarpment Plan. Research on bird populations will be presented to highlight the importance of combining monitoring programs with research (Milne and Bennett, 1998) and management (CVC, 1999) on the central Niagara Escarpment and the Credit Valley Watershed. Finally, a framework for integrating the various monitoring programs will be presented.

Niagara Escarpment Biosphere Reserve

The Niagara Escarpment is a dominant landscape feature of Southern Ontario, extending for over 700 km from the US border at the Niagara River to the head of the Bruce Peninsula. From the late 1950s, concerned citizen groups began to lobby for some form of preservation and controls on land use planning and development (Moss and Milne, 1998). In 1973, the Niagara Escarpment Planning and Development Act was passed, establishing the Niagara Escarpment Commission (NEC) which published its Proposed Plan for the Niagara Escarpment in 1979 (see NEC, 1979). The Niagara Escarpment Plan was approved in 1985 and subsequently revised as a result of further review initiated in 1990 by the Ontario Ministry of Environment and Energy (see OMEE 1994; Moss and Milne 1998).

The plan represents a land use management strategy that provides for the multi-use of this landscape for activities including agriculture, aggregate extraction, tourism and natural heritage. It also links a series of public lands from Tobermory to Niagara Falls, through a natural and protected corridor. The nature of this land use plan emphasizes the importance of combining stewardship of surrounding private land with multi-use public lands.

In response to this arrangement, in 1990, the Niagara Escarpment was designated a World Biosphere Reserve by UNESCO (United Nations Educational, Scientific and Cultural Organization), one of six currently in Canada. Biosphere reserves promote and demonstrate a balance between people and nature and act as working models for land managers and sustainable development. A key characteristic of biosphere reserves is also their support of research, education and monitoring.

Monitoring

There has been a global recognition for the need to monitor ecosystem components, to provide important evidence of environmental change and stimulus to further experimental research (Burt, 1994). Monitoring has been recognized as an important directive for the management of biosphere reserves. It provides: knowledge and interaction between humans and the biosphere; monitoring and research

projects; education, public awareness and involvement of communities; and training of managers and the community.

For example, there has been a strong initiative to establish baseline information and monitor long-term trends of populations of neotropical and forest-interior birds following the revelation of significant declines in these species (Askins et al., 1990; Newton, 1995). In Ontario, there has been a lack of long-term records of richness and abundance of birds for land systems. Monitoring of these species will aid in gathering scientifically defensible wildlife population data and for filling in gaps in information such as species and demographic coverage (Cheskey, 1995). Recently, volunteer projects have been initiated by a number of groups and individuals on the Escarpment including the Forest Bird Monitoring Program and Forest Bird Productivity Study (Canadian Wildlife Service) (Wyatt et al., 1998) and Species of Conservation Concern (Credit Valley Conservation) (Puddister and Milne, 1998).

ONE Monitoring Program

In response to this demand, the Niagara Escarpment Commission developed the ONE Monitoring Program based on an ecosystem approach to planning, which includes environmental monitoring and cumulative environment effects. This approach provides a means to assess the success of the Plan.

The purposes of the ONE program are:

1) Answer planning questions including: Are the purpose and objectives of the Niagara Escarpment Plan Act being achieved? Are ecosystem health and land use compatibility achievable?
2) Complete planning analysis and response. This includes assessing if Plan policies are adequate to achieve the Act's purpose and refining the monitoring strategies to meet this goal. Following this, there will be a review and change to policies, implementation and stewardship strategies.
3) Provide information on the condition of Escarpment ecosystems. The focus of this would be on: change in the physical/ecological/cultural conditions; change in terms of landscape structure and function; and results of change on the landscape.
4) Monitor the cumulative effects of development and land use change. This would include identifying the source of threats and patterns of human disturbance across the landscape.

These goals are linked as outlined in Figure 1. Monitoring initiatives, which include land use and landscape monitoring, will be to establish baseline conditions and spatial and temporal change to the system. The nature of the information to be collected is dictated by the planning questions as related to the purpose and objectives of the Act. The results of the monitoring will assist in completing a cumulative effects analysis (Ramsay, 1996).

The ONE monitoring framework is composed of monitoring objectives, questions, and components which determine the indicators and targets for specific monitoring programs and subsequently the techniques and protocols to be employed. The objectives are a combination of the terrestrial ecology, water, recreation, open land-

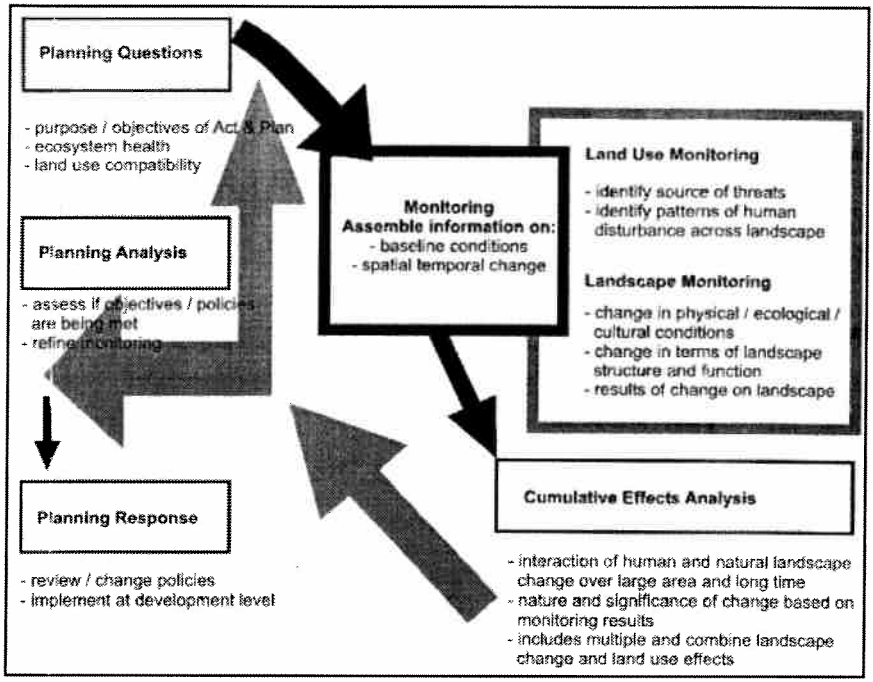

Figure 1: Relationship between Monitoring, Evaluating Cummulative Effects, and Planning Decisions (from Ramsey 1996).

scape character, land use and public access (Figure 2). For each objective there are related questions and components. For example, the water objective would include questions on the quality and quantity of groundwater and surface water. Related components would include streams, ponds and groundwater.

Goals of ONE include:

- building a strong and integrated network of partners and volunteers working towards monitoring for cumulative effects along the Escarpment;
- the transfer of expertise to others such as municipalities, Long Point Biosphere Reserve, non-governmental organizations (NGOs) and conservation authorities;
- providing independent researchers with access to the central repository of monitoring and research including the meta database, an annotated bibliography and integration of spatial and tabular data through Geographic Information Systems (GIS);
- the development and implementation of a complete suite of monitoring protocols; and,
- spatial and temporal information on the Escarpment ecosystems to provide a basis for the development of ecosystem based planning policies.

Partnerships

The key to implementation has been in the development of monitoring partnerships. This allows for resources to be shared and built upon as well as an ex-

Monitoring Objectives					
Terrestrial Ecology	Water	Recreation	Open Landscape Character	Land Use	Public Access
Monitoring Questions					
Natural processes and habitats? Regenerating fields and former aggregate areas?	Quality and quantity of groundwater? Quality and quanity of surface water?	Recreational activites and opportunitie? Recreational demands and carrying capacity?	Open landscape character?	Permitted uses and activites? Permitted land management practices?	Road access and trail access? Stress on access points?
Monitoring Components					
Cliff face, valleys, forests, wetlands	Streams, ponds, groundwater	Public and private parks, conservation areas	Access points, walking trails	Designated areas, land use classes	Landform, vegetation, views, land use, heritage
Indicators					
Targets					
Techniques					
Information Management		**Analysis and reporting**		**Management Actions**	

Figure 2: ONE Monitoring Program Framework

change of expertise. This program includes connection with the Parks system, for example, coordinated programs at Bruce Peninsula and Fathom Five National Park including the Ecological Integrity Monitoring Program. Other partnerships include government agencies such as the Canadian Wildlife Service, Ministry of Natural Resources, and Ministry of the Environment (e.g. the Forest Bird Monitoring Program (FBMP) and Forest Bird Productivity Study). Academic institutions include Sir Sanford Fleming College, the University of Guelph and University of Waterloo. Examples of these projects include the Cliff Ecology Research Group at the University of Guelph and the Land Use Change Project at Sir Sanford Fleming. Other affiliations include the Ontario Heritage Foundation and the Canadian Biosphere Reserves Association.

Integrating Programs

The information from partners and other researchers is being gathered at varying scales throughout the Biosphere Reserve. Not all this information will have immediate use or a need for integration, but could in the future fill a vacancy. Awareness of available information will prevent the duplication of similar research in the future. It will also allow the building of chains of data that can be funneled upwards to broader projects and policy. The following example examines some of these linkages.

Monitoring of Bird Populations

Site Specific Research

Along the central portion of the Biosphere Reserve, from Hockley Valley to Georgetown, seasonal bird populations have been monitored within public lands including provincial parks and conservation lands (Milne and Bennett, 1998). The specific goal of this research was to establish seasonal trends in bird populations for woodlots in southern Ontario and to develop a model of the relationships between the spatial pattern of birds and biophysical processes on the Niagara Escarpment.

Three years of seasonal data from a site located at the Forks of the Credit Provincial Park is presented in Figure 3. This graph portrays the variation in average species richness throughout the year. The results indicate the importance of Escarpment forested areas for neotropical migrants in the breeding and migration periods. Spring and fall migration has not been investigated in the past for this area. Similarly, little is known of the distribution of species during the winter months. The numbers are lower at this time of year, compared to the summer months but abundance values suggest these sites are important components of the winter bird systems (Milne and Bennett, 1998). Overall, the seasonal data provides a more comprehensive overview of avian systems on the Escarpment and will be instrumental in refining ecosystem management strategies for individuals or groups of species.

At this site, Milne and Bennett (1998) have also investigated avian use of specific landform components such as escarpment slopes and stream valleys (Figure 3). The research indicates that some areas of the Escarpment system, especially where geomorphic processes are more active, attract a greater diversity of bird species. This information is useful when developing land use management plans

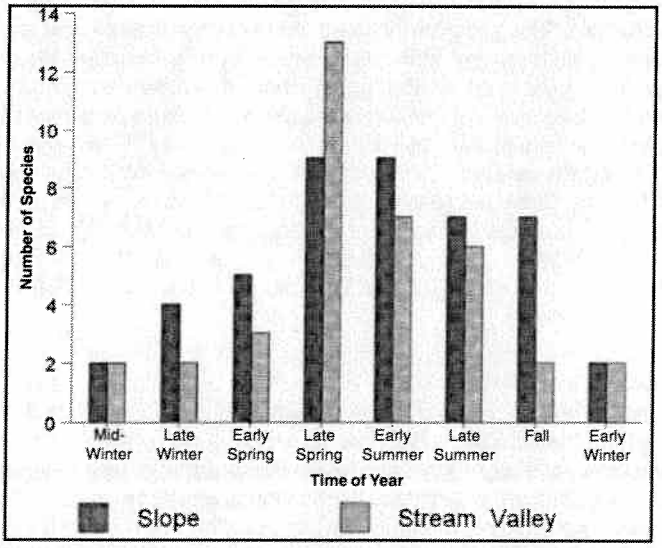

Figure 3: Average avian richness by season at Forks of the Credit Provincial Park, 1996-98 (from Milne and Bennett 1998).

at larger planning scales. This aids in identifying sites within the Plan which may be more significant or sensitive to changes in the functioning of the system (Moss and Milne, 1998). This information also improves our understanding of the processes that maintain the dynamic relationships between bird species and their habitats.

This work complements the research of monitoring and productivity projects of the Canadian Wildlife Service which focus on undisturbed areas of upland forest on the Escarpment (Wyatt et al., 1998) and has been utilized by the Niagara Escarpment Commission as base information for site specific projects (Braid, 1997). Similarly, this site level information on avian populations has also been integrated into ecological land classification projects on subwatersheds within the Credit Valley watershed (CVC, 1999).

Credit Valley Conservation Monitoring Program

Credit Valley Conservation has recently developed 'species of conservation concern' lists. These lists include species that are targeted for monitoring and mapping within the watershed (Puddister and Milne, 1998). The goal of this project includes promoting volunteer site records to develop a tracking system of population distributions throughout the watershed over time. As with the ONE program, this project involves acquiring information at the site level from research projects and applying the results to improve land use planning at the regional level. These goals, directly linked to conservation concerns, emphasize the need to acquire and integrate monitoring information over a hierarchy of scales (Puddister and Milne, 1998).

At the site level, information on species of concern will aid in designating the significance of a disputed property (e.g. ecologically significant area). Providing a suite of indicator species, such as vulnerable, threatened and endangered species (VTEs), encourages the public to provide data for a more detailed assessment of the property.

In contrast, at the landscape scale this information will aid in evaluating land use planning. This includes the combinations of land use pattern and landscape dynamics to answer questions such as the importance of wildland complexes as local sources or sinks for avian species (e.g. Wyatt et al., 1998)

Finally at the watershed level, this data will assist in completing an overview of the spatial distribution of natural resources of the watershed and to assist planning at the watershed or ecosystem level (Puddister and Milne, 1998). This will be achieved through projects such as the proposed watershed bird atlas which will assist in determining the importance of the watershed within Ontario for specific species (e.g. Couturier et al., 1998).

Integrating Monitoring Programs

The ONE monitoring program recognizes the need to develop a mechanism that allows for greater integration of monitoring programs. The users need to be aware of what complementary research and monitoring has occurred in the past and is currently taking place. This information has to be integrated and assessed, as a

form of gap analysis, to determine what critical linkages are missing and conversely what projects are duplicating monitoring energies.

The challenge is to broaden the scope of existing monitoring arrangements, to allow the inclusion of different agencies, groups and individuals. This can be accomplished by increasing the direct participation in partnership between the ONE program with other groups or by at least establishing a system that allows for the exchange of data as well as information on data.

The first step in this process is to identify the target groups and individuals. In this area of the Escarpment, partners, users and contributors to ONE could include: government agencies such as Credit Valley Conservation; academic institutions such as the Geography Departments at Wilfrid Laurier University, the University of Waterloo and the University of Guelph; as well as non-governmental, volunteer organizations such as the Halton-North Peel and Upper Credit Naturalists Clubs. For example, the Commission has established a monitoring course through the University of Waterloo, which combines data collection with educational field experience.

One way this can be accomplished is through the creation of a central repository which can include a meta database, library references (e.g. annotated bibliography) and Geographic Information Systems (GIS) data collections. In the following discussion the linkages related to a meta database will be presented, recognizing that similar strategies could be developed for other data sources. The structure of this linkage is outlined in Figure 4, and begins with the initiation or recognition of related interests between partners of the ONE monitoring program and similar research conducted by other organizations and individuals.

Meta Database

To organize this information it was essential to create a meta database. Meta data is data about data, monitoring data in this case, not actual data sets. As mentioned this data can include information from government and non-government organizations, naturalists groups, universities, consulting firms, and independent researchers. A database is used to store and retrieve collected meta data. The purpose of the meta database is to assess spatial gaps in monitoring along the Escarpment and gaps in terms of which objectives of the Niagara Escarpment Planning and Development Act are being targeted. As this information is gathered, it is inputted into a central database for storage, retrieval, analysis and queries, which will also eventually be made available to many users through mechanisms such as the Internet.

Gap Identification

Once this information is assembled, how can it be used in the management of protected areas? Initially, the meta database allows for the completion of a gap analysis of the research. The users can identify critical knowledge areas that are weak or non-existent and develop monitoring or research strategies to fill the gaps. This could take the form of new monitoring programs within the ONE monitoring program, initiated by one of the partners, or as feedback to the other associated groups as suggestions for future projects.

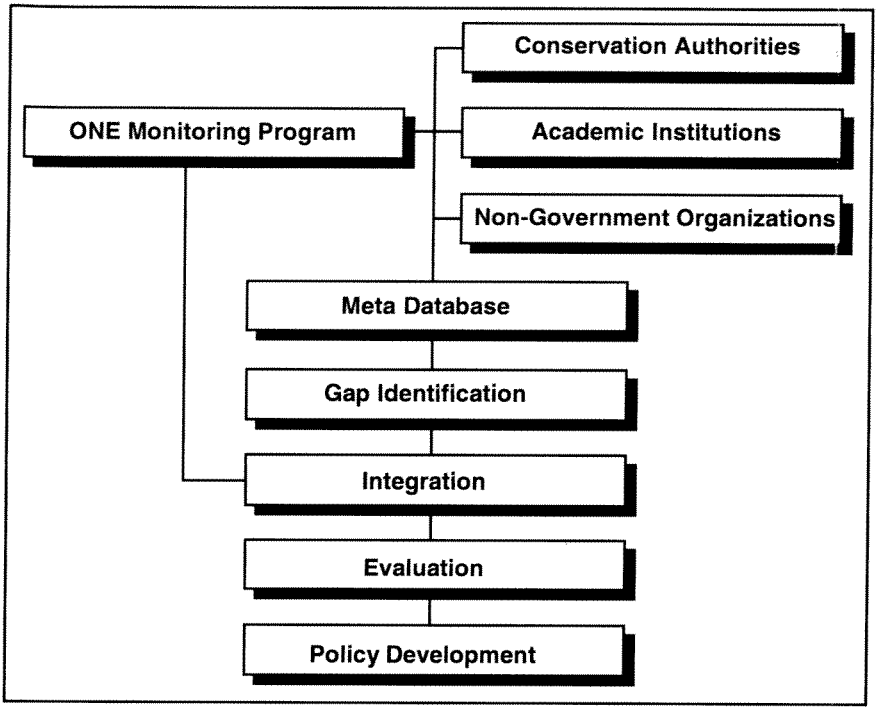

Figure 4: Framework for ONE monitoring program and integration with other related programs.

Integration, Evaluation and Policy Development

Next, information from the data sets will be used to assess the status of the monitored subject, such as bird population patterns, forest dynamics and health, etc. These results will be integrated with other related data to gain a better understanding of the state of the system. Following integration, an evaluation of the results will take place to be used in the review of the Niagara Escarpment Plan. Presently, the Plan is to be reviewed every five years. This will take the form of decisions that can be enacted upon to develop new policies or to modify the existing framework of the plan to improve on the environmental impacts. Cumulative effects monitoring programs will be developed, with integration and exchange with environmental and planning organizations along the Escarpment.

Conclusions

The ONE monitoring program was initiated to assist in the gathering and integration of the growing wealth of data and environmental information that is accumulating on the Niagara Escarpment. The program was also established to synthesize and evaluate this information to provide an ongoing assessment of the Niagara Escarpment Plan. Associated research, from a variety of sources including groups and individuals, can augment monitoring that is currently taking place within the ONE program. This research is occurring at varying scales across the Biosphere

Reserve, from the monitoring of forest birds within individual woodlots to the assembling of subwatershed and regional bird inventories. It is important that communication is improved between the ONE program and these other groups to create cooperative and efficient monitoring programs and to improve the integration of research and management strategies.

References

Askins, A.R., Lynch, J.F., and Greenberg, R. 1990. Population declines in migratory birds in eastern North America. In D.M. Powers (ed.), *Current Ornithology*, vol. 7. New York: Plenum Press.

Braid, A.M. 1997. *Hockley Valley Site Report: Ontario's Niagara Escarpment Monitoring Program.* Niagara Escarpment Commission, Georgetown.

Burt, T.P. 1994. Long-term study of the natural environment - perceptive science or mindless monitoring? *Progress in Physical Geography* 18(4):475-496.

Cheskey, E.D. 1995. *Towards Conserving the Birds of Ontario.* Federation of Ontario Naturalists, Toronto.

Couturier, A., McCracken, J. and Bradstreet, M. 1998. *Conservation Priorities for the Birds of the Niagara Escarpment Plan Area* (draft report). Bird Studies Canada/Long Point Bird Observatory.

Credit Valley Conservation (CVC). 1999. *Caledon Creek and Credit River Subwatershed Study* (draft report). Credit Valley Conservation, Mississauga.

DeSante, D.F. and Rosenberg, D.K. 1998. What do we need to monitor in order to manage landbirds. In J.M. Marzluff and R. Sallabanks, eds. *Avian Conservation: Research and Management.* Washington D.C.: Island Press, 93-106.

Milne, R.J. and Bennett, L. 1998. Seasonal patterns of avian populations on the central Niagara Escarpment. In S. Carty, R. Murzin, S. Powell, and D. Ramsay, eds. *Leading Edge '97 Conference Proceedings.* Ministry of Natural Resources, 115-121.

Moss, M.R. and Milne, R.J. 1998. Biophysical processes and bioregional planning: The Niagara Escarpment of Southern Ontario, Canada. *Landscape and Urban Planning* 40:251-268.

Newton, I. 1995. The contribution of some recent research on birds to ecological understanding. *Journal of Animal Ecology.* 64:675-696.

Niagara Escarpment Commission (NEC). 1979. *The Proposed Plan for the Niagara Escarpment Commission.* Niagara Escarpment Commission, Georgetown.

Ontario Ministry of Environment and Energy (OMEE). 1994. *The Niagara Escarpment Plan.* Ontario Ministry of Environment and Energy, Toronto.

Puddister, M.J. and R.J. Milne. 1998. Community-based bird monitoring programs in the Credit Valley Watershed. In S. Carty, R. Murzin, S. Powell, and D. Ramsay, eds. *Leading Edge '97 Conference Proceedings.* Ministry of Natural Resources.

Ramsay, D. 1996. *A Landscape Approach for Measuring and Monitoring the Cumulative Effects of Land Use Change for the Niagara Escarpment Plan Area.* M.A. Thesis, University of Waterloo.

Wyatt, V., Cadman, M., Friesen, L. and Ramsay, D. 1998. Is the Niagara Escarpment a source for songbirds? A case study of the Wood Thrush. In S. Carty, R. Murzin, S. Powell, and D. Ramsay, eds. *Leading Edge '97 Conference Proceedings.* Ministry of Natural Resources, 154-160.