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MONITORING IN ONTARIO'S PARKS AND PROTECTED AREAS

University of Waterloo

Ontario Parks

Canada

Edited by:
Christopher J. Lemieux
Paul A. Zorn
Tim J. Bellhouse
J. Gordon Nelson

Monitoring in Ontario's Parks and Protected Areas

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Edited by:
Christopher J. Lemieux, Paul. A. Zorn,
Tim J. Bellhouse and J. Gordon Nelson,

Supporters:

Ontario Parks, Ontario Ministry of Natural Resources (OMNR)
Parks Canada
Parks Research Forum of Ontario (PRFO)
University of Waterloo

Publication of Parks Research Forum of Ontario (PRFO)

Contact:
E.S.1, Room 351, University of Waterloo
Waterloo, ON N2L 3G1
Phone: (519) 888-4567 x2072
Fax: (519) 746-2031
E-Mail: coordinator@prfo.ca
Web: www.prfo.ca

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Top: Prickly pear cactus (*Opuntia humifusa*), Rondeau (Natural Environment) Provincial Park. (Photo by T. Beechey)
Middle: Benthic sampling at Georgian Bay Islands National Park. (Photo by D. Upton)
Bottom: Sand River Nature Reserve Zone, Lake Superior (Natural Environment) Provincial Park (Photo by T. Beechey)

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Workshop Planning Team:

Paul Zorn (Parks Canada)
Tim Bellhouse (Ontario Parks)
Jennie Aikman (Ontario Parks)
Rob Davis (Ontario Parks)
Francois Marineau (Parks Canada)
Dan Mulrooney (Ontario Parks)
Dan Paleczny (Ontario Parks)
Josh Van Wieren (Parks Canada)

PRFO Steering Committee:

Gordon Nelson (Chair), University of Waterloo
Rob Davis, Ontario Parks
Paul Zorn, Parks Canada
Stephen Murphy, University of Waterloo
Tom Nudds, University of Guelph
Michael Troughton, University of Western Ontario
Bob Payne, Lakehead University
Dawn Bazely, York University
Tom Beechey, Canadian Council on Ecological Areas (CCEA)
Brian Craig, Ecological Monitoring and Assessment Network (EMAN)

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Introduction

These proceedings represent a summary of an Ontario Parks - Parks Canada workshop on ecological monitoring held on January 11 to 13, 2005 in Peterborough, Ontario. This timely meeting was prompted by an effort by both agencies to strengthen their mandates to protect, monitor, and report on the ecological integrity of park ecosystems. Regarding provincial parks, the Ontario government has introduced new, stronger legislation for the protection of provincial parks and conservation reserves (Government of Ontario, 2005). This new legislation recognizes that ecological integrity is of primary importance and aims to include key policies that promote protection of ecological integrity and support sound management of protected areas. The new *Provincial Parks and Conservation Reserves Act* received first reading on October 25, 2005. Regarding national parks, the Government of Canada emphasized ecological integrity as the top priority in the management of national parks and provided a legal definition of ecological integrity in the revised Canada National Parks Act (Government of Canada, 2000).

Common in these two pieces of legislation is the requirement to report to the public on the state of parks. Reporting in a meaningful way on the state of ecological integrity requires a comprehensive and affordable long-term monitoring program. Ecological integrity monitoring represents a tremendous challenge to both Ontario Parks and Parks Canada. Parks contain open and dynamic ecological systems and their boundaries are usually not delineated in accordance with ecological criteria. There are major complexities in terms of the selection of ecological indicators and measures for monitoring, the development of robust study designs that minimize the effects of confounding factors, and the establishment of monitoring thresholds and targets (just to name a few). Long-term monitoring programs must be designed so that they are affordable and operationally sustainable within each agencies' financial and human resource capabilities. Trade-offs between a monitoring program's comprehensiveness and operational sustainability will have to be made to be successful.

In order to find new and innovative solutions to our shared problems, Ontario Parks and Parks Canada met over a three day period to discuss common needs, opportunities and priorities for collaboration. This workshop was a very good starting point for what will hopefully become a more productive partnership on ecological integrity monitoring and protected areas management in general.

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Day 1 Morning:

Protected Areas – Context for Policy, Planning and Management

Protected areas provide important opportunities to conduct research and monitor environmental features and conditions, northwestern Ontario. (Photo by T. Beechey)

Adaptive Management in the 21st century

Paul Gray
Senior Program Adviser
Applied Research and Development Branch, Ministry of Natural Resources (OMNR)
Robinson Place, 6th Floor South
300 Water St.
P.O. Box 7000, Peterborough, Ontario, K9J 8M5
Phone: (705) 755-1967
E-Mail: paul.gray@mnr.gov.on.ca

Abstract

In the 1970s a few scientists formally advocated the use of experiments to improve natural asset management decision-making through explicit and detailed analyses of policy options and identification of inherent uncertainties. Since then, a number of studies designed to explore behaviour-based adaptive management techniques have been completed. Given that adaptive management will remain a necessary and important technique in 21st century, this paper outlines some of the variables requiring consideration during the design and application of projects and programs.

Introduction

Earth is a dynamic, uncertain place — always has been, always will be. Survival, therefore, is about biological and/or behavioural adaptation to Earth's ever-changing ecosphere. For example, people adjust, alter, or modify a tool, technique, or decision to reduce or eliminate a threat (reduce a risk) in order to live safer and longer. It means that people use data and/or information generated from an event, decision, or action to learn. Heinlein's (1973) adage that *"you live and learn or you don't live long"* underscores the rationale behind behaviour-based adaptive management. This paper summarizes behaviour-based adaptive management and describes some of the variables requiring consideration during the design and application of projects and programs.

Adaptive Management Defined

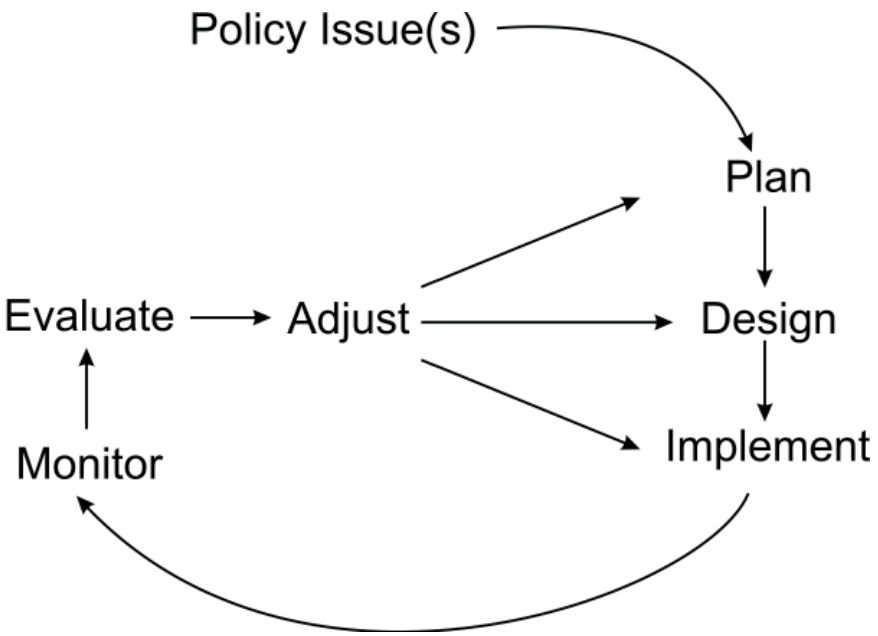
Behaviour-based adaptive management can be envisioned as a cyclical process of doing and learning using any number of feedback mechanisms available to natural asset managers. The cycle can be sophisticated or simple, subject to the approach selected by the sponsoring agency or organization. For example, a cycle can include planning, designing, implementation, monitoring, evaluation, and adjustment phases (Figure 1).

Behaviour-based adaptive management is perhaps best understood as a continuum of learning tools ranging from: 1) reactive, event-by-event, trial-and-error decision-making; to, 2) single policy design, implementation, monitoring, and modification as required (passive); to, 3) multiple policy evaluation using sophisticated active experiments and comparative analyses (Hilborn, 1992). Each of these tools uses some or all of the phases depicted in Figure 1.

With the reactive or *"crisis management"* approach, change (adaptation) results from one or more external drivers, including, but not limited to, public reaction to issues (MacDonald *et al.,* 1999), emerging socio-eco-

nomic trends, and threats to life and property. This elemental form of adaptation is based on a response to immediate and/or emerging circumstances using information derived from the event or crisis. While it can be used successfully (e.g., eliminate a behaviour that does not work should the crisis happen again in the future), the reactive approach provides little information to managers in support of proactive planning and the ability to mitigate the issue or impact before it occurs. Responsive adaptive management is also called management by trial-and-error (Walters, 1997).

Figure 1. A generic representation of an adaptive management cycle.



Passive adaptive management involves the implementation of a single policy or decision identified as the most likely to succeed. People learn when anticipated outcomes or targets are established and monitoring programs implemented to evaluate policy success. Harvest program targets established (and constantly adjusted) on the basis of long-term and ongoing wild life population monitoring exemplify this type of adaptive management, which is also referred to as management by monitor-and-correct (Walters, 1997).

Emphasis on a more rigorous approach to reducing uncertainties distinguishes active adaptive management from reactive and passive approaches where Walters and Hilborn (1976), Holling (1978), Walters (1997), and others advocate the use of experiments to make decisions based on explicit and detailed analyses of policy options and identification of major uncertainties. Experimental adaptive management requires replication of management strategies and use of control sites. Experimental management is most useful when there is significant uncertainty about the effects of a number of potential management policies (Fleming and Baker, 2002), and in cases where replication is, in fact, possible.

While active adaptive management is the most sophisticated and informative approach, it is the most difficult to design, and is not always possible to complete. Given that some adaptive techniques are global in scope (e.g., some of the management techniques implemented to combat global warming) and that financial and/or other resources may be limiting, agencies and organizations (including academic institutions, companies, and non-government organizations) equipped to use a variety of adaptive management techniques will be better suited for 21st century decision-making than those that are not.

Factors to Think About in the Design of an Adaptive Natural Assest Management Program

The ability to adapt in the 21st century will, in large part, depend on agency and organization commitment and on how well staff and partners are equipped to deliver programs. The following variables may require consideration during project and program design and implementation:

1. Space and Time.
A spatial and temporal context for decision-making is critical because all species, small and large, short-lived and long-lived, specialists and generalists, survive by accessing a niche to eat or draw up nutrients, shelter, and reproduce. Natural asset management agencies responsible for wild life, for example, must therefore be capable of adaptive decision-making in a variety of small and large spatial contexts, including ecosystems (e.g., small ecosites to large ecozones), administrative units (e.g., Wild Life Management Units), and thematic units (e.g., parks and other types of protected areas), and according to short (e.g., minutes, days, and months) and long (e.g., months, years, decades, and centuries) periods of time.

2. Corporate Culture and Function.
Adaptive management is possible when institutional culture and function is used in support of programs designed to reduce uncertainty and risk. While an institution that promotes and supports experimental adaptive management is important (MacIver and Dallmeier, 2000), the ability to adapt to circumstances as they emerge (e.g., reactive adaptive management) is also required. Agencies and organizations should constantly assess the corporate capability to anticipate and respond to policy issues requiring some kind of adaptive approach.

3. Partnership.
No single agency or organization has cornered the market on expertise and know-how. And given the scope and complexity of global-local issues (e.g., climate change), no agency or organization can manage and care for a jurisdiction's natural assets alone. Therefore, partnership is a fundamental prerequisite to behaviour-based adaptation. The partnership literature is large and filled with case studies — there are many ways to work together, including advisory and expert committees, working groups, and work programs negotiated between managing parties that actively involve citizens in caring for natural assets. Success in any one of these relationships requires constant attention, encouragement, incentive, modification, and in some instances where the partnership is cyclical, revitalization. Sponsoring and participating organizations must ensure that the partnership remains viable and when necessary fine-tuned to enhance the chances of success (NRPTF, 1992; Trauger *et al.,* 1995) in our ever-changing world.

4. Data and Information Management.
Accessible data and information gathering and management programs (such as research, inventory, monitoring and assessment) to advance our knowledge of ecospheric function and human impact are fundamental requirements. It is important to note, however, that it is not practical to measure and monitor everything. Success at adaptive decision-making likely will be best realized through the careful selection of the unique data and information needs of each agency or organization (MacIver and Dallmeier, 2000; UNDP, 2003: 8), including decisions based on well-replicated experimental design and direct measurement of policy responses (Walters, 1997). Data and information sharing agreements can be used to strengthen agency and organization adaptive capabilities.

5. Strategic Planning.

Strategic planning is used to identify, establish, and modify short- and long-term direction in support of an organization's vision of the condition to which it aspires (e.g., sustainable living). Agencies or organizations committed to adaptive management constantly employ strategic planning to develop and assess scenarios about the future, often from a variety of perspectives and using a variety of spatial and temporal tools. Scenarios can introduce and describe several policy options, improve the quality of decision-making, and identify important but poorly understood questions for further study. For example, the Intergovernmental Panel on Climate Change (e.g., IPCC, 2001) uses scenarios to assess vulnerability (the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change) and risk to the ecosphere caused by numerous climatic conditions resulting from a variety of human actions that might occur during the next 100 years.

6. Policy.

A policy is a statement of commitment that guides decisions and actions in response to program goals, objectives, and strategic direction. Rarely does a single solution to a natural resource management issue or problem exist, and policy must reflect this reality — agencies and organizations must constantly and where appropriate collaboratively search for a range of policy options. Policy formulation and the science that supports it must therefore be progressive and flexible, and permit managers to respond effectively to unexpected or unconventional issues and problems (Dovers and Handmer, 1992). Lee (1993) argues that natural resource policy formulation in a dynamic, uncertain world must subscribe to a simple imperative — *"policies are experiments; learn from them"*. Whenever possible, agencies and organizations should use data and information to compare expectations to reality and transform the comparison into learning by correcting the errors, improving imperfect understanding, encouraging commitment, and changing direction, action, or plans as needed.

7. Communication.

How well we discover, use, and share information and knowledge about ecosystem function and the impacts of people who live and work in each of them is critical to cultural, social, ecological, and economic health in the 21st century. The creation and maintenance of networks and other forums that allow people who are engaged in adaptation theory, policy, and implementation to work together will foster knowledge exchange and dissemination, and facilitate continuous learning (Parry *et al.,* 2005). In addition, knowledge dissemination through life-long learning opportunities that are accessible and current (e.g., education, extension, and training programs) can be used to optimize community-based decisions.

Summary

The world is a dynamic, risky place, and agencies and organizations will need to use a variety of tools and techniques (some more sophisticated and scientific than others) to adapt. The ability to adapt in the 21st century will, in large part, depend on agency and organization commitment and on how well program staff are equipped to deliver behaviour-based adaptive management. An important part of being adaptive requires that program staff ask the right questions in support of the decisions that are required. In many situations, natural asset managers may find it helpful to examine requirements related to spatial and temporal context, corporate culture and function, partnership needs, data and information management needs, proactive action through strategic planning, dynamic policy formulation, and effective communication.

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Protected Areas: Context for Planning and Management – Parks Canada Perspective

Mark Yeates[1] and Paul Zorn
[1] A/Manager, Ecosystem Conservation
Parks Canada, Ontario Service Centre
111 Water Street East
Cornwall, Ontario, K6H 6S3
Phone: (613) 938-5937
E-Mail: mark.yeates@pc.gc.ca

Abstract

Parks Canada is currently updating its long-term ecological integrity monitoring program. Through this process Parks Canada has identified "bioregions" *containing national parks clusters around the country. In Ontario, the* "Great Lakes Bioregion" *contains all the national parks within the province. The Great Lakes Bioregion is working to update its entire monitoring program including the selection of ecological integrity indicators, monitoring measures, protocols, sampling designs, and so on. From this effort a series of potential partnership opportunities between Parks Canada and Ontario Parks are suggested.*

Introduction

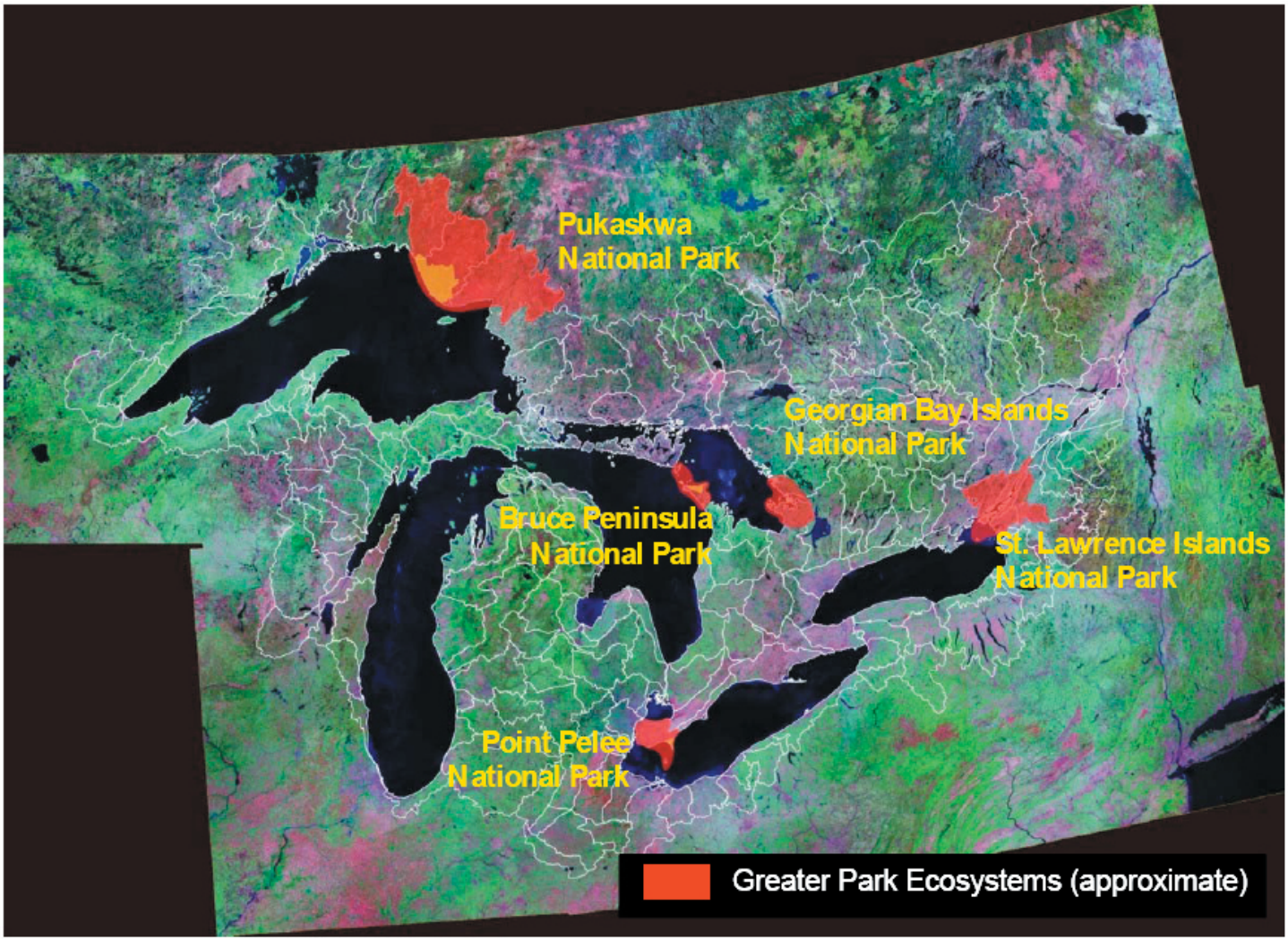
Following the Minister's *First Priority* report (Parks Canada, 2001), ecological integrity (EI) monitoring has received an elevated priority within the national parks system. EI monitoring now plays a stronger role in park management planning and reporting through the new requirement for every national park to produce a state of the park report every five years (Government of Canada, 2000). In addition to this new legislative requirement, Parks Canada recognizes the enhanced role monitoring must play to be successful in a range of program areas including species at risk, environmental assessment, active management and restoration.

In Ontario, Parks Canada has a relatively high level of investment in EI monitoring. There are five national parks in Ontario each initiating development of a formal EI monitoring program since the mid to late 90's (i.e., Zorn and Upton, 1997). The scale of EI monitoring at a national park focuses on *"greater park ecosystems"* (Figure 1) that represent an area surrounding a park that encompasses the majority of stresses and processes that influence the EI of that park. These existing monitoring programs need to be reviewed in light of new legislative requirements and program areas developed within the Canadian national parks system. Parks Canada's limited monitoring resources need to be targeted to support an effective, affordable EI monitoring program that meets many park management needs. To this end, this Ontario Parks — Parks Canada Monitoring Workshop is very timely. Ontario Parks is a major protected areas partner for national parks in Ontario and efforts to work collaboratively on monitoring will need to be successful if Parks Canada will meet its monitoring obligations within the *First Priority* report.

Parks Canada's Evolving Monitoring Program for Ecological Integrity

Since the release of the *First Priority* report Parks Canada's EI monitoring program has undergone some significant changes. The first of these changes was the creation of a new national monitoring coordinator position (Dr. Donald McLennan). In addition, Parks Canada has created bioregional groupings of national parks across the country. These bioregions are clusters of national parks that are relatively similar in terms of their ecosystems and stresses and represent the primary scale at which parks are to develop and coordinate their EI monitoring and reporting programs. The intent of bioregional coordination is that these parks, due to their similarities, will have similar monitoring needs. By addressing these needs as a bioregional team, parks will be able to achieve cost-efficiencies, develop joint monitoring protocols, participate in consistent training programs, improve shared expertise within the agency, and increase the quality of our monitoring programs. Six bioregions were created through this process, they are: Northern, Pacific Coast, Mountain Parks, Interior Plains, Great Lakes, and Atlantic/Québec. In Ontario, all national parks form the Great Lakes bioregion.

Figure 1: Greater park ecosystem boundaries around the 5 national parks occurring in Ontario.



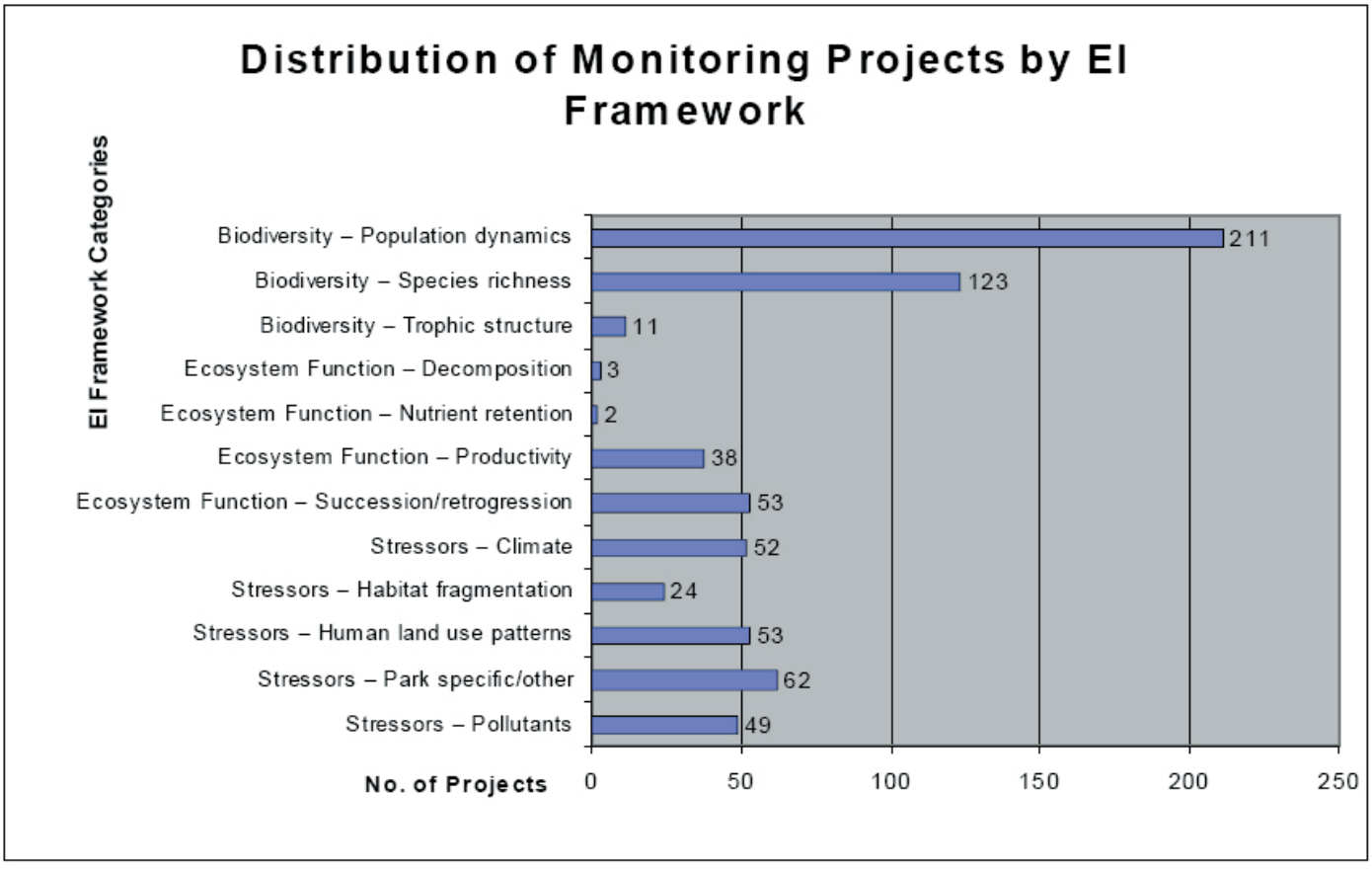
In addition to the national monitoring coordinator, each bioregion has also created new bioregional coordinator positions (Great Lakes bioregional coordinator, Paul Zorn). The national and bioregional coordinators, with other key staff throughout the national park system, form the new *National Ecological Integrity Monitoring Committee* (NEIMC) created in 2002. The NEIMC develops strategic direction of Parks Canada's evolving EI monitoring and reporting program, coordinates the program across bioregions, evaluates park monitoring working plans, and attempts to provide national standards and guidelines for park level prac-

tioners. The NEIMC also makes recommendations on the dispersement of new funds for improving monitoring programs at individual national parks.

In 2003, in Québec City, Parks Canada held a national EI monitoring conference that engaged all national parks, service centres, and the national office. This conference was hosted by NEIMC and its purpose was to: discuss the program direction received from Parks Canada's *Executive Board* following the *First Priority* report; identify monitoring program issues, needs and gaps; and, to discuss steps forward to achieving *Executive Board's* direction by 2008 (for more information on this direction, see Zorn and McLennan, this volume). As part of this effort, Parks Canada undertook an inventory of existing monitoring projects through the national park system to identify current levels of investment and program gaps. Figure 2 shows the breakdown of the approximately 700 monitoring programs identified and their relationship to our national EI framework. Generally speaking, existing monitoring projects under-represent ecosystem functions relative to biodiversity and stressor components.

Starting from this monitoring project inventory, Parks Canada undertook an assessment of the quality of these monitoring activities based on the following nine criteria: 1) link to management plan; 2) well defined question; 3) methods defensible; 4) methods available; 5) results linked to larger scale; 6) data availability; 7) sample power; 8) study design; and, 9) feasibility. These assessments form the basis for annual monitoring working plans, developed by every national park in the country, and documents each park's plan to build upon these projects to create a comprehensive, useful and affordable EI monitoring and reporting program by 2008. Bioregions meet on an ongoing and regular basis to build upon these working plans in a way that maximizes effectiveness and efficiencies for parks within bioregions. Every year parks update their annual monitoring working plans to build upon bioregional progress, and these working plans provide the basis for the allocation of enhanced monitoring funding to individual national parks.

Figure 2. Breakdown of the number of monitoring projects occurring in national parks per category within Parks Canada's ecological integrity framework (as of 2004).



Timing for Protected Areas Collaboration on Monitoring in Ontario

The above discussion provides some context as to why this workshop on monitoring with Ontario Parks is very timely. Following the external review of Parks Canada's EI program by the *Ecological Integrity Panel* (2000) and the *First Priority* report, EI monitoring has become a system-wide priority for national parks. Parks Canada has received some increased funding and capacity to make significant advancements in monitoring by 2008 (the final year of Parks Canada's current enhanced funding through its EI Treasury Board submission) and beyond. Individual parks now receive improved support and direction from NEIMC and bioregional coordinators. In Ontario, all national parks within the province (Bruce Peninsula National Park/Fathom Five National Marine Park, Georgian Bay Islands National Park, Point Pelee National Park, Pukaskwa National Park, and St. Lawrence Islands National Park) now form the Great Lakes bioregion, and this bioregion has a dedicated coordinator. This level of national park coordination provides a more effective mechanism for Ontario Parks to communicate and collaborate with on monitoring at park, regional and provincial scales. The focus for EI monitoring investment at a national park is at the greater park ecosystem scale, which includes many provincial parks. In this regard, Ontario Parks represents Parks Canada's most significant protected areas partner. Our management goals are similar as are our monitoring needs. This workshop represents an important first step to more formal and consistent collaboration on a shared protected areas monitoring strategy for Ontario.

Potential Opportunities for Collaboration on Protected Areas Monitoring in Ontario

Based on discussions from this workshop and additional meetings between Parks Canada and Ontario Parks staff, the following are some suggestions for areas of collaboration on monitoring.

What we monitor:

- *Shared, multi-scale ecological conceptual models.*
  Collaborating on the development of conceptual ecosystem models of parks and park ecosystems will allow Parks Canada and Ontario Parks to develop a shared understanding of how we think the ecosystems represented by our protected areas function. These models can facilitate the selection of shared monitoring indicators and measures.

- *Collaboration of stress identification.*
  Using the same process to identify and rank stressors that impact park ecosystems will facilitate a coordinated response to monitoring their effects on parks.

- *Shared monitoring databases on indicators, measures, protocols, data, and analyses.*
  Developing a shared, accessible database that contains details on our monitoring programs will allow us to share expertise and experience on best practices for monitoring and reporting.

- *Ongoing dialogue on planning and management issues.*
  Our agencies would be well served to continue our dialogue on monitoring and its link to park planning and management — specifically, as monitoring relates to park management plans. This will allow provincial and national parks to partner on other aspects of their conservation programs in addition to monitoring.

- *Some common protected area monitoring measures.*
  Cooperation on the above elements will likely lead to the adoption of common monitoring measures and protocols. Increasing the level of standardization in monitoring among protected areas in Ontario will improve data quantity and coverage across the province. An increased standardized monitoring network in protected areas will provided improved data for a variety of purposes and a range of scales.

Where we monitor:

- *Integrated, hierarchical sampling designs involving park clusters.*
  Opportunities exist to supplement existing sampling designs, and create new designs, for various monitoring indicators and measures in and around national and provincial parks. These designs can focus on park clusters involving a range of protected areas in different parts of the province. Sampling designs within park clusters can focus on particular ecosystem types, specific stressors and involve local and regional partners. Status and trend assessments using monitoring data among park clusters can provide larger scale information that would be useful for reporting.

- *Shared, common inventory formats and standards.*
  Ontario Parks and Parks Canada should employ the same natural resource inventory standards so that monitoring data can be more easily shared. This is already occurring in some areas through partnerships on *Ecological Land Classification* (ELC) and *Southern Ontario Land Resource Information System* (SOLRIS) initiatives.

- *Shared spatial databases.*
  Whether Parks Canada and Ontario Parks are able to develop joint monitoring programs or not, both agencies should endeavour to consistently share their respective monitoring databases. These shared databases will provide each agency with greater information and opportunities to integrate the findings of monitoring programs (i.e., meta-analysis) for improved decision making.

How we monitor:

- *Shared protocols.*
  Monitoring protocols developed or adopted by Parks Canada or Ontario Parks should be shared among agencies and partners. This will facilitate standardization in monitoring methods used throughout Ontario.

- *Coordinated training, quality assurance, and quality control.*
  Ontario Parks and Parks Canada can achieve some cost savings by coordinating monitoring activities and jointly developing training opportunities for staff (i.e., *"train the trainer"* models). As part of training programs to improve the quality of monitoring data and reduce measurement error, the two agencies should also consider collaborating on related quality assurance / control efforts (i.e., plot audits) to ensure data quality.

- *Co-funded contracts/partnerships for monitoring.*
  Where opportunities exist, Parks Canada and Ontario Parks should consider jointly funding projects that enhance each other's monitoring programs. This kind of joint business planning will help reduce redundancies and help leverage funds by using each other's contribution as matching funds.

- *Co-funded* "roving" *monitoring technicians.*
  If individual parks within a region cannot afford dedicated monitoring staff, the two agencies may want to consider co-funding *"roving"* monitoring technician teams. These teams can concentrate on joint monitoring measures shared among provincial and national parks. Teams can sample individual parks within a region according to a shared, strategic sampling design. By sharing resources, Parks Canada and Ontario Parks can offer longer-term monitoring positions and, therefore, attract and hold on to higher quality science staff.

- *Staggered, rotating sampling frequencies.*
  Related to the above bullet, national and provincial parks within a region can participate in shared sampling designs that involve a panel design where groups of monitoring stations in and out of protected areas are sampled on a rotating, staggered sampling frequency. Such a design will provide a balance between status and trend assessments and allow the agencies to expand the number of monitoring stations sampled.

Communication on monitoring:

- *Consistent communication tools and methods.*
  Monitoring information needs to be effectively communicated to managers, stakeholders, partners and the public to be useful. The two agencies should share information, ideas and methods on how to improve the communication of monitoring information. This sharing may take the form of consistent communication tools and methods.

- *Shared reporting tools on the state of park clusters.*
  Park clusters, if identified, may want to consider developing *"state of the park cluster"* type documents that communicate the status and trends of different kinds of protected areas at a regional scale. These kinds of communication tools may be of particular relevance to upper-tier municipalities, land trusts, biosphere reserves, and so on.

- *Internet, newsletters, posters, etc.*
  To build upon collaborative efforts and communicate our willingness to partner on issues like monitoring, Parks Canada and Ontario Parks may want to consider developing joint communication packages such as websites, newsletters, or posters that can be used to communicate information to a range of audiences.

Conclusion

The above bullets are meant as a brainstorm list of ideas that may be pursued for the improvement of both agencies' monitoring programs. Not all items in this list will be accomplished, but hopefully it will provide a starting point for future collaboration following this workshop. Future meetings between Ontario Parks and Parks Canada on monitoring may want to consult this list as a starting point for shared action.

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Ontario's Protected Area System: How can we turn it into a Network (if it isn't one yet), and then what?

William J. Crins
Senior Ecologist
Planning and Research Section, Ontario Parks
Robinson Place, 6th Floor South
300 Water St.
PO Box 7000, Peterborough, Ontario, K9J 8M5
Phone: (705) 755-1946
E-Mail: bill.crins@mnr.gov.on.ca

Abstract

The protected area system in Ontario is composed of the classical regulated protection mechanisms such as national parks, provincial parks, and conservation reserves, but it extends well beyond these mechanisms to include over forty different mechanisms, some of the them public, and some of them private. In order to determine whether or not the system actually comprises a functional network, the full array of mechanisms that provide both full and partial protection must be considered, especially in southern Ontario, where very little land is in public hands. This paper briefly reviews some of the conceptual requirements of a functional network, and proposes a few possible ways in which the present system of protected areas can be assessed, and from there, how a network can continue to be built. Enhanced cooperation and communication among conservation practitioners will be essential.

Introduction

From a biodiversity conservation perspective, the traditional view of protected areas requires that several conditions be met. Generally, these include:

- Strong protection mechanism (legislation or regulation);
- Permanence;
- Exclusion of industrial activities; and,
- Primary focus on biodiversity conservation.

However, there are many other types of areas in a landscape that may contribute to protection objectives in one way or another. Especially within settled and developed landscapes, areas with partial levels of protection play an essential role in contributing to connectivity across the landscape, and in conserving portions of the biodiversity of that landscape.

Thus, the answer to the question, *"what constitutes Ontario's system of protected areas?"*, is not necessarily straightforward. An international conservation organization, the IUCN (International Union for the Conservation of Nature and Natural Resources, now called the World Conservation Union), has developed a classification scheme to account for varying forms and degrees of protection (Phillips and Harrison, 1997). A major advantage of using a classification system such as this is that it enables conservation and protected area practitioners around the world to communicate with a common language. Furthermore, it provides a standard against which to measure the individual components of a protected area system, and to evaluate the contribution of each component.

The IUCN classification system contains six categories, with the first category having two subcategories, as follows:

- Ia: Strict Nature Reserve;
- Ib: Wilderness Area;
- II: National Park;
- III: Natural Monument;
- IV: Habitat/Species Management Areas;
- V: Protected Landscape/Seascape; and,
- VI: Managed Resource Protected Area.

If we expand our thinking beyond the traditional view of protection, the answer to the question of what constitutes Ontario's system or network of protected areas becomes very different. Recent work by the Ontario Ministry of Natural Resources (OMNR) has focussed on categorizing over forty different mechanisms and forms of protection within the IUCN classification system (Gray *et al.,* 2005). Not all of these mechanisms fall within an IUCN category. Thus, they recognize the fact that there are degrees of protection, and they have designed a decision tree for differentiating between full and partial protection. Table 1 outlines the mechanisms of protection (full and partial) that exist in Ontario at the present time. Their work acknowledges the contribution of numerous forms of protection to the protected area network in the province.

The question of what constitutes full versus partial protection is subject to interpretation and debate. Nevertheless, the following definitions may be helpful:

Fully protected: managed on a long-term basis primarily for natural heritage/biodiversity conservation purposes through legal or other effective means; and,

Partially protected: unregulated but having as an objective some level of natural heritage/biodiversity conservation, or regulated but with natural heritage/biodiversity conservation as a subsidiary objective.

Functionality of the Network

If we admit all of the types of protected areas noted in Table 1 into our concept of a protected area network, a more realistic assessment of functionality and connectivity within the network may be possible. First of all, we must determine what constitutes functionality in a network.

A network may be defined as a complex arrangement of intersections and interstices, with interconnections among its segments or parts. If one assesses these elements of a network, it can be argued that the current system is complex, in that it has many parts, of varying sizes and configurations, meeting varying objectives, and represents components of many ecological systems across the province. With regard to intersections and interstices, the system can be considered to be a partial network. In some areas, particularly along water courses, there are intersections with larger terrestrial blocks of natural cover. There are numerous interstices, which are those portions of the land base that are not part of the protected area system. In terms of interconnections, again, waterways provide the major linkages between the non-water-based parts of the system. However, additional connections are provided where the protected area system encompasses lateral features that may run perpendicular or oblique to the water courses, such as end moraines, old shoreline features, and green spaces paralleling transportation corridors.

Functionality, in the context of natural heritage networks, may be understood to mean the maintenance of *"… focal abiotic and biotic patterns and processes within their natural ranges of variability over time frames relevant*

to conservation planning and management (e.g., 100-500 years)" (Jalava *et al.,* 2001: 27). Nudds *et al.* (1998b) provided a discussion of the important attributes of connections, in a protected area network context. They point out that functionality and connectedness are inter-related concepts. Thus, *"...in order to be functional, connections between reserves must provide avenues for dispersal, daily movements, seasonal migration, genetic interchange, range shifts necessitated by changing climatic or environmental conditions, escape to refugia in the case of catastrophic disturbance within reserves, and recolonization following disturbance."* (367) This is a species-centric view of connectivity, and the design parameters for connections would be species-dependent, but it provides a good, tangible basis for thinking about the kinds of attributes that must be considered in the design and assessment of the functionality of connections between protected areas in a network.

Table 1. Types of Protected Areas in Ontario (from Gray et al.*, 2005).*

International	National	Provincial	Municipal	Private
Ramsar Convention Sites	National Parks	Provincial Wilderness Parks	Municipal Parks and Open Space	Eastern Habitat Joint Venture Projects
Biosphere Reserves	National Marine Conservation Areas	Provincial Nature Reserve Parks	Natural Heritage Features in Urban and Rural Areas	Nature Conservancy of Canada Nature Preserves
Important Bird Areas	National Historic Canals	Provincial Waterway Parks	Rouge Park	Federation of Ontario Naturalists Nature Reserves
	National Historic Parks and Sites	Provincial Natural Environment Parks		Bruce Trail Association Properties
	Canadian Heritage Rivers	Provincial Historic Parks		Carolinian Canada Sites
	Migratory Bird Sanctuaries	Provincial Recreation Parks		Conservation Land Tax Incentive Program Sites
	National Wildlife Areas	Conservation Reserves		Managed Forest Tax Incentive Program Sites
	Marine Wildlife Areas (Canadian Wildlife Service)	Wilderness Areas		Ontario Heritage Foundation Properties
	National Capital Commission (NCC) Lands	OLL Forest Reserves*		Conservation Easements
		OLL Enhanced Management Areas*		Land Trust Properties
		Provincially Significant Wetlands		
		Areas of Natural and Scientific Interest		
		Wildlife Management Areas		
		Crown Game Preserves		
		Fish Sanctuaries		
		Niagara Escarpment Commission		
		Niagara Parks Commission		
		St. Clair Parkway Commission		
		St. Lawrence Parks Commission		
		Conservation Authority Protected Areas		
		Remote Tourism Management Area		
		Forest Management Reserves		
		Restricted Access Areas		

**OLL = Ontario's Living Legacy*

Further to the species-based attributes, cycles and fluxes need to be considered as part of the functionality of the network. Thus, sources of energy, water, and nutrients, directionality and variability of flows, and destinations of ecosystem outputs need to be integrated into the design and assessment of protected area networks, as well. In his consideration of ecological integrity in relation to individual parks, Merriam (2001: 7) made similar points regarding *"… a functional set of processes …"*, but stressed the need to examine ecological processes at multiple scales.

There are several possible approaches to assessing the level of functionality and/or connectivity in networks. The simplest approach may be to overlay the existing protected area system with some existing or derived, hypothetical, connected network, and using various metrics to determine the degree to which the existing hypothetical systems coincide. In the case of southern and central Ontario, such a hypothetical network exists in the form of *The Big Picture* [Nature Conservancy of Canada (NCC) and Natural Heritage Information Centre (NHIC), 2003]. Although numerous assumptions were required to derive this network, given those assumptions, *The Big Picture* attempts to derive a parsimonious solution for connecting existing core areas, existing corridors, and potential ecological restoration areas.

Another approach would be to model a functional network by identifying the most parsimonious linkages among the existing protected areas, constraining the model with a set of ecological functionality requirements. Various metrics could then be used, as above, to assess the current system against this newly derived, most parsimonious, functional network.

Both of these approaches would provide estimates of how close we are to having a functional or viable network of protected areas, the first assessed against a target of 30% natural cover (at least south of the Precambrian Shield, as in the first iteration of *The Big Picture*), and the second assessed against a most parsimonious ecological solution, given the present landscape.

It also may be legitimate, in such a large jurisdiction as Ontario, to consider portions of the protected area system, perhaps on an ecozonal or ecoregional basis, in order to assess functionality of parts of the overall system. In a sense, this is the approach that has been adopted by Nudds and his students to assess the protected area system in parts of Ontario (by faunal provinces), using the concept of minimum reserve area (MRA) as it relates to interior forest bird and mammal faunas (Nudds *et al.,* 1998a). Although their approach does not address explicitly the connectivity and flows among components of the system, it assumes that, if enough suitable area of appropriate configuration is available in protected areas, the species that are dependent on that area, and the ecological processes that ensure the perpetuation of functioning ecosystems, will be sustained in those protected areas.

Aside from the work of Nudds and his associates, most of the types of analyses mentioned above have not yet been conducted. However, it is safe to say that, at present, the protected area system, in the broad sense, must be considered to be only a partial network. It contains some of the components of a network, and on a local scale, it may meet the tests of functionality and connectivity. However, on a regional or provincial scale, it is not yet a fully functional network.

Building the Network

As noted above, an examination of the functionality of a protected area network requires some type of ecologically based goal against which to measure. This may be an area goal, a connectivity goal, a biotic goal, or combinations of these. At the provincial level, the goal for the natural heritage areas system is focussed on representation, *"...to establish a system of protected natural heritage areas, representing the full spectrum of the province's natural features and ecosystems."* (OMNR, 1997: 3). Most conservation planning projects concentrate on ecologically defined areas that are considerably smaller than the province. Generally, these

projects identify goals and objectives, and sometimes, also higher level visions, to provide a philosophical context, as well as tangible, shorter term, measurable targets against which to assess progress. Ecoregional conservation planning projects are being conducted by non-governmental and government agencies worldwide (Anderson *et al.,* 1999). In Ontario, some notable examples include the *Great Lakes Conservation Blueprint* (Henson and Brodribb, 2005; Wichert *et al.,* 2005), bird conservation planning under the auspices of the *North American Bird Conservation Initiative* (NABCI), and a protected area network project mandated through the *Canada – Ontario Agreement Respecting the Great Lakes Ecosystem* (COA). All of these projects have the potential to identify areas that would supplement the current system of protected areas, and thus, contribute to the building of a functional network.

The first iteration of *The Big Picture* took a forward-looking approach by developing a vision that 30% of the Carolinian region of Ontario should be in natural cover in 300 years [Nature Conservancy Canada (NCC) and Natural Heritage Information Centre (NHIC), 2003]. This vision provided a framework for developing a hypothetical, efficient, connected network that was built from the existing cores and corridors. Jalava *et al.* (2001: 25) provided a discussion of the approach used in developing this vision, pointing out that the goal was *"… to generate replicable, rule-based mapping of a landscape-scale natural heritage system for southern Ontario … that would increase landscape functionality, ensure ecological integrity, and help to focus biodiversity conservation activity within the region."* Such a vision would help to focus conservation, securement, restoration, and other stewardship activities where they would have the most benefit in building a functional, connected network.

Also focusing on southern Ontario, Wiken (1999) discussed the importance of conveying the vision underlying protected areas, specifically noting that the vision should be credible, authoritative, and understandable, outlining the roles, functions, and purposes of protected areas, including biodiversity conservation, sustainable resource use, health, environment, and the economy. The vision should identify the link between protected areas and research, education, preservation, recreation, leisure, tourism, representation, and wildlife habitat.

Taking advantage of some of the concepts already applied in conservation planning initiatives, then, some of the elements of a vision for the protected area network for the Great Lakes Basin, or for the province as a whole, should include the network being:

- Protected;
- Representative at multiple scales (ecosystems, species, populations);
- Connected;
- Functional;
- With soft edges, where possible;
- With ecological integrity; and,
- Monitored, with adaptive feedback loops for ecosystem-based management.

The last element, monitoring in an adaptive management context, will be necessary to determine if the vision and its subsidiary goals and targets are being met. A monitoring program should be designed in such a way that reporting of progress can be made at regular intervals, and also so that there is a feedback mechanism to adjust goals or targets, if necessary, or to identify problems of design and functionality within the network.

Some of the elements of a vision for the protected area network are already in place. Broad policy direction exists in the forms of *Nature's Best* (OMNR, 1997) and *Our Sustainable Future* (OMNR, 2005a), where the desired components of a protected area system are identified, and where ecological sustainability is identified as the mission of the Ontario Ministry of Natural Resources (under whose mandate substantial portions of the protected area system fall). Parks Canada has a mandate to ensure ecological integrity in its holdings,

and has been applying the *"greater park ecosystem"* concept in an attempt to provide a broader landscape context for its parks (Parks Canada, 2002). At the local level, various mechanisms, tools, and programs are in place to assist with the building of the protected area network. These include planning designations that may result in open space and environmentally sensitive area designations, the *Provincial Policy Statement* that indicates that municipal plans must be consistent with several categories of provincially significant natural heritage features [Areas of Natural and Scientific Interest (ANSI), wetlands, endangered and threatened species, woodlands, valleylands, and wildlife habitat], and tax incentive programs for private land owners and environmental non-governmental organizations, to name a few. All of these contribute to the development of a connected, functional protected area network.

Current and Future Needs with Regard to the Network

Clearly, the development of a functional network of protected areas in the province will require continuing efforts to retain the existing cores and corridors, and to build up cores and corridors where these are too small to be functional, or where they do not exist at all at present. Conservation practitioners (government departments at all levels, environmental non-governmental organizations, stewardship councils, etc.) must keep an open mind with regard to the mechanisms that can be used to conserve or build these cores and corridors. As noted in Table 1, there is a plethora of types of protected areas, and there are numerous conservation and stewardship tools available to assist with the development of such a functional network. Conservation practitioners also must remember that this will be an ongoing, long-term process, as acknowledged in *The Big Picture*.

To assist with the task, a broad and long-term vision for the protected area network must be adopted. This vision must be adaptable to take advantage of future conservation achievements, but it must contain the necessary requisites of functionality, representation, and connectivity. As noted above, there are many conservation planning initiatives underway or recently completed in Ontario. Some of these include T*he Big Picture*, the *Great Lakes Conservation Blueprint* (OMNR, 2005b), the *North American Bird Conservation Initiative* (BSC, 2005), the *Oak Ridges Moraine Conservation Plan* (MAH, 2002), *Natural Spaces* (OMNR, 2005c), the *Northern Boreal Initiative* (OMNR, 2001), the *Superior Mixed Forest Conservation Plan* (NCC, 2002), watershed planning, and the Forest Stewardship Council's forest certification program. In the context of the vision that will be adopted, there will be a need for more effective cooperation and communication among the host of conservation agencies and practitioners in all aspects of network design, establishment, and maintenance, including monitoring.

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Ontario Parks: Policy and Planning Context

Dan Paleczny
Resource Management Coordinator
Ontario Parks (currently on leave)
c/o IUCN-The World Conservation Union
Wadi El Rayan Protected Area
Egyptian Italian Environmental Cooperation Program
Fayoum, Egypt
Phone: 010 2507468 (mobile)
E-Mail: dan.paleczny@iucn.org

Abstract

Enhanced collaboration between Ontario Parks and Parks Canada in the field of monitoring and adaptive management requires an understanding of the current and evolving policy and planning context for Ontario Parks. This paper provides an overview of the Ontario Parks organization and the Ontario Ministry of Natural Resources (OMNR) planning system. It describes current monitoring and adaptive management requirements in the policy and planning context, and identifies evolving opportunities.

Introduction

This paper aims to provide an overview of the Ontario Parks policy and planning context in which to consider needs for monitoring and adaptive management by Ontario Parks and possible collaboration with Parks Canada. While the need for monitoring has long been recognized, the focus for information collection in the 1970s, 80s and much of the 90s was on carrying out standard inventory of the resources. With enhanced funding arising in response to through the *Ontario Living Legacy* initiative (OMNR, 1999), important advancements in the area of monitoring have occurred. At the same time, Ontario Parks has faced several challenging resource management issues and has gained additional experience with the concept of adaptive management and monitoring.

Definitions

According to the International Centre for Protected Landscapes (ICPL) (2001: 1.14) adaptive management is: *"...based on an approach where managers focus on monitoring and evaluation to enable them to learn both from their own, and other managers, past success and mistakes."* MacDonald *et al.* (1999: 1) define adaptive management as: *"...a process for addressing the uncertainties of resource management policies by implementing the policies experimentally and documenting the results."* They illustrate the process as a cycle (Figure 1). In support of these definitions, Hocking and Phillips' (1999: 6) view of protected area management, *"...is that it is circular, not a linear process, and that evaluation is about using information concerning the past to enhance the way management is conducted in future – helping management to adapt through a learning process."* These definitions rely on a foundation of information, derived through inventory, research and monitoring.

Ontario Parks in the Ministry of Natural Resources (OMNR) Organization

Ontario Parks is a branch organization within the OMNR's *Natural Resources Management Division*. However, it operates differently from other branches in that it has line management responsibility for the field level operation of provincial parks, whereas other branches deliver programs at district level through the *Field Services Division*. In addition, Ontario Parks maintains a special purpose account in which general revenues from park operations are retained and used to manage the park system. Within Ontario Parks, the *Planning and Research Section* is responsible for program coordination and development for provincial parks and conservation reserves, through its two units, one that focuses on policy and planning, and another on science and information. These program areas are implemented through the six administrative zones for provincial parks, and 23 districts for conservation reserves.

Figure 1: The Adaptive Management Process (adapted from MacDonald et al., *1999).*

OMNR Planning System

OMNR's planning system is hierarchical, with four basic levels, as follows:

1) Legislation and strategic level corporate direction, which includes cabinet approved policy and OMNR strategic directions;
2) Broad land use planning, which includes the identification of protected areas through systems planning and the allocation of these lands through public land use planning;
3) Site specific planning, which includes management plans or other interim plans. Management can be passive or active, depending upon the situational needs; and,
4) Project level implementation activities that are planned and evaluated in accordance with the *Environmental Assessment Act* (EAA) (Government of Canada, 1992).

These levels of policy and planning require monitoring and adaptive management, to assess and determine the degree of compliance (did we act on our plans?), the positive or negative effects of our actions, the overall effectiveness of initiatives, and the state of the protected area (e.g., the stresses affecting the area, the condition or health of the ecosystems, human or natural responses).

Monitoring and Adaptive Management Requirements

Some elements of the planning system, as it relates to protected areas, have explicit requirements for moni-

toring and/or adaptive management (Table 1). For example, in the park management planning process, the sixth and final step, review and amend, includes options for full plan review or ongoing amendments. In this sense, the direction exists to apply monitoring and adaptive management, however this practice is not fully applied. In the recently approved *Class Environmental Assessment for Provincial Parks and Conservation Reserves* (OMNR, 2005a), all category B, C and D evaluations, that is, projects having potential for negative impacts, must consider the need for monitoring. In addition, a process for reviewing and adjusting projects, based on monitoring information is described. In more complex situations involving adaptive management, a monitoring plan should be prepared and should demonstrate a thoughtful approach to monitoring that will provide appropriate information to assess the effectiveness of the management interventions. The plan may include the following elements:

- *Purpose:* why monitoring, what are the potential effects;
- *Acceptable Outcomes:* predicted effects to be monitored and range of acceptable outcomes;
- *Methods:* techniques, equipment, indicators, measurements, duration, frequency;
- *Results:* description of the results related to the acceptable outcomes;
- *Remedial Action:* actions to mitigate a problem and related monitoring; and,
- *Reporting:* when and how, adjustments to projects to reflect learnings.

Reporting would include an overall analysis of the effectiveness and any environmental effects of the project and adjustments to the project arising from the results of monitoring. Specifically, reporting would include:

- *Results:* a description and assessment of the results with respect to the acceptable outcomes, and any recommendations; and,
- *Remedial Action:* additional recommended actions that may be required to mitigate a problem, including any related monitoring.

Land use planning and policy development processes do not have explicit requirements for monitoring or adaptive management, however examples do exist where monitoring, reviews and adjustments have been carried out. OMNR's new strategic directions, *Our Sustainable Future*, include a stewardship principle concerning adaptive management: *"The planning for and management of natural resources should strive for continuous improvement and effectiveness through adaptive management of natural resources."* (OMNR, 2005b: 7).

Table 1. Requirements in the OMNR protected area planning system for monitoring and adaptive management.

Level	Effects	Effectiveness	Review	Adjust
Legislation, Corporate Strategy	–	–	–	yes
Land Use Planning	–	–	–	yes
Policy	–	–	–	yes
Management Planning	–	–	yes	yes
Project Evaluation (Environmental Assessment)	–	–	yes	yes

Opportunities and Needs

Important improvements have occurred in recent years with respect to monitoring and adaptive management. Additional initiatives are needed to provide direction and the necessary tools to support staff. In general, a cultural shift is still required, wherein staff think, plan and act in an adaptive management manner at the range of scales including legislation, strategic planning, land use planning, policy development, management planning and project evaluations. More specifically, there is a need for:

- A general policy on adaptive management to establish broad direction for its application;
- A review date should be included in policies and directives, and include measurable indicators of effectiveness;
- Guidelines and staff training on how to apply adaptive management approaches — when the Ontario management planning manual is revised it should explicitly recognize and describe the adaptive management concept as it applies to this level;
- Monitoring protocols for environmental assessment evaluations — this should include guidance on setting objectives and identifying indicators; and,
- Continued opportunities for sharing experiences, both successful and unsuccessful efforts — this should include closer collaboration with Parks Canada.

Summary

With the continued improvements in the design and application of monitoring approaches and adaptive management, Ontario Parks can look forward to greater effectiveness in its efforts. More work is required to design and apply these concepts. Closer collaboration with Parks Canada in this field can be expected to yield important benefits and synergies.

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Parks Canada's Management Planning Framework

François Marineau
Manager, Heritage Planning
Parks Canada, Planning and Business Management
111 Water Street East
Cornwall, Ontario, K6H 6S3
Phone: (613) 938-5727
E-Mail: francois.marineau@pc.gc.ca

Abstract

The objectives of this paper are to: 1) raise the awareness of the Parks Canada Agency and its programs; 2) describe in general terms the planning framework and processes at Parks Canada; and, 3) identify some of the functional challenges and opportunities the planning community will be addressing over the next few years. Workshops such as this provide an important opportunity to renew collaborative relationships with other conservation stakeholders.

The Parks Canada Agency

The Parks Canada Agency (PCA) is a key instrument for the Government of Canada to achieve its sustainable development and heritage conservation goals. The Agency plays a leading role in federal government activities related to recognizing places representative of Canada's natural heritage and places of national historic importance, and in protecting and presenting these places to the public. With an annual budget of approximately $500,000,000 and 4,000 full-time employees, Parks Canada protects and presents Canada's natural and cultural heritage in every region of the country.

In 1998, Parliament passed the *Parks Canada Agency Act* (Government of Canada, 1998) establishing Parks Canada as a separate Government of Canada agency. In 2000, Parliament passed the *Canada National Parks Act* (Government of Canada, 2000). This *Act* modernized Parks Canada's historic role, and established ecological integrity as its first priority. In a similar fashion, the *Canada National Marine Conservation Areas Act* (Government of Canada, 2002) calls for the creation of a system of marine conservation areas representative of the country's oceanic and Great Lakes waters. Responsibility for the PCA rests with the Minister of the Environment.

Parks Canada Mandate

The Parks Canada mandate states: *"On behalf of the people of Canada, Parks Canada protects and presents nationally significant examples of Canada's natural and cultural heritage, and fosters public understanding, appreciation and enjoyment in ways that ensure the ecological and commemorative integrity of these places for present and future generations."* (Parks Canada Agency, 2004a: 17) Parks Canada also contributes to an international heritage agenda through its leadership role in, or participation in international conventions, programs, agencies and agreements. These include, among others, the United Nations Educational, Scientific and Cultural Organization's (UNESCO) *World Heritage Convention*, the Ramsar *Convention on Wetlands of International Significance*, the *Convention on Biological Diversity* and the UNESCO *Biosphere Reserves Program*.

Because heritage areas and sites cannot be managed in isolation, cooperative working relationships are ac-

tively sought with agencies and individuals involved in the management of surrounding or adjacent landscapes, ecosystems and communities. Agreements with provincial and territorial governments, as well as with allied non-governmental organizations and Aboriginal peoples, can be significant means of ensuring recognition, establishment and protection of heritage places.

The Agency's top priorities during 2004-2005 were to:

- Maintain or improve the ecological integrity of national parks, the commemorative integrity of national historic sites and cultural resources, and the sustainability of national marine conservation areas;
- Establish new national parks and new national marine conservation areas in regions which are not yet represented in the systems of national parks and national marine conservation areas of Canada;
- Designate new national historic sites of Canada, with an emphasis on women, Aboriginal peoples and ethnocultural communities;
- Engage Canadians by sharing with them our passion for the preservation of the protected heritage areas of Canada and fully involving them in all aspects of our mandate;
- Maintain and improve visitor services and visitor experiences; and,
- Ensure adequate long-term funding and financial sustainability of Parks Canada's programs.

The Planning Framework at Parks Canada

The planning framework at Parks Canada consists of three key planning processes that are implemented at three organizational levels: 1) multi-year corporate strategic planning; 2) five-year protected heritage area management planning; and, 3) annual business planning. These planning processes allow Parks Canada to plan, monitor and report on the state of Parks Canada's system of protected heritage areas over a five-year cycle.

The *Canada National Parks Act* (Government of Canada, 2000) requires that all national parks have a management plan approved by the Minister and tabled in both houses of Parliament within five years of park establishment, and that the plan be reviewed every five years. The *Parks Canada Agency Act* (Government of Canada, 1998) sets out the same requirements for national historic sites and other protected areas.

For both national parks and national historic sites, management planning starts with the preparation of a *Scoping Document* that identifies the main issues to be addressed and the proposed time frame to complete the plan. Once the Chief Executive Officer (CEO) of Parks Canada approves the scoping document, formal management planning is launched. Appropriate public participation at the national, regional and local levels is an essential part of the development of management plans. Once a plan is completed, it is submitted to the Minister for approval, on the recommendation of the CEO.

The process typically takes one to two years to complete, depending on the complexity of the issues involved. The national parks, national historic sites and national marine conservation areas management planning activities fall under the responsibility of a Field Unit Superintendent. The planner provides a professional planning service in support of planning programs. Multi-disciplinary teams are the basis for all Parks Canada planning programs. Multi-disciplinary input is ensured to account for the wide range of factors considered in developing the long-range direction central to a management plan.

The Purpose of a Management Plan

A management plan is a strategic guide to future management of a national park, national historic site or national marine conservation area. It is the primary public accountability document for these heritage places. They are also commitments to the public of Canada from the Minister regarding the use and protection of these places.

National park management plans must be consistent with national legislative and policy requirements, such as the PCA *Corporate Plan* (Parks Canada Agency, 2004b) direction, and be tailored to address regional requirements and circumstances. For national parks, the primary goal of a management plan is to ensure that there is a clearly defined direction for the maintenance or restoration of ecological integrity, understanding that maintaining ecological integrity is essential to the quality of visitor experiences. Heritage presentation programs are also described as a fundamental means of achieving both protection and use objectives.

In partnership with neighbouring communities and organizations, the plan sets a long-term vision and identifies strategies that will be implemented to ensure that the vision can be realized. The plan also guides subsequent actions and operations for the park that are implemented on a yearly basis.

Linkages Between Management Planning and Other Planning and Reporting Processes

The management plan is not an end in itself. Rather, it sets out a framework within which subsequent management, planning and implementation will take place. The *Field Unit Business Plan* sets out the implementation strategy for the management plan, and allocates resources according to the management plan priorities. An annual reporting process assesses progress towards implementing a management plan.

The *Canada National Parks Act* (Government of Canada, 2000) requires that a management plan be reviewed every five years to assess progress toward achieving long-term goals and to set new management priorities and actions for the next five years. The five-year plan review begins with consideration by Parks Canada staff (along with others in the case of cooperatively managed parks, national historic sites and marine conservation areas) of progress in implementing the current plan.

The *Minister's Action Plan in Response to the Report of the Panel on the Ecological Integrity of Canada's National Parks* (Parks Canada Agency, 2000) directs that there will be a five-year *State of the Park Report* for each national park. Since then, the management planning process for national parks includes the preparation of a state of the park report prior to the scoping document. The report is focussed on the state of ecological integrity in the park in the context of the greater park ecosystem. Its findings are a key consideration in evaluating the effectiveness of the park's current management plan, and the magnitude of adjustments that may be required. This in turn will influence the nature of the subsequent plan review process to be proposed in a scoping document. In essence, for national parks the state of the park report is the first step in the five-year plan review process.

The overall status of management plans for the systems of national parks, national historic sites and national marine conservation areas is reported to Parliament every two years through the *State of the Protected Heritage Areas Report*. Accomplishments related to management planning are also be reported in the *Parks Canada Annual Report* (e.g., Parks Canada Agency, 2004a).

Conclusions

The Parks Canada planning community has evolved over the years to fulfill new legislative requirements, address changing corporate directions, and ensure it continues to offer a high quality, professional planning expertise and advice to its clients in the field. We find that both Parks Canada and Ontario Parks share common professional and heritage protection challenges. We are both public agencies managing and protecting systems of heritage areas systems for the benefit of future generations. While facing similar greater ecosystem human use stressors, we are both challenged to report on the state of our protected heritage areas. This context offers many opportunities for engaging in professional networking, sharing lessons and experiences, and building a closer relationship between our respective team.

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Day 1 Evening:

Monitoring in Parks and Protected Areas

Forest micro-climate condition sampling in Bruce Peninsula National Park. (Photo by P. Zorn)

Monitoring for Ecological Integrity and State of the Parks Reporting

Donald McLennan[1] and Paul Zorn
[1]National Monitoring Biologist
Parks Canada, Ecological Integrity Branch
25 Eddy Street
Gatineau, Québec, K1A 0M5
Phone: (819) 953-6464
E-Mail: donal.mclennan@pc.gc.ca

Abstract

A brief summary of the Parks Canada Agency program for ecological integrity (EI) monitoring and state of the park reporting is given. These program elements are required as part of recent legislation and policy changes following the review of the Ecological Integrity Panel and the Minister's First Priority Report. *The intent of the Agency's ecological integrity monitoring and state of the park reporting programs are to clearly and concisely answer two fundamental questions: 1)* "What is the state of EI of Canada's national parks?"*; and,* 2)"What is Parks Canada doing to improve that state?"

What is Ecological Integrity?

The following definition of ecological integrity (EI) is taken from the *Canada National Parks Act* (Government of Canada, 2000): *"….'ecosystem integrity' means, with respect to a park, a condition that is determined to be characteristic of its natural region and likely to persist, including abiotic components and the composition and abundance of native species and biological communities, rates of change, and supporting processes."* Section 2. (1) *Canada National Parks Act* [2000: Section 2(1)]. A state of EI implies that both abiotic and biotic processes of park ecosystems are functioning properly, and that they support, and will continue to support, viable populations of the suite of organisms representative of the natural area the park was established to represent.

What is Ecological Integrity Monitoring?

EI Monitoring measures changes over time in ecological variables of interest, in a repeatable manner, in relation to some standard or reference level of the ecological variable. A useful definition for monitoring EI in protected areas has been put forward by Elzinga *et al.* (1998): *"… the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective."* In the context of monitoring EI in national parks, the over-riding management objective is the maintenance or restoration of EI. Typical sub-objectives will include maintaining all native species at viable population levels, maintaining a forest ecosystem productivity that optimizes representation and habitat requirements, or maintaining lake and stream water quality to a predefined standard. To meet these objectives park managers need reliable information on progress towards or away from management targets. To this end, park EI monitoring will collect and analyze data on a suite of carefully selected monitoring indicators in a rigorous and consistent manner, and compare and report results to pre-identified management targets and thresholds.

Why Monitor For Ecological Integrity?

The requirement for monitoring and reporting EI in Canada's national parks is rooted in the enabling legislation that underlies the formation and mandate of the agency. Parks Canada Agency (PCA) was created by the Government of Canada *"…for the purpose of ensuring that Canada's national parks, national historic sites and related heritage areas are protected and presented for this and future generations."* (Government of Canada, 1998). The PCA mandate underscores the responsibility to *"protect and present"* national parks. This mandate can be expressed as a three-point agency responsibility to protect EI, provide high quality visitor experiences, and effectively present heritage values to Canadians: *"On behalf of the people of Canada, we protect and present nationally significant examples of Canada's natural and cultural heritage and foster public understanding, appreciation and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations."* (Parks Canada, 2005).

Finally, the *Canada National Parks Act* (Government of Canada, 1998: Section 8.2) makes clear the role of EI within the agency: *"Maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks."* Thus the principle reason for monitoring and reporting EI in national parks is to provide clear information to all Canadians that national parks are being protected *"for present and future generations"*. Monitoring information generated by the program will provide essential data to report to Canadians on one of the key objectives of the *National Parks Action Plan*: *" ….to ensure that the state of ecological integrity... is improved over the next 10 years in each of Canada's 42 national parks"*. (PCA, 2000: n.p.)

Monitoring Questions

A goal of EI monitoring and *State of the Parks Reports* (*SoPRs*) is to clearly communicate answers to the following questions:

1. What is the state of park EI and how is it changing?
Park managers are required to report the EI of national parks to Canadians through individual *SoPRs* very five years, and national-scale *State of the Protected Heritage Areas Reports* (*SoPHARs*) every two years. SoP and *SoPHA* reports will provide comprehensive assessments of the state of park EI, based on clearly communicated and scientifically credible information gathered through park EI monitoring programs.

2. How are our management activities affecting park EI?
A second, equally important function for EI monitoring and reporting is to provide useful and clear feedback to managers on the ecological outcomes of park management activities. Programs to measure these outcomes will be aimed at answering specific EI monitoring questions about particular management activities such as ecosystem restoration, prescribed fire, the creation of an improved heritage presentation program, or changes in how visitors use the park.

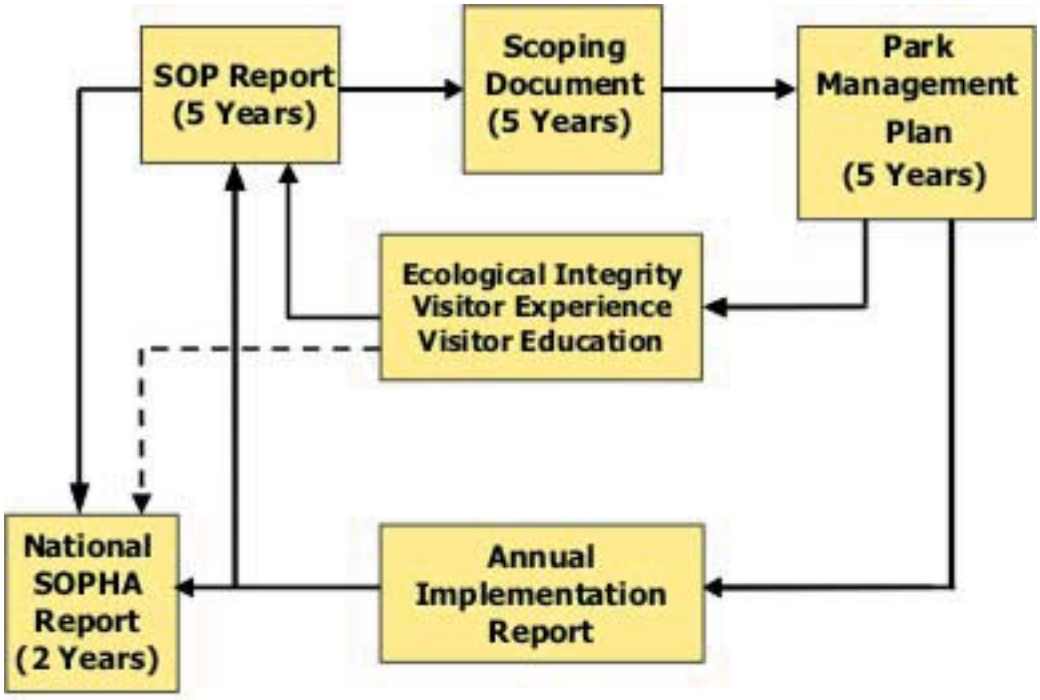
The PCA *EI Monitoring and Reporting Program* builds on the considerable amount of monitoring already ongoing across the PCA network to develop park monitoring programs that meet these new park reporting requirements.

Park Management and Ecological Integrity Monitoring

The principal aim of the PCA *EI Monitoring and Reporting Program* is to provide clear and relevant information for park managers on the state of park EI, and the effects of our management actions on it. The agency

impetus to conduct EI monitoring flows from the requirements of Section 11 of the *Canada National Parks Act* (Government of Canada, 2000), which states that: *"The minister shall, within five years after a park is established, prepare a management plan for the park, containing a long-term ecological vision for the park, a set of ecological integrity objectives and indicators and provisions for resource protection and restoration, zoning, visitor use, public awareness and performance evaluation, which shall be tabled in each House of Parliament."* Park EI monitoring thus flows from a long-term EI vision statement in the park management plan, as illustrated in Figure 1. The requirement in the *Act* for the development of EI objectives and indicators provides clear direction and motivation for the development of EI monitoring programs in all parks. Furthermore, the *Act* also directs that the EI indicators developed must measure the present state of park EI, and report progress towards achieving the EI vision outlined in the park management plan. This requirement from the *Canada National Parks Act* (Government of Canada, 2000), along with PCA's *Executive Board* direction, provides park biologists with their *"marching orders"* for the development of park EI monitoring and reporting programs.

Figure 1. EI monitoring and links to key park management planning documents.



Understanding the relationships amongst the park management plan, the EI monitoring program, the *SoPR* and the *Scoping Document* is critical to building the PCA *EI Monitoring and Reporting Program* in a way that responds to, and informs, management needs. Specifically: *"The park management plan establishes the future vision for the park, including the elements of a long-term vision for ecological integrity. Objectives and actions for achieving the ecological vision are contained in the management plan. Ecological integrity indicators (6-8), tied to the long-term ecological vision, are defined in the management plan. For each indicator, targets, i.e. a desired future condition, and thresholds, i.e., levels of the indicator that represent high, medium and low ecological integrity and invoke appropriate and prescribed management response, are defined in the management plan."* (PCA, 2005: n.p.).

An important challenge for each park EI monitoring program will be to interpret park EI vision in the context of the EI indicators. The monitoring program will track the current condition and trend of a series of ecological measures, which are combined into clear and well-communicated statements of EI — the EI indicators. EI indicators and measures will include management thresholds and targets that define biologically meaningful levels of the indicators and measures. A second purpose of the park EI monitoring program is to monitor the ecological impact of individual management actions, i.e., management effectiveness, which also flow from the management plan, and are an important component of actively achieving the vision

stated in the management plan and the *National Parks Action Plan* (PCA, 2000).

The *SoPR* uses EI monitoring data (and data drawn from other sources) to assess the state of EI of the park. More specifically, it reports on the current condition and trend of the EI indicators and on the effectiveness of the individual management actions taken, and it identifies key ecological issues facing the park. The *Scoping Document* takes the conclusions of the *SoPR*, i.e., the key ecological issues facing the park, and identifies the need to address them, along with other park management issues, in the next park management planning cycle.

Given the iterative nature of the relationship among the management plan, EI monitoring, the *SoPR* and the *Scoping Document*, it is very important that monitoring programs develop in close connection with the ecological vision and objectives outlined in the park management plan. The park monitoring program must in turn deliver very clear messages on progress towards meeting these goals back to the park management planning process. Also, park ecological vision and management objectives, actions, targets and thresholds can change over time, and these new priorities and directions will need to be reflected in adaptations to the park management plan and the park monitoring program. For all of these reasons, early, ongoing, and meaningful dialogue between management teams and those developing the park monitoring program is critical.

Program Vision and Challenge

A major challenge in designing park monitoring and reporting will be to translate the general definition of EI from the *Canadian National Parks Act* (Government of Canada, 2000) into useful and measurable, park-specific interpretations that can be expressed by a meaningful group of measures and indicators for each of our national parks. This will require park biologists and managers to describe an EI vision and park management goals in the context of specific park ecological characteristics. For example, what distribution of forest ecosystems in a park represents a desirable state of forest EI? How do management activities such as prescribed fire affect this objective? What population of speckled trout is desirable in park aquatic ecosystems, and how does recreational fishing affect this objective? How do we set biologically meaningful targets so we can interpret monitoring results and provide clear assessments for park management? The PCA mandate includes park visitors, but at what level of effect on a coastal dune ecosystem would we conclude that the effects of visitor activities are no longer compatible with our vision for park EI? How do we show the improvements in EI we make by managing visitors in creative ways that maintain or improve the visitor experience and improve park EI? How do we account for the positive effects of restorative management activities such as riparian ecosystem restoration, invasive alien plant eradication, or road fencing in the context of park EI? The answers to all of these questions, as they apply to a park, will be an important and required component of park EI monitoring and reporting programs.

Program Vision

The vision for the program is to develop park EI monitoring and reporting programs so that each park has an effective program in place by the 2008-2009 fiscal year. Park monitoring programs will be directly linked to park EI vision expressed in the park management plan, communicated through the development of ecosystem conceptual models, and assessed and reported through a small suite of carefully selected EI indicators that report the state of park EI. Monitoring and reporting programs will be designed to reflect the financial and human resources committed to deliver them, and will optimize those resources through bioregional cooperation among parks, careful consideration of the most cost-effective suites of measures, and by working cooperatively with partners and stakeholders to develop and sustain regional-scale monitoring initiatives. Information generated by park monitoring programs will form the basis for *SoPRs*, and for assessing and reporting the effectiveness of park management actions in the context of park EI.

Program Challenge

To achieve the vision described for the program, park monitoring and reporting will need to be designed to be *useful, comprehensive,* and *feasible*. A *useful* program will provide clear messages about the state of park EI and how it is changing, and will provide feedback on the effectiveness of park management activities, in the context of EI. A *comprehensive* program includes measures from all major park ecosystems that are targeted to our reporting and management needs, that are measured using scientifically robust methods, and that are effectively synthesized and communicated to both non-technical and technical audiences. *Feasible* programs are sustainable in the long-term in terms of both financial and human resources, and are within the capabilities of park technical and scientific capacities.

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Healthy Ecosystems, Healthy People: A Monitoring Framework for Ontario Parks

Tim Bellhouse
Senior Monitoring Ecologist
Planning and Research Section, Ontario Parks
Robinson Place, 6th Floor South
300 Water St.
PO Box 7000, Peterborough, Ontario, K9J 8M5
Phone: (705) 755-1235
E-Mail: tim.bellhouse@mnr.gov.on.ca

Abstract

Ontario Parks has developed a comprehensive monitoring framework to enable monitoring and tracking of ecological sustainability within the 600+ provincial parks and conservation reserves across the province. The framework, which is based on a criterion and indicators approach, is based on strategic direction by the Ontario Ministry of Natural Resources (OMNR). Monitoring will facilitate adaptive management and state of protected areas reporting.

Growth of the Protected Areas System

Ontario's Provincial Park system has evolved over the past 100 years into a world class network of protected areas. This system, which began with Algonquin Park in 1893, grew slowly in the first half of the 20th century. The 1990s began with a system of 261 provincial parks including 6.3 million hectares of lands and waters. In the early years of the decade, 60 new areas and 900,000 hectares were added to the province's protected area system and conservation reserves were established under the *Public Lands Act* (Government of Ontario, 1990).

In the late 1990s growth was even more impressive, with the addition of 378 new protected areas totalling 2.4 million hectares of lands and waters. The result of these efforts is a protected areas system today of 636 Provincial Parks and Conservation Reserves encompassing an area of 9.5 million hectares. While this growth has been substantial, setting areas aside is merely the first step in protection. Over the past 30 years, public demand for outdoor recreation opportunities has grown tremendously, coupled with an increasing awareness of nature, wild spaces and the imperative to protect global biological diversity. As human population and demands on natural resources continue to grow, new pressures will pose difficult challenges and require innovative solutions. To help meet these demands, while ensuring ecologically sustainable management of protected areas, Ontario Parks has developed a comprehensive program to monitor and report on ecological, social and economic aspects of protected areas to support planning, management and informed decision-making.

Ontario Parks Goals and Objectives

Ontario Parks has policy, planning and management responsibilities for provincial parks and policy and planning responsibilities for conservation reserves. Management responsibility for conservation reserves lies with *Field Services Division* of the Ontario Ministry of Natural Resources (OMNR).

The goal and objectives for Provincial Parks as set out in the *Provincial Parks Policy Statement* (OMNR, 1992) provide a strategic direction for Ontario Parks. The goal is:

- *To provide a variety of outdoor recreation opportunities and to protect provincially significant natural, cultural and recreational environments in a system of provincial parks.*

This goal is supported by the following four objectives:

- *To protect provincially significant elements of the natural and cultural landscape of Ontario.*
- *To provide Provincial Park outdoor recreation opportunities ranging from high-intensity day-use to low-intensity wilderness experiences.*
- *To provide opportunities for exploration and appreciation of outdoor natural and cultural heritage of Ontario.*
- *To provide Ontario's residents and out-of-province visitors with opportunities to discover and experience the distinctive regions of the Province.*

The goal and objectives for Conservation Reserves, the second major type of provincial protected area in Ontario by the OMNR, is:

- *To protect natural heritage values on public lands while permitting compatible land use activities.*

This goal is to be achieved through the following five objectives:

- *To identify conservation reserves though a scientific process.*
- *To ensure that potential conservation reserves are withdrawn from staking.*
- *To confirm conservation reserves through a Ministry land-use planning process.*
- *To afford conservation reserves legal protection.*
- *To manage conservation reserves to protect the integrity of their natural values.*

This paper describes the rationale behind the monitoring and reporting framework, outlines the framework structure and provides details on the various components of that framework. The framework is applicable to both Provincial Parks and Conservation Reserves.

What is Monitoring and why is it done?

Monitoring is the collection of data and information in a systematic manner, over time. Generally, the intent of monitoring is to detect change (or lack of change) in natural resources through time. The important terms to consider are *systematic, time* and *change*.

It is important that the data is collected in a *systematic* manner. This means that the data is collected in a standard way every time it is collected and in every location where data is gathered. This ensures that the information is consistent. Simply put, it ensures that we are comparing apples to apples, rather than trying

to compare apples to oranges. Therefore, the data is more reliable and defensible, allowing for better decision-making.

If *change* occurs in natural resources, the impact of that change could be either positive or negative. While some change may occur rapidly, other changes may be slow and barely noticeable from year to year. The *timeframe* over which change occurs may not be related to the severity of the impact of that change. Change may be swift and ecologically acceptable (wildfire is a natural component of boreal ecosystems) or may be slow and disruptive (climate change). It may be necessary therefore, to collect data for many years to determine whether or not change is actually occurring and the impact of that change.

Through monitoring, the status of natural resources can be determined at a point in time. Data can then be compared to similar assessments at another point in time to determine what change, if any, has occurred. The state of a resource can also be compared to the objectives that have been established for the resource to determine if those objectives are being met.

Why Should Ontario Parks be Involved in Monitoring?

Ontario Parks has responsibility for planning and management of the system of protected areas within Ontario. There are three major objectives associated with that responsibility that are supported by a monitoring program. First, monitoring will help to determine if the goal and objectives of Ontario Parks are being achieved. Second, monitoring will allow the establishment of undisturbed benchmarks in the system of protected areas against which conditions in the more disturbed intervening landscape can be measured. This helps to address the OMNR's ecological sustainability mandate, not only within protected areas, but also across the Provincial landscape. Third, Ontario Parks is accountable to the people of Ontario and the various partners and stakeholders with interests in the system of protected areas, to be able to demonstrate that the system is being managed in a sustainable manner.

Adaptive Management

Timely, accurate and relevant knowledge and information are required to enable sustainable management of resources. Information and knowledge are supported through experience and research. As new information and knowledge are gained, Ontario Parks must be prepared to learn and adapt. An adaptive management approach is fundamental to ecologically sustainable management of resources (see Gray this volume for a detailed discussion on adaptive management). Monitoring supports an adaptive management approach by providing information to enable an evaluation of management activities in achieving program goals and objectives.

Comprehensive Monitoring Framework

Our Sustainable Future: OMNR Strategic Direction

We are a part of the environment in which we live. As such, our existence demands that the resources that we depend upon to derive our enjoyment and our livelihood must be managed in an ecologically sustainable manner, now and in the future. This link between human life and resources has been recognised by OMNR and is expressed in its vision statement in the strategic direction document *Our Sustainable Future* (OMNR, 2005). The vision of OMNR is: "*A healthy environment that is naturally diverse and supports a high quality of life for the people of Ontario through sustainable development.*" (OMNR, 2005: 6) This vision statement identifies three basic components that must be integrated in the decision-making process — environmental considerations, social needs, and economic objectives. This vision is built upon the principle that in meet-

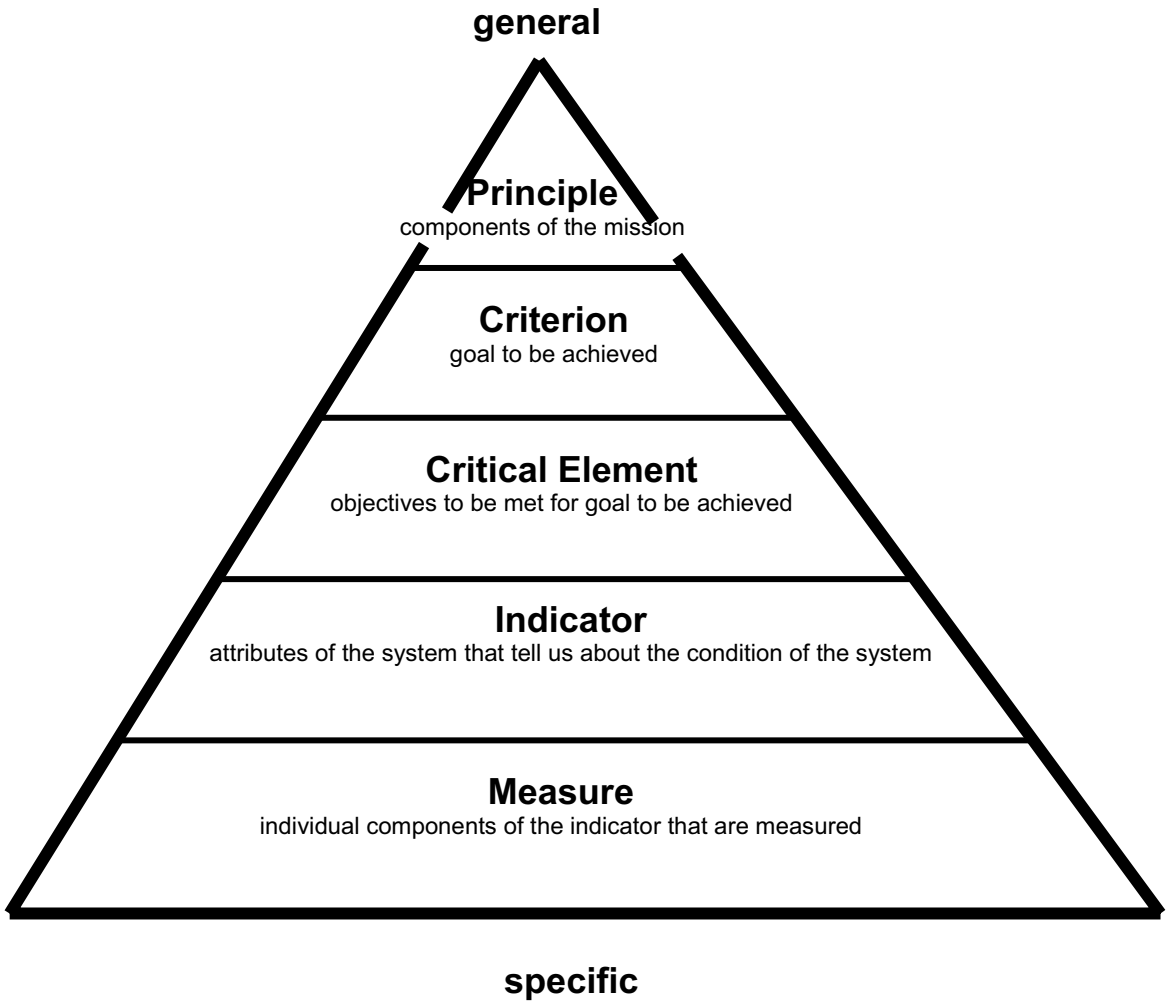
ing the needs of today, we must not compromise the ability to meet the needs of future generations. This is reflected in the mission statement of OMNR: "*To manage our natural resources in an ecologically sustainable way to ensure they are available for the enjoyment and use of future generations.*" (OMNR, 2005: 6)

Ecosystem sustainability is recognised as the foundation of sustainable development. The social and economic benefits that our society derives from natural resources, now and in the future, are dependent on sustainable ecosystems. Since we are part of the environment, our own health and wellbeing is intricately connected to the sustainability of ecosystems. Achieving sustainable development in a context of ecological sustainability is based upon the strategic direction provided through *Our Sustainable Future* (OMNR, 2005).

Framework Structure

Ontario Parks has developed a comprehensive, ecosystem-based approach to monitoring to support planning and management of protected areas across Ontario. The framework is hierarchical, simply meaning that it is composed of a series of connected levels ranging from broad-based to the specific. Within this hierarchical framework (Figure 1), Ontario Parks has adopted a criterion and indicator approach, with principles (broad-based), criteria, critical elements, indicators and measures (most specific). Reference values are the standards against which measures and/or indicators are compared to determine if objectives are being achieved.

Figure 1. Hierarchical framework of criterion and indicator approach.



The monitoring and reporting framework is an Ontario Parks perspective on *Our Sustainable Future* (OMNR, 2005). The framework begins with a vision — *Healthy Ecosystems, Healthy People* — which reflects the ecological, social and economic roles of protected areas. *Healthy Ecosystems* refers to the sustainability mandate of OMNR and within that, the protection mandate of Ontario Parks. *Healthy People* indicates the role parks play for outdoor recreation, opportunities to explore the natural and cultural heritage of Ontario and peace of mind in knowing that the heritage values of the province have been protected in a system of protected areas. Protected areas also have a role to play in local economies and the provincial economy through employment and tourism, a further contribution to society.

This vision is supported by a mission of ecological sustainability, consistent with OMNR strategic direction. Ecological sustainability is an all encompassing term, referring to three inter-related, supporting principles: *ecological integrity*, *social wellbeing* and *economic health*. Associated with each of these three principles are criteria — three ecological, four social and two economic — which provide an Ontario Parks perspective on the strategic direction set out in *Our Sustainable Future* (OMNR, 2005). Table 1 highlights the three principles and nine criteria of the Ontario Parks monitoring and reporting framework.

Table 1. The three principles and nine criteria of the Ontario Parks monitoring and reporting framework.

Principle	Criterion
ecological integrity	- protection of significant values and features
	- maintenance of eco-diversity
	- sustainable resource management
social well-being	- outdoor recreation available
	- life, property and natural resources protected
	- use and transfer of best knowledge and science
	- public involvement
economic health	- fair return for resource use
	- economic potential maintained

Principle: Ecological Integrity

Ontario Parks has adopted the following definition of ecological integrity (EI): "*Ecological integrity refers to a condition in which biotic and abiotic components of ecosystems and the composition and abundance of native species and biological communities are characteristic of their natural regions and rates of change and ecosystem processes are unimpeded.*" (Government of Ontario, 2005) In addition to contributing to measuring EI, certain aspects of the criteria within this principle establish benchmarks within protected areas against which the intervening, managed landscape can be compared.

The three criteria within the EI principle are:

Criterion 1: Protection of Significant Values and Features.
This criterion refers to the representation aspect of the protected areas system, dealing with park class targets on an eco-regional and eco-district basis, the representation of earth and life science features and values, and landscape level targets for old growth forest.

Criterion 2: Maintenance of Eco-diversity.
This criterion deals with the current state of protected area resources. The term eco-diversity is used to represent the full spectrum of diversity associated with protected areas including both earth and life science features. This criterion represents a measure of the state of a protected area at a point of time, against which another measure at another point in time can be compared. This criterion covers a broad ecological spectrum, including terrestrial, aquatic and atmospheric perspectives of protected area environments.

Criterion 3: Sustainable Resource Management.
This criterion is focussed at the individual protected area level and deals with issues on a park by park basis. Aspects of this criterion include ongoing research and monitoring activities, whether conducted by Ontario Parks' staff or by partners such as colleges, universities, other government agencies and non-governmental organizations (NGOs). Guidance for priority setting for monitoring and research is aided by the *Ontario Parks Research Strategy* and by an ecological stress identification process conducted by Ontario Parks.

Principle: Social Well-being

Ontario has a complex and diverse society. Numerous groups of people are interested in protected areas, some with singular interests, while others have multiple interests. Generally, these interests include resource protection, access, outdoor recreation, exploration of natural and cultural values, and economic opportunities. The public has an interest in the management of protected areas, to know that protected areas are accessible, protected and properly managed.

The four criteria associated with the principle on *Social Well-being* are:

Criterion 4: Outdoor Recreation Available.
This criterion deals with opportunities for outdoor recreation and involves access to protected areas, the recreational facilities and programs that are available, and the demand for recreation.

Criterion 5: Life, Property and Natural Resources Protected.
This criterion addresses the protection of protected area cultural and historical resources and infrastructure, and the safety and security of protected area staff and visitors. This involves both preparedness (pro-active) and responsiveness (reactive) of Ontario Parks to issues of protection, safety and security.

Criterion 6: Use and Transfer of Best Knowledge and Science.
This criterion involves the use of information and knowledge to support informed decision-making an adaptive management approach to protected area planning and management. Ontario Parks both conducts and supports research in and about protected areas. Further to this is the need to distribute this information within Ontario Parks, to the public and to the broader scientific community.

Criterion 7: Public Involvement.
This criterion deals with the association and involvement of First Nations and the public in general with park values and initiatives, and planning and management.

Principle: Economic Health

Increasingly, there is a general understanding and acceptance that environmental protection and the conservation of the earth's natural resources are essential to sustain human life and economic development. Parks and protected areas provide a host of economic benefits to individuals, communities and the province. The social and economic health of many communities across the province is dependent, all or in part, upon a Provincial Park or Conservation Reserve.

The two criteria associated with the principle on *Economic Health* are:

Criterion 8: Fair Return for Resource Use.
This criterion addresses the valuing of resources and opportunities, and about pricing (economic value, rent, willingness to pay, comparable pricing, etc.). This relates to the cost of doing business and the gap between costs and revenues. The ability to close this gap depends on the cost to provide the service, the number of users and the willingness to pay.

Criterion 9: Economic Potential Maintained.
This criterion refers to the capital stock (built and natural) associated with protected areas, the market goods and services provided by protected areas (revenue and output) and the contribution of protected areas to local economies and the Provincial economy (employment, income and expenditures).

Where will the Information come from?

Ontario Parks is not alone in the management of natural resources on the Ontario landscape. There are many other monitoring and management activities being conducted by other branches of OMNR, other Ontario ministries, municipal governments and non-governmental organizations (NGOs). Whenever possible, Ontario Parks intends to build upon the activities and experiences of these other resource managers, making use of existing data, rather than creating an entirely new monitoring system. This integrated and coordinated approach will be more efficient and more cost effective in the long run. However, Ontario Parks will continue to conduct monitoring and research within protected areas and will also encourage similar activities by various partners, including colleges and universities.

State of the Protected Areas Reporting

The results of these monitoring activities will inform Ontario Parks planning and management and help Ontario Parks achieve the goals and objectives of Ontario Parks and OMNR. Ultimately, monitoring will enable *State of the Protected Areas Reporting*, which will help to demonstrate Ontario Parks performance in managing protected areas.

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Day 2:

Concurrent Workshop Sessions

*Old-growth trees, here white pine (*Pinus strobus*), record evidence of climatic trends and conditions in their annual growth rings, Quetico (Wilderness) Provincial Park. (Photo anon., Ontario Ministry of Natural Resources)*

Using Ecosystem Conceptual Models to Measure and communicate Park Ecological Integrity

Donald McLennan
National Monitoring Biologist
Parks Canada, Ecological Integrity Branch
25 Eddy Street
Gatineau, Québec, K1A 0M5
Phone: (819) 953-6464
E-Mail: donald.mclennan@pc.gc.ca

Abstract

Conceptual ecosystem models are useful tools in the design of ecological monitoring programs and as communication devices that clearly articulate key drivers of ecosystem structure and functioning. The paper describes conceptual ecosystem models in general and their application to the development of Parks Canada's ecological integrity monitoring programs.

Introduction

A central perspective of the approach of Parks Canada's ecological integrity (EI) monitoring and reporting program is that, to be comprehensive and feasible, park EI monitoring needs to be designed and organized within a series of interrelated and hierarchical conceptual ecosystem models. Ecosystem conceptual models and sub-models should identify, for the main park ecological systems (e.g., forests, tundra, grasslands, wetlands, lakes, streams, near-shore marine), key ecosystem components (e.g., biodiversity, ecosystem processes/functions, social factors, and stressors; see Figures 1 and 2) at a range of scales, and identify the principal drivers and linkages among the components.

The rationale for investing considerable time and energy in conceptual ecological models as a foundation for park EI monitoring and reporting programs include the following:

1. Capturing long-term ecological vision.
The *Canada National Parks Act* (Government of Canada, 1998) is clear that all park management plans require a *"long-term ecological vision"* to guide management activities and determine management objectives. The principal purpose of the park EI monitoring program is to measure and report our achievement in meeting these objectives. Parks are composed of a variety of terrestrial, aquatic and marine ecosystems that interact internally and externally in complex ways across and outside of park landscapes. To provide comprehensive and achievable EI monitoring and reporting it is imperative that we reduce this complexity to a manageable number of fundamental ecosystem components and processes that capture the most important and relevant ecosystem qualities of the long-term ecological vision.

2. An ecological framework for identifying EI measures.
Another important challenge for redesigning park monitoring and reporting programs is to select a small group of measures that will provide maximum information about changes in park ecosystems. By reducing ecosystem complexity to its most important components, processes, and stressors, conceptual models will provide an ecological framework to identify gaps in present

monitoring programs and help guide selection of the most parsimonious suite of EI measures.

Figure 1. Conceptual ecosystem model showing local forest ecosystem (stand-level) components, processes and stressors, with a proposed suite of inter-related forest measures to be co-located in a replicated series of long-term EI monitoring plots.

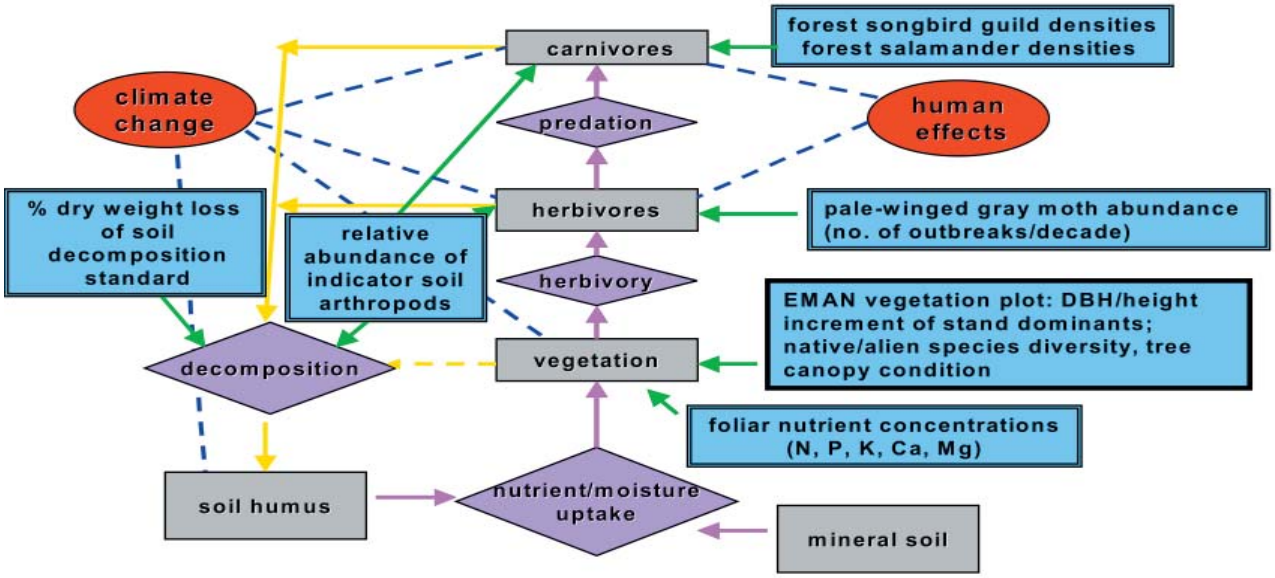
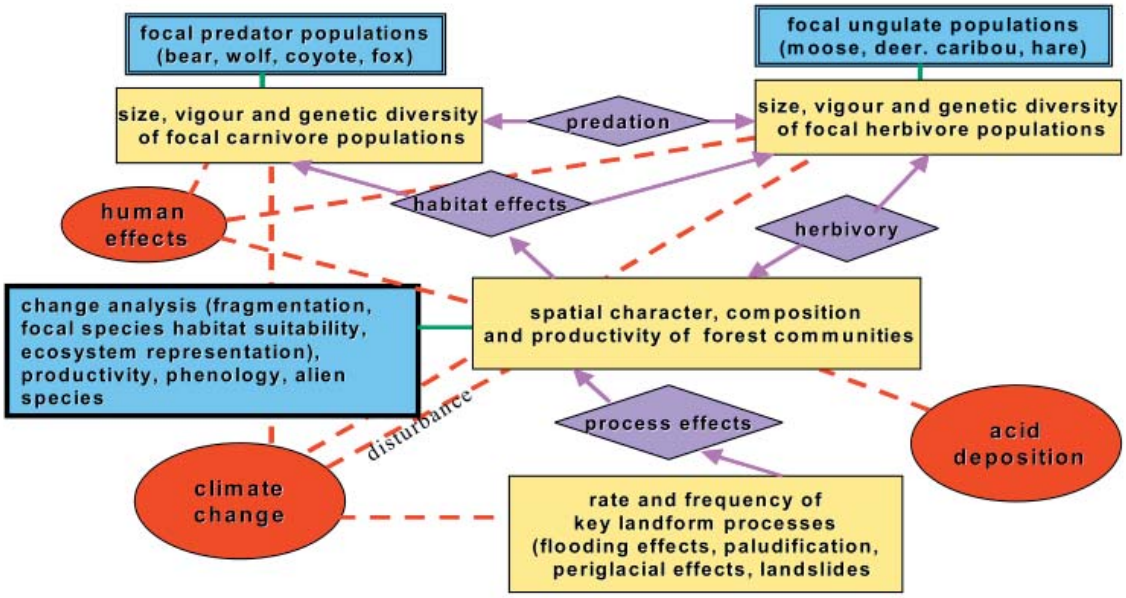


Figure 2. Conceptual ecosystem model showing landscape-level forest ecosystem components, processes and stressors, with a proposed suite of inter-related forest measures with information coming primarily from GIS data and satellite monitoring.



3. Facilitating EI reporting across bioregions and nationally.
Parks Canada has a legislated mandate to report every two years on the condition of EI across the national parks network. This requirement can be greatly facilitated in the long run by building program elements into park models through core bioregional components (i.e., model components that are common to major ecosystems across a bioregion can act as core components of park ecosystem models).

4. An interactive frame for assessing EI monitoring results.
Conceptual ecosystem models will describe major ecosystem components, the processes that link them, and the stressors that affect them. Since model components are conceptually inter-related, and if measures are co-located in long-term permanent sample plots, the changes in the measures that represent those components will also be logically inter-related, and this will greatly improve the interpretation of changes in individual EI measures. Because of the logical connection among monitored ecosystem components, monitoring results can be more easily combined into an EI indicator for that park ecosystem component.

5. Communicating monitoring results to external audiences.
Providing a clear and concise picture of park EI and how it is changing is a critical EI monitoring and reporting program component. Complex ecosystems and the factors that affect them are difficult to communicate to non-specialist audiences, and the proposed conceptual ecosystem models will create a clear, shared picture of park ecological systems that can be communicated widely. High-level conceptual diagrams that combine model components with animated interpretative graphics will effectively communicate to non-specialist audiences (Figure 3), while specialists can use the models to navigate through program logic and arrive at the fundamentals of program design and measurement (Figure 4). Low level control models, such as that illustrated in Figure 4, would be appropriate to include in a monitoring protocol for a monitoring measure such as soil decomposition, and would provide a conceptual link from that small program component to all other aspects of the program through the system of hierarchical models.

Figure 3. Conceptual ecosystem diagram — forest nutrient cycling.

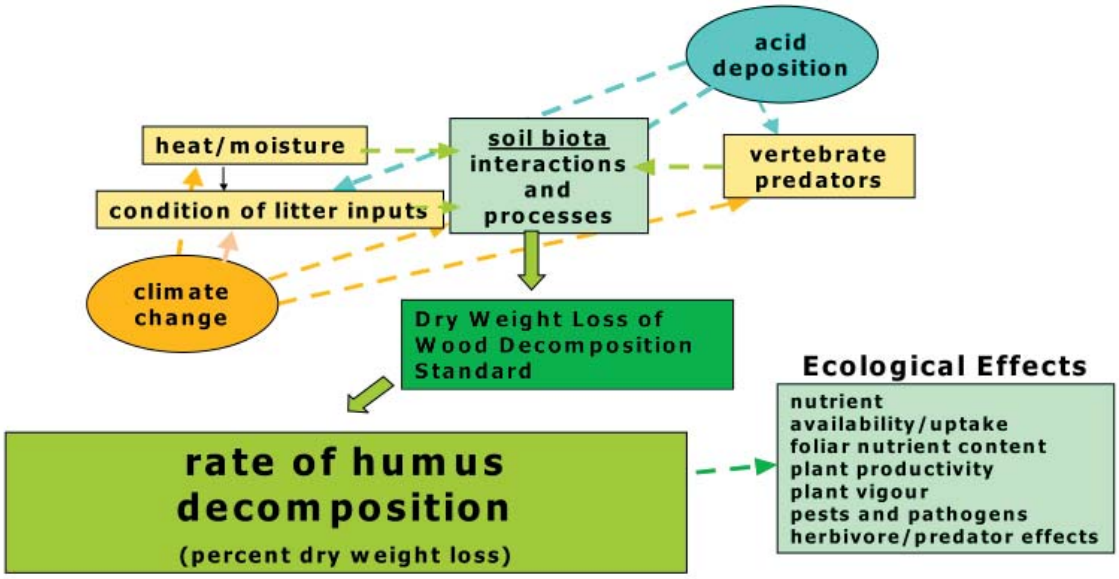
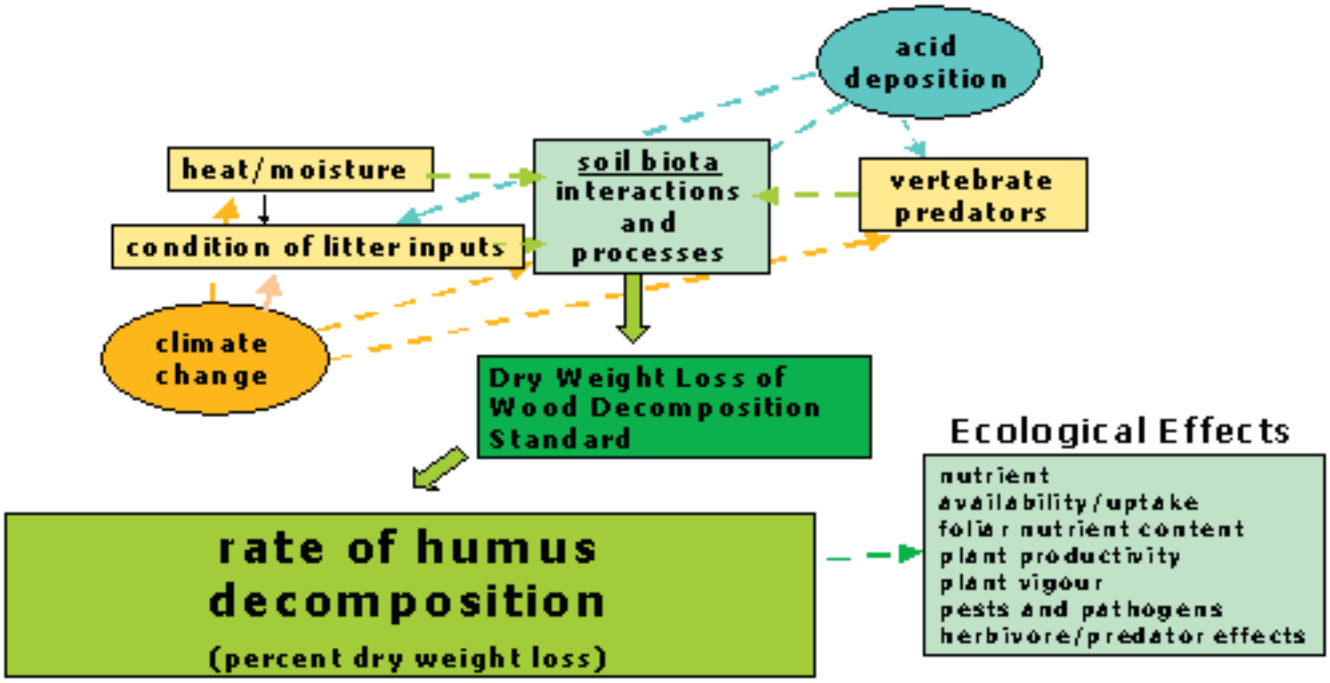


Figure 4. Conceptual ecosystem model showing inter-relationships between a monitoring measure (dry weight loss of wood decomposition) and related ecological components and processes.



6. Communicating internally.
Model development and refinement will take place in park and bioregional workshops, and it is anticipated that this will generate a common and shared understanding of park ecosystems, and EI vision in a park and across a bioregion. The group learning that accompanies the development of the models will lead to an increased mutual appreciation of ecosystem function and complexity, park EI, and monitoring program development. This will in turn provide a common forum for cooperating to develop park programs across a bioregion.

Conclusions

It is anticipated that development of final park conceptual models will take several years and iterations up to 2008. By that date, all park EI monitoring programs should have a hierarchical series of inter-related conceptual models that capture park EI, and provide a useful and well-articulated conceptual foundation for the park EI monitoring and reporting program.

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Ontario Parks Ecological Stress Identification

Tim Bellhouse
Senior Monitoring Ecologist
Planning and Research Section, Ontario Parks
Robinson Place, 6th Floor South
300 Water St.
PO Box 7000, Peterborough, Ontario, K9J 8M5
Phone: (705) 755-1235
E-Mail: tim.bellhouse@mnr.gov.on.ca

Abstract

Ontario Parks has adopted a structured stress identification process used by other jurisdictions. This process relies on the knowledge of protected area staff to identify possible stressors on an individual protected area basis. Knowing what stresses are occurring in an individual protected area or across portions of the protected area system will allow Ontario Parks to identify future research and monitoring priorities. The report outlines the stress identification process in use by Ontario Parks.

Introduction

Ontario's Provincial Park system has grown over the past 100 years into one of the world's outstanding networks of protected areas. This protected area system includes more than 600 provincial parks and conservation reserves and 9.5 million hectares of lands and waters, almost 9% of the total area of the Province of Ontario.

Awareness of nature, wild spaces and the imperative to protect global biological diversity has increased tremendously, coupled with a growing demand for outdoor recreation. As human population and demand for natural resources grow, new pressures and issues will pose difficult challenges and demand innovative solutions. To meet these needs, Ontario Parks has developed a comprehensive approach to monitor ecosystem sustainability within the system of protected areas.

This approach recognises ecological integrity, social well being and economic health as fundamental aspects of healthy ecosystems and sustainable living. To maintain the ecological integrity of individual protected areas, and the protected areas system as a whole, the status of those protected areas needs to be monitored and assessed. Due to the complexity of ecosystems, sustainability cannot be measured or assessed using a single tool, so a number of tools will be required as part of an ecological monitoring toolkit.

One aspect of ecological monitoring to be considered is an assessment of the stressors acting on the protected areas, individually and collectively. A stress assessment is only one of a suite of tools in the ecological monitoring toolkit. Identifying the types and effects of stresses will increase awareness of the factors affecting the integrity of protected areas, will provide benchmark information for future assessments and will position Ontario Parks to determine the best course of action to mitigate those stressors.

Background

Protected areas throughout Ontario are subject to a variety of internal and external stresses, ranging from the numbers of hikers and campers within protected areas, to intensive agriculture or forestry on adjacent lands, and to the effects of climate change across the entire landscape. One tool used to identify and monitor stressors is a stress assessment, a tool that has already been used in Canada by Parks Canada (Parks Canada, 1994 and 1998) and British Columbia Parks (BC Parks, n.d.), and by Parks Victoria in Australia (Parks Victoria, 2000).

Ontario Parks staff have developed a similar approach for use in Ontario as part of the ecological component of a comprehensive monitoring program. Stress identification will increase awareness and knowledge regarding potential stressors causing ecological stresses on the protected areas, enabling Ontario Parks staff to identify areas of concern at a variety of scales, ranging from Provincial to the individual protected area.

Stress assessment is an adaptive process, a series of steps that involve both qualitative and quantitative approaches. These steps are:

1. Identify potential stressors;
2. Prioritise stresses;
3. Research and/or monitor stresses;
4. Mitigate stresses; and,
5. Assess response to stresses.

The first step is to identify the possible stresses. This is accomplished through structured interviews of knowledgeable protected area staff — an informed opinion approach common in social science research. The second step is to prioritise for further action (research, monitoring or management response) the stresses identified. Priorities are established based on uncertainty and risk. Uncertainty is associated with the quality of the information currently available about the stressor. The risk to resources is related to the current intensity of the specific stress and its trend. Risk to resources also differs among the various stressors. Therefore, priorities may vary from one protected area to another, and across areas of the Province. Third, conduct research, monitoring or other evaluations to determine if these possible stresses are indeed stresses within the individual protected area and the protected areas system, the magnitude of the stress and to develop a course of action to mitigate those stresses. Fourth, implement management practices to mitigate the stress. And finally, the fifth step is to assess the response to the stress (i.e., the mitigative management practice) to determine if it was effective. This final step facilitates an adaptive management approach to resource management within protected areas.

This paper addresses the first of five steps of stress assessment, stress identification. The following four objectives associated with stress identification relate both to individual protected areas and to the system of protected areas as a whole:

1. Identify possible stresses;
2. Determine Ontario Parks' responses to those stresses;
3. Identify possible research needs and priorities; and,
4. Identify possible monitoring needs and priorities.

In addition to helping to determine monitoring and research priorities, stress identification will contribute valuable information to efforts by Ontario Parks to report on the state of the protected areas system.

Methodology

Stress Identification Procedure
The identification of stresses is accomplished though a structured interview process whereby qualified staff provide informed opinions concerning stressors on an individual protected area basis. This is a qualitative approach to information gathering common in social science research.

For non-operating parks and conservation reserves, protected areas for which there may be limited current information, the collection of standard data during site visits is recommended.

The suite of potential stressors is standard for all protected areas. Questions are standardised across all stressors and a range of possible responses is identified and defined for each question, with the exception of two open-ended questions where additional detail can be provided.

Interviews are conducted on an individual protected area basis with the park superintendent and other staff knowledgeable about the specific protected area, led by zone representatives (planners and ecologists) and by main office staff.

Criteria for setting priorities on a zone basis include:

- Park superintendent has recently retired, is about to retire or is about to change parks — to get the most from their experience;
- Protected area is thought to be under considerable stress at this time — to document those stresses; and,
- Protected area has current or pending planning needs — to respond to program priorities.

Discussion sessions generally require one to four hours to complete, depending on the amount of information currently available for each protected area. Information gathered during these discussions is recorded in a Microsoft ACCESS™ database during the sessions.

It is emphasised at the beginning of each session that stress identification is directed at ecological impacts associated with the protected area — impacts on the quality of the experience of users of the protected area (other than ecological) are not to be considered. Social and economic aspects of protected area use and user experience are currently dealt with through other survey mechanisms within Ontario Parks. Ultimately, there are linkages between ecological, social and economic aspects of protected areas that will need to be considered and addressed.

Who Should Be Involved?
Each stress identification session involves a zone representative, the protected area team and possibly a main office representative. The protected areas team usually includes the Park Superintendent, and others knowledgeable about the specific protected area. Examples of *"other"* knowledgeable participants include Assistant Park Superintendents, Natural Heritage Education staff, zone, protected area or district planners and ecologists, other zone, protected area or district staff and representatives from other organisations such as *"Friends of …"* groups, naturalist groups and staff from the Nature Conservancy of Canada. Information on who is involved in the sessions and when and where the discussions occur is recorded in the database for each protected area.

Stressors

Fifty-four potential stressors have been identified for assessment. These stressors fall within the follow-

ing eight categories: commercial; fish and wildlife management; lands and waters management; mortality; problem species; recreation; toxins and pollutants; and, vegetation management (Table 1). The list of stressors was derived from the list of permitted activities, approved management actions and recommended possible stressors to be investigated (OMNR, 1992 and NSEI, 2001). The identification of additional stresses specific to a particular protected area is encouraged.

Table 1. Stressor categories and associated stressors considered for stress identification in regulated protected areas in Ontario.

Commercial	
outfitting services	resorts/lodges
outpost camps	restaurants/concessions
Fish and Wildlife Management	
fish stocking	wildlife population management
fish habitat management	wildlife habitat management
Lands and Waters Management	
aggregate extraction	mineral exploration/extraction
agriculture	water level control
hydro generation	
Mortality	
commercial baitfishing	scientific collecting
commercial fishing	traditional/Aboriginal collecting
hunting	trapping
poaching	vehicle kills
Problem Species	
exotic aquatic fauna	exotic terrestrial flora
exotic aquatic flora	hyper-abundant species
exotic terrestrial fauna	
Recreation	
aircraft landing	mountain biking
all terrain vehicles	rock climbing/scrambling
boating	sailing/sailboarding
camping – car	skin/scuba diving
camping – interior	snowmobiling
canoeing/kayaking	snowshoeing
crosscountry skiing	spelunking
hiking	swimming beaches
horseback riding	
Toxins and Pollutants	
	air quality
	soil contamination
	noise pollution
	water quality

Commercial Activities
Four commercial activities may be permitted within protected areas are — outfitting services, outpost camps, resorts/lodges and restaurants (including food concessions). Specific activities are determined initially by the classification of the protected area and further refined during the management planning process (OMNR 1992 and 1994). In some cases, these activities may be situated in the protected area, while in other instances the base of the activities may be outside the protected area, while making use of the protected area and its resources.

Fish and Wildlife Management
Four management practices are identified in two categories, habitat and populations. These activities are fish stocking, fish habitat management, wildlife habitat management and wildlife population management (enhancement or reduction). Stresses could result from activities internal or external to an individual protected area.

Lands and Waters Management
Five lands and waters management activities are considered, three terrestrial and two aquatic — aggregate extraction, agriculture, hydro generation, mineral exploration and/or extraction and water level control (other than for hydro generation). These activities can occur either inside or outside of protected areas.

Mortality
The impacts on populations of flora and fauna by activities associated with protected areas are considered in nine activities — commercial baitfishing, commercial fishing, hunting, poaching, scientific collecting, sport fishing, traditional/Aboriginal collecting, trapping and vehicle kills. While impacts from activities occurring internal to the protected area are most relevant, impacts from activities occurring externally are also considered. While the majority of these activities are related to fish and wildlife management practices regulated through the *Fish and Wildlife Conservation Act* (Government of Ontario, 1997), some activities are controlled by policies of Ontario Parks.

Problem Species
The impact of populations of flora and fauna on the protected area environment is considered in five categories. Four of these categories, broadly classed as exotic and possibly invasive species, include exotic aquatic fauna, exotic aquatic flora, exotic terrestrial fauna and exotic terrestrial flora. The remaining class is hyper-abundant species. Impacts originating both internally and externally are considered.

Recreation
Seventeen recreational activities are considered. The list of activities for a specific protected area (see Table 1) is determined initially by the classification of the protected area and further refined during the management planning process (OMNR, 1992 and 1994). These activities are considered primarily as internal to the protected area, although exceptions are possible [e.g., All Terrain Vehicle (ATV) access to a protected area by way of forest access roads along the periphery of the protected area].

Toxins and Pollutants
A number of toxins and pollutants within the three categories of air quality, soil contamination and water quality are to be considered to promote discussions. However, specific toxins and pollutants are not necessarily recorded as individual stressors (provide details in the Comments). Noise is considered from the perspective of the impact that it may have on the protected area environment, and not the impact of noise on the quality of the experience for protected area users. While some noise may be inconvenient for users, the impact may not be detrimental to the protected area environment. Sources of toxins and pollutants both inside and outside the protected areas are included.

Air pollutants to consider include: carbon dioxide (CO_2); ground level ozone (O_3); nitrogen dioxide (NO_2);

smog; sulphur dioxide (SO_2); and, suspended particulates. The following possible stressors are considered to promote discussions concerning soils: erosion (human induced); heavy metals; herbicides; mine tailings; pesticides; petrochemicals; sewage; and, solid wastes (dumps). Water quality concerns include: acid precipitation; bacterial contamination; heavy metals; herbicides; mercury; polychlorinated biphenyls (PCBs); pesticides; petrochemicals; and sewage.

Vegetation Management
Six vegetation management practices have been identified — insect/disease suppression, fire suppression, forestry, herbicide spraying, lawn/roadside mowing and prescribed burning. These are largely suppressive activities that may be occurring internal or external to individual protected areas.

Stressor/Stress Information

Sixteen to nineteen questions are asked about each potential stressor, depending on the category of the stressor. These questions are intended to provide a comprehensive picture about each possible stressor and the associated stress. The questions and possible responses are standardised across all stressors to aid data recording and analysis. Descriptions of the questions and the possible responses follow. Not all questions will be answered in all cases. For instance, if the activity does not occur inside or outside the protected area, then stress cannot be occurring and answering all questions would be meaningless. However, there is a minimum number of questions that do need to be answered for all stressors.

Is this activity permitted in the protected area?
This question *applies to recreational stressors only and must be answered for all recreational activities for each protected area* and is intended to identify the list of permitted recreational activities associated with the individual protected area. This information, in combination with the following question will help determine what activities are occurring in protected areas that are not permitted by policy or planning.

Possible responses include:

- *yes:* activity is permitted;
- *no:* activity is not permitted;
- *may:* activity may be permitted, dependent on future management planning; and,
- *NA*: not applicable — this activity is not physically possible, opposed to not being permitted in the protected area (e.g., boating cannot occur if there are no water bodies or water courses in or adjacent to the protected area; however, if caves exist but spelunking is not permitted, then the answer would be *"no"*, and not *"NA"*).

If the response to the question is *"NA"*, then questioning about this stressors may be essentially complete, unless it is an activity occurring outside the protected area that could have an impact on the protected area environment. It is recommended to answer the first three questions.

Does this activity occur in the protected area?
This question *applies to all stressors in all categories and must be answered in all cases, with the exception of Problem Species and Toxins and Pollutants.* This question will demonstrate those activities that occur in the protected area. In association with the previous question (recreational activities only), this question will also reveal those activities occurring that should not be occurring in the protected area.

Possible responses include:

- *yes:* activity is occurring;

- *no:* activity is not occurring; and,
- *unknown:* unknown if the activity is occurring in the protected area.

Does this activity occur outside the protected area?
This question applies to all stressors in all categories and must be answered in all cases, with the exception of Problem Species and Toxins and Pollutants. This question will demonstrate those activities that occur outside the protected area.

Possible responses include:

- *yes*: activity is occurring;
- *no:* activity is not occurring; and,
- *unknown:* unknown if the activity is occurring outside the protected area.

If the responses to this and the preceding question are *"no"*, then questioning about this stressor is complete, and questioning about the next stressor on the list can begin.

Is ecological stress occurring in the protected area?
This is the most important question about the stressor, setting the tone for the remaining discussions. For that reason, it needs to be made very clear to all participants that only ecological impacts are to be considered. Since any activity will cause some amount of stress within the natural environment, it must be emphasised that only stresses beyond those anticipated by the use or activity need to be considered, since it is stresses beyond those planned that may not be sustainable. For example, campgrounds are designated within development zones in some parks. The development of a campground results in a level of stress that is deemed acceptable within the development zone. Therefore, the presence of a campground is not considered a stress. However, if the use of the campground does have ecological impacts that are beyond those considered to be acceptable, then the use of campgrounds could be considered a stress within that portion of the development zone. This would not necessarily be, however, a stress upon the protected area as a whole.

Possible responses include:

- *yes:* stress is occurring;
- *no:* stress is not occurring;
- *unknown:* uncertain if stress is occurring — used in situations when it is unknown if a stress is occurring or when a stress is known to occur, but currently not affecting protected area environment; and,
- *legacy*: source removed, but stressor continues to stress protected environment.

If a stress is occurring, there is a legacy stress, or it is unknown if a stress is occurring, proceed with the remainder of the questions. If no stress is occurring, move on to the next stressor.

What are the observed ecological impacts?
This question addresses impacts on protected area resources from specific stressors. Examples of stresses would include such things as changes in population size or community structure, erosion, siltation and the development of social trails. While all protected area resources are to be considered, pay specific attention to species at risk. Try to capture the impact in simple terms or phrases and provide additional details in the comments section.

What is the intensity of stress?
What is the level of stress associated with the stressor? This question is one measure of the risk to protected area resources associated with the particular stressor and will assist in the setting of priorities for further study (research and/or monitoring) or management action.

Possible responses include:

- *low:* little or no impact on protected area environment — unlikely to impair sustainability of the specific resource in question;
- *moderate:* some impact on protected area environment — possibility that sustainability of resources may be impaired;
- *high:* major impact on protected area environment — sustainability of resources in jeopardy; and,
- *unknown:* impact on sustainability unknown or poorly understood.

What is the trend of the stress?
What trend is observed regarding the impact of the stressor on protected area resources? This question is another measure of the risk to protected area resources associated with the particular stressor and will also assist in the setting of priorities for further study (research and/or monitoring) or management action. This question may be answered to reflect the trend in the activity as a surrogate for the impact on the resource.

Possible responses include:

- *increasing:* activity and/or associated stress increasing;
- *decreasing:* activity and/or associated stress decreasing;
- *stable:* activity and/or associated stress stable; and,
- *unknown:* trend of activity and/or associated stress unknown.

What is the quality of data/information used (to make the assessment)?
How good is the information about the stressor and the possible stress that may be occurring? This question addresses the quality of the information available to assess the stressor, providing an indication of the uncertainty associated with the impact of the activity. This information will also assist in setting priorities for further action (research, monitoring and/or management action).

Possible responses include:

- *poor:* no data or information available or anecdotal information only;
- *intermediate:* incidental observations only — non-standardised methods; and,
- *good:* systematic – based on established protocol.

What is the source of the data (answered for good quality data only)?
Since the previous question provides a first assessment of the source of the data, this question only applies to those cases where 'good' quality data is available. The source of the information should be indicated, whether from protected area reports, research paper, etc.

Where does the stress originate?
Does the stress originate internally, or is it external to the protected area? Stresses associated with permitted recreational activities will generally originate within the protected area. All other potential stressors could originate internally, externally or both.

Possible responses include:

- *internal:* activity causing stress originates inside the protected area;
- *external:* activity causing stress originates outside the protected area (although it may occur in the protected area); and,
- *both:* activity causing stress originates both inside and outside the protected area.

Where in the protected area is the stress occurring?
This question indicates in a general sense where in the protected area the stress is occurring. Locations are identified as the protection portions and the recreation portions of the protected area. In the case of provincial parks, this will depend on within-park zoning, while in the case of conservation reserves, they are classed as protection only. Protection portions include the following zones: nature reserve, natural environment, wilderness and in some cases, historical. Recreation portions include the following zones: development, access and in some cases, historical.

Possible responses include:

- *protection:* activity causing stress occurring in protection zones of the park or throughout a conservation reserve;
- *recreation:* activity causing stress occurring in recreation zones of the park (does not apply to conservation reserves); and,
- *both:* activity causing stress occurring in both protection and recreation zones of a park.

What is the extent of stress?
What is the spatial extent of the stress? How this question is answered will depend, in part, on the stressor. In many cases, the stress may be restricted to the locality where the activity occurs. For example, stresses associated with hiking may be restricted to the trail and the immediate vicinity of the trail (localised), whereas aerial spraying for insect or disease control could affect a large area of the protected area (widespread). Some activities with a localised impact may be occurring throughout the protected area (e.g., proliferation of ATV trails throughout a park zone or the entire protected area). In these instances, the activity could be classed as widespread.

Possible responses include:

- *localised:* stress occurring in a relatively small area immediately adjacent to the location of the activity causing the stress — activity not widespread through the protected area; and,
- *widespread:* stress occurring throughout the protected area, or if associated with a small area immediately adjacent to the activity, activity is occurring throughout the protected area.

In what season(s) does the stress occur?
When does the stress occur? While occurrences could be cyclic and/or periodic, this question is looking for the period within a year that stress is occurring and compliments the following question on the frequency of the stress. Possible answers include individual seasons, combinations of seasons and year round stresses.

How frequently does the stress occur?
This question looks at the frequency of the stress (i.e., how often it occurs) and compliments the previous question regarding the timing of the stress.

Possible responses include:

- *occasional:* the stress occurs infrequently;

- *periodic:* the stress occurs with some frequency, but is not an annual event; and,
- *annual:* the stress occurs annually.

Recommended Management Action(s)

What action is recommended to mitigate the stress? This is an opportunity to describe what is being done or what could be done in response to the stressor. These ideas may form the basis for further action (research, monitoring or management).

How long to mitigate the stress?
What time would be required to mitigate the stress? In other words, if the recommended management actions were implemented, how much time would be required to remove the stress, or to reduce its impact? This information may assist in setting priorities for further action.

Possible responses include:

- *immediate:* mitigation would occur within 1 year;
- *short-term:* 1- 5 years;
- *medium term:* 5-10 years;
- *long-term:* > 10 years; and,
- *ongoing:* requires ongoing action.

How long to recover from the stress?
Once the stressor was removed (i.e., recommended action implemented and stress mitigated), how much time would be required for the protected area environment to recover?

Possible responses include:

- *immediate:* recovery would occur within 1 year;
- *short-term:* 1- 5 years;
- *medium term:* 5-10 years;
- *long-term:* > 10 years; and,
- *ongoing:* recovery will be coincidental with ongoing mitigation.

Comments
This is an opportunity to record additional details and any comments that the protected area staff feel are pertinent or that may provide additional clarification regarding the stressor, its impacts on protected area resources or actions to address the stressor and its impact.

Additional Information

These sections are intended to provide additional information about the protected area and activities occurring within the protected area that are related to the protected area environment. This information needs to be considered for each protected area.

Development and Infrastructure
In developing and managing a protected area, managers may require buildings, access and facilities for users of the protected area. This section is intended to represent a measure of that 'footprint' on the protected

area environment, and simply provides an inventory of a number of aspects of that footprint.

Research and Monitoring

A number of ecological monitoring activities occur on the Ontario landscape and some of those activities are conducted in Provincial Parks. This section provides a list of some of the more common ecological monitoring activities and is simply an opportunity to inventory the activities occurring in each protected area.

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Monitoring, Inventory and Research Needs in Parks Canada

Paul Zorn
Monitoring Ecologist (Great Lakes Bioregion Coordinator)
Parks Canada, Ecosystem Management
2630 Sheffield Road
Ottawa, Ontario, K1A 0M5
Phone: (613) 998-7248
E-Mail: paul.zorn@pc.gc.ca

Abstract

This paper presents some common monitoring, inventory and research needs in Parks Canada with a focus on our evolving ecological integrity monitoring and reporting program. These needs are shared by every national park in Ontario and by the Great Lakes Bioregion as a whole. The intent of this paper is to highlight some common needs in the hope that they are shared by Ontario provincial parks, and therefore, may facilitate some joint action between Parks Canada and Ontario Parks.

What to Monitor?

At our current stage of development for Parks Canada's ecological integrity monitoring and reporting program we are still making decisions on what to monitor. The Parks Canada Agency (PCA) has received some detailed direction from our *Executive Board* for monitoring that will shape these selections (see McLennan and Zorn, this volume, for a summary of this direction). Among the most important items of this direction is that individual national parks are to monitor and report on the status and trends of ecological integrity in six to eight indicators. Indicators in this context refers to composite indices made up of several measures, similar to a ultravioloet (UV) index or Dow Jones index. Measures refer to specific variables whose data are collected during the implementation of a park's monitoring program. To facilitate decisions on what to monitor within Parks Canada's Great Lakes Bioregion we have identified some needs that we plan to pursue in the short-term (up to 2008). The needs that will be highlighted here include: conceptual ecosystem models; sensitivity analyses along stress gradients; gap analyses of currently identified ecological integrity indicators; and, shared database of monitoring protocols among agencies.

Conceptual Ecosystem Models
Parks Canada is investing in a series of park-based conceptual ecosystem models. These models, targeting a range of spatial scales (e.g., within park, whole park, greater park ecosystem), will summarize the key ecosystem structures, processes and stressors that most affect a park. "*Stock and flow*" type models will be used to summarize the linkages among model components using modeling software such as Stella™. Sensitivity analyses can also be done using these tools as a method to rank potential monitoring measures within the models. High graphic versions of these conceptual models will also be created to assist in communication with partners, stakeholders, and park visitors.

Sensitivity Analyses Along Stress Gradients
Parks Canada has already identified a candidate short list of monitoring measures for a variety of ecosystem types that occur in national parks in Ontario. These candidate measures have been identified from previous monitoring or research projects, species at risk recovery plans, existing databases that reside in and out of Parks Canada, proposed monitoring measures selected from environmental consultants under contract, and from monitoring programs conducted by partner agencies. These monitoring measures and

their associated protocols as a whole are too expensive to incorporate into an affordable, long-term monitoring program. To assist in the selection of monitoring measures and protocols from this list Parks Canada would like to invest in a series of research projects that test the sensitivity of these measures to known stress gradients that occur within national parks and surrounding greater park ecosystems. Stress gradients will be selected *a priori* from Parks Canada's national stress questionnaire and *State of the Park Reports (SoPRs)* (these stress gradients will also be consistent with Ontario Parks' stress identification initiative, see Bellhouse this volume). The focus of these research projects will be to address the questions: *"To what extent can candidate monitoring measures reliably discriminate among sites along known stress gradients?; At what point along these gradients do measures exhibit an observable signal (monitoring thresholds)?"*; and, "*How can individual measures with known sensitivities to stress gradients be aggregated to maximized the discriminatory power of sites along these stress gradients (developing multi-metric indices)?"*

Gap Analyses of Currently Identified Ecological Integrity Indicators

For reporting purposes each national park must identify six to eight indicators that it will use to report on and communicate the state of ecological integrity (see McLennan and Zorn, this volume). These six to eight indicators must be standardized across all national parks within a bioregion (in our case, the Great Lakes Bioregion). The initial set of ecological integrity indicators that the Great Lakes Bioregion has selected are: 1) human footprint; 2) habitat change; 3) pollutants; 4) stewardship; 5) biodiversity; 6) terrestrial ecosystems; 7) aquatic ecosystems; and, 8) wetland ecosystems. This is our initial list and is subject to evolve over time. Each of these indicators are in different stages of development in terms of selected measures, protocols, sampling designs, trained staff to implement, etc. The Great Lakes Bioregion has identified the largest gaps within its aquatic and wetland ecosystem indicators and has prioritized them as its short-term focus. Parks Canada will be looking to invest and develop partnerships related to these two indicators in particular.

Shared Database of Monitoring Protocols Among Agencies

As a mechanism to share information on monitoring measures and protocols in use throughout Ontario, Parks Canada would also like to invest in a shared, accessible database of monitoring protocols. A shared database between Parks Canada and Ontario Parks would be a strong first step in sharing this kind of information.

Where to Monitor?

Generally speaking, the sampling designs of Parks Canada's current monitoring activities in Ontario are weak. In particular, we suffer from: too few replicates in both space and time; data points that are autocorrelated; data points that don't represent the full ecological and stress gradients we care about for park management; scale mismatches between the coverage of current monitoring stations and the ecological processes we want to assess; and, monitoring stations that are biased due to accessibility, remoteness, incomplete inventories; etc. The greatest determining factor in the weakness of Parks Canada's existing sampling designs is capacity. We simply can't afford to resample a large number of monitoring locations at a range of spatial scales with a sufficient sampling frequency.

To the extent possible, the Great Lakes Bioregion tries to mitigate our sampling design problems with the use of power analyses as a tool to make decisions on how to deploy our limited monitoring capacity. Using existing baseline data and power analysis software (e.g., PASS 2005™) we assess potential sampling frames associated with monitoring measures and determine the relationships between effect size (or minimal detectable change), variation, Type I and Type II error rates, and sample size. From here we are able to build sampling scenarios that address the questions: *"What magnitude of change can I reliably detect with the sample sizes we can afford?"*; and, *"What level of risk (Type I and Type II errors measured separately) is associated with our sample sizes and is this level of risk acceptable?"* Using power analysis to build sampling scenarios at least let's us optimize the use of our limited capacity and provides us with a means to make decisions on how to

strategically allocate resources to achieve certain sampling frame targets and allows us to understand how sampling frames should differ among measures within our monitoring programs.

While power analysis has become a predominant tool for us to make decisions on sampling designs, our sampling designs still remain too weak to address all the monitoring questions (at their range of scales) identified in national park management plans. Since many national and provincial parks in Ontario share similar management concerns we hope that there is an opportunity to develop joint sampling designs that are shared by a number of parks in a region [as well as other protected area types like conservation authorities, Areas of Natural and Scientific Interest (ANSIs), etc.]. Within a *"protected area cluster"*, Parks Canada, Ontario Parks, and other agencies can jointly develop shared sampling designs for a range of indicators that address each agencies' management needs. Individual monitoring budgets can be supplemented such that each agency takes part in resampling their portion of the cluster. Collectively the resultant data can be used to assess ecological status and trends at a range of scales, both within and beyond park boundaries, at a higher sample power that otherwise is unachievable by each agency on their own. This level of coordination would mean that Ontario Parks and Parks Canada would have to monitor standardized measures with standardized protocols and training. This level of standardization would further improve cost-efficiencies as each agency could share costs on protocol development, training courses, database development, analytical tools, field equipment, and possibly even on shared field staff.

How to Monitor?

Sometimes monitoring protocols exist, are field tested (usually through a short-term graduate thesis) and scientifically reviewed, and are still not appropriate for use by Parks Canada. To make protocols useful for Parks Canada's long-term monitoring program they need to be easily repeatable with different observers (given high levels of staff turnover), quick and easy (to minimize costs), implemented with low measurement error with the expertise of our staff (for quality control), and be precise *"enough"* to inform management decisions (precise *"enough"* for park managers is usually coarser than what's academically published). These coarser requirements make our monitoring programs more affordable and more accurate while still providing sufficiently robust information (*"Coarse"* in this context refers to larger, but still acceptable, effect sizes, Type I and Type II error rates.) For many measures within our ecological integrity monitoring and reporting program we are still looking to develop/adopt/adapt protocols. The lack of comprehensive, repeatable, and useful protocols is a significant constraint to Parks Canada's monitoring program moving forward.

An area of substantial potential partnership between Parks Canada and Ontario Parks is in the co-investment in developing, testing, and implementing useful monitoring protocols for a variety of abiotic, biotic and cultural elements of park ecosystems. These protocols need to be mindful of park capacity, expertise, staff turnover, and ease of replicibility. In addition to field methods these protocols should outline training, quality control/quality assurance, data management, and data analysis requirements.

Conclusion

This brief paper is meant to highlight some common Parks Canada monitoring needs that are shared by all national parks in Ontario. Action on these issues can occur at a park scale, a regional scale, or a provincial scale as opportunities arise. Parks Canada is especially willing to invest in these areas leading up to 2008 (our end point for the current round of Parks Canada ecological integrity funding). For more information or to discuss moving forward with joint projects please contact the lead author.

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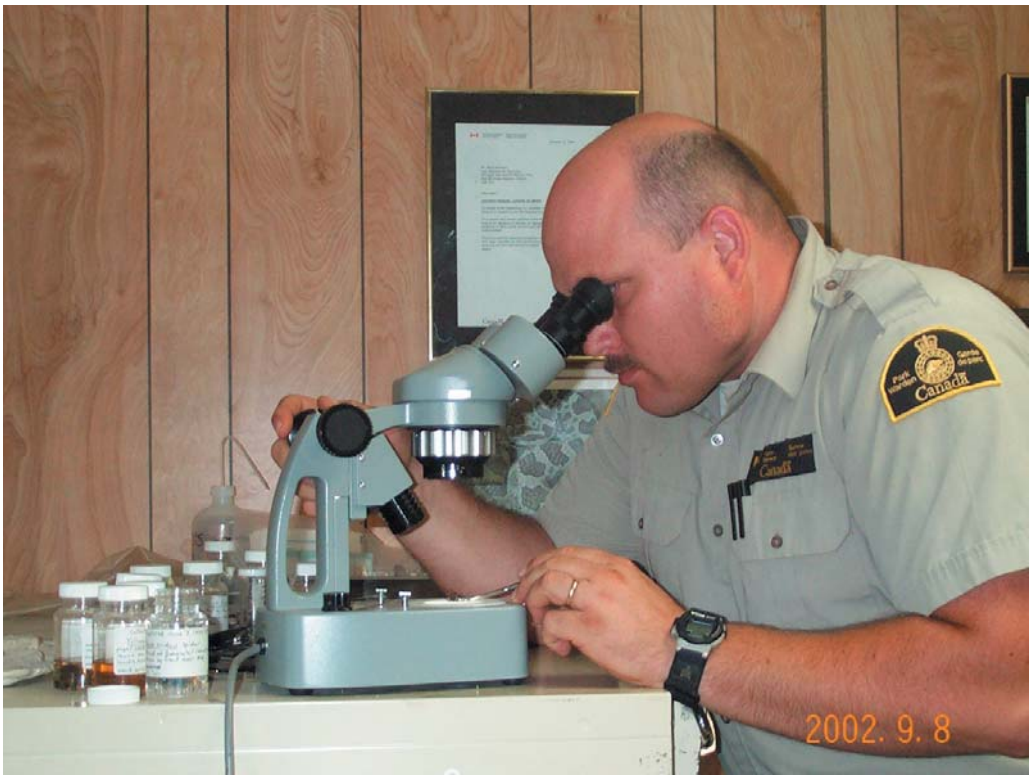
Appendices



Warden with microscope at Georgian Bay Islands National Park. (Photo by D. Upton)

Highlights from Workshop Case Studies

In order to facilitate a discussion of common monitoring needs and solutions for Ontario Parks and Parks Canada, a series of breakout sessions were held that focused on four specific case studies: 1. Rondeau Provincial Park; 2. St. Lawrence Islands National Park; 3. Wabakimi Provincial Park; and, 4. Bruce Peninsula National Park. For each case study groups discussed real management issues at the focus park within the context of that park's existing capacity and programs. The intent was, by focusing on specific parks, that management and operational issues pertaining to ecological integrity monitoring would be identified that may not have been highlighted during a more general discussion. The discussions were guided by the following list of questions and answers to these questions were used to scope out specific action items and areas for collaboration.

What to monitor and why?

1. How can the link between monitoring and management be improved?
2. How can we ensure that the right monitoring objectives target the right management questions?
3. Given limited capacity, how should monitoring priorities (and management questions) be set?
4. How should we identify the appropriate monitoring indicators and measures (i.e., conceptual ecosystem models, natural and social science research)?

Who should do the monitoring?

1. Can the effort of monitoring be cost shared among partners? If yes, how?
2. How can protected area agencies better collaborate to enhance our capacity to monitor?
3. What should be the role of universities?
4. How can we build effective partnerships and local, regional and provincial scales to develop and implement monitoring programs?
5. How can we minimize staff turnover in technician positions so we can attract and maintain well-trained, experienced staff?
6. How can we provide cost-effective training and quality control standards for the implementation of monitoring programs?
7. How can the long term sustainability of monitoring programs be improved?

How, where and when should monitoring be conducted?

1. Are our natural resource inventories of sufficient coverage, scale and quality to adequately inform where we should locate monitoring stations? If no, how can our inventories be improved?
2. How should sampling designs for monitoring indicators / measures be developed? Is there a way to integrate designs from multiple indicators / measures within or among parks?
3. How should we identify appropriate sampling frames (i.e., minimum detectable change, confidence levels, statistical power, sample size, sampling frequency)?
4. How can we improve the identification and use of standardized monitoring protocols?
5. How can we improve data management, access and sharing?
6. Should there be (can there be) a standard process or set of criteria to identify monitoring thresholds and targets?
7. How can we improve the communications aspects of monitoring to better engage staff (including managers), protected areas agencies, and partners?

Potential actions items that resulted from these discussions included the following:

- Collaboration in an ecological stress identification exercise to identify key stressors impacting ecological integrity throughout the province;
- Development of a shared monitoring database that contains data, protocols and study design information for existing monitoring programs implemented in provincial and national parks throughout Ontario;
- Provision of joint training opportunities for park staff from both agencies on monitoring protocols of various types;
- Identification of "regional clusters" of national and provincial parks as pilot projects. These pilot projects would include efforts to collaborate on a standardized approach to monitoring across protected areas including selection of indicators and monitoring measures, study design, data management, analysis, communication, and integration with the management process; and,
- Collaboration on data mining of existing information sources external to Ontario Parks and Parks Canada in order to identify low-cost sources of monitoring information.

These suggestions are intended to provide a starting point for specific partnerships between Ontario Parks and Parks Canada as each agency moves forward with its development of their ecological integrity monitoring program.

Author Biographical Statements

this list includes **lead authors only and is presented in alphabetical order.*

Tim Bellhouse
Tim Bellhouse received a BSc from the University of Guelph in 1976 and an MSc from Laurentian University in 1991. Over the past 30 years, Tim has worked throughout the province of Ontario on a variety of projects related to fisheries, and wildlife, with an emphasis on ungulate habitat and populations. Since 2001, Tim has held the position of Senior Monitoring Ecologist with the Planning and Research Section of Ontario Parks in Peterborough, where he is involved in the development of monitoring and state of protected areas reporting.

Bill Crins
Bill Crins obtained a B.Sc. degree from the University of Guelph, and MSc and PhD degrees from the University of Toronto. He then held post-doctoral positions at UBC and the New York State Museum in Albany. His research has included evolutionary and ecological studies of sedges, grasses, and tarweeds (sunflower relatives). After post-graduate work, he worked as an environmental consultant, and for the past 15 years, as an ecologist with the Ontario Ministry of Natural Resources. He now holds the position of Senior Conservation Ecologist in the Planning and Research Section of Ontario Parks, in Peterborough.

Paul Gray
Paul Gray attended the University of Waterloo and York University. He has worked on a variety of natural asset management projects in Ontario, Alberta, the Northwest Territories, and Zimbabwe. He is currently a Senior Program Advisor, Applied Research and Development Branch, Ontario Ministry of Natural Resources (OMNR).

François Marineau
Francois is the acting manager of the Heritage Planning section of the Ontario Service Centre (Parks Canada) in Cornwall, Ontario. Francois has been involved in the management planning and consultation process for national parks and national historic sites for years, particularly in eastern Canada.

Donald McLennan
Donald McLennan is currently the National Monitoring Ecologist for Parks Canada. Donald is responsible for the development and coordination of Parks Canada's entire ecological integrity monitoring program. Donald has been with Parks Canada for 3 years. Prior to joining Parks Canada Donald managed an environmental consulting firm in B.C. for over 20 years.

Dan Paleczny
Dan worked at the Ministry of Natural Resources and Ontario Parks at park, district, regional and main office levels over the last 20 years. For the past five years, Dan has been the Resource Management Coordinator for Ontario Parks, and Project Coordinator for OMNR Strategic Directions Project. Currently, Dan is on a three year assignment with IUCN-World Conservation Union as International Co-manager at Wadi El Rayan Protected Area in Egypt. Dan is also pursuing his PhD part-time through the International Centre for Protected Landscape, UK, in the field of protected area assessment and reporting.

Mark Yeates
Mark Yeates is the acting Manager of the Ecosystem Conservation Section in the Ontario Service Centre, Parks Canada. Concurrent to this position, Mark also functions as Parks Canada's environmental assessment coordinator for Ontario. Mark has approximately 20 years professional experience with Parks Canada at a number of sites across the country.

Paul Zorn
Paul Zorn is a Monitoring Ecologist for the Ontario Service Centre, Parks Canada and is the Great Lakes Bioregion Coordinator. Paul has 12 years experience with Parks Canada and is a PhD candidate with the Department of Biology, Carleton University.

Original Program

Ontario Parks – Parks Canada Monitoring Workshop
Waterfront Holiday Inn, Peterborough, Ontario
January 11th-13th, 2005

Workshop Agenda

Day 1 – Tuesday, January 11th, 2005, Garden Court

9:00 – 12:00: Power Analysis Training Session, Regency C	*Paul Zorn, Regional Conservation Biologist — Parks Canada* Those attending the power analysis training session will register for the workshop at the beginning of the training session. Lunch will be provided for participants.
12:00 – 1:00: Workshop Registration	Select morning session for Day 2.
1:00 – 1:15: Opening Remarks	*Barton Feilders, Manager, Planning and Research Section — Ontario Parks*
1:15 – 1:45: Adaptive Management: Concepts and Framework for Workshop	*Paul Gray, Senior Programme Advisor — Ontario Parks* Adaptive management - concepts and principles.
1:45 – 2:45: Protected Areas: Context for Planning and Management	*Mark Yeates, A/Manager Ecosystem Conservation Section — Parks Canada* Legislation, policy, management planning and project-level evaluations in the context of adaptive management. *Bill Crins, Senior Conservation Ecologist — Ontario Parks* Parks Canada overview on policy and planning needs in the context of adaptive management.
2:45 – 3:00: Refreshment Break	
3:00 – 4:00: Policy and Planning Context	*Dan Paleczny, Resource Management Coordinator — Ontario Parks* Legislation, policy, management planning and project-level evaluations in the context of adaptive management. *François Marineau, Protected Heritage Areas Planner — Parks Canada* Parks Canada overview on policy and planning needs in the context of adaptive management.
4:00 – 5:00: Monitoring in Parks and Protected Areas	*Paul Zorn, Regional Conservation Biologist — Parks Canada* Monitoring for ecological integrity and State of the Parks reporting. *Tim Bellhouse, Senior Monitoring Ecologist — Ontario Parks* Monitoring for ecological sustainability in Ontario Parks.

6:00 – 7:00: Refreshments and Poster session

7:00 – 10:00: Buffet Dinner in the Garden Court

Day 2 – Wednesday, January 12th, 2005, Garden Court

8:30 – 8:45: Plenary

Introduction and context for morning sessions — *Paul Zorn*

8:45 – 10:00: Concurrent Workshop Sessions

In these concurrent breakout sessions staff will be presented with the concepts and will discuss the needs from the perspectives of Parks Canada and Ontario Parks.

Session 1A — Modelling and Stress Identification, Regency A

Ecosystem Modelling in Parks Canada — *Donald McLennan*

Stress Identification in Ontario Parks — *Tim Bellhouse*

Session 2A — Monitoring, Inventory and Research Needs, Regency B

Monitoring, Inventory and Research Needs in Parks Canada — *Paul Zorn*

Monitoring, Inventory and Research Needs in Ontario Parks — *Dan Mulrooney, Rob Davis and Jennie Aikman*

10:00 – 10:30: Refreshment Break

10:30 – 12:00: Concurrent Workshop Sessions

Session 1A — Modelling and Stress Identification, Regency A

Group Discussion: Common needs and approach, scale and opportunities for cooperation and collaboration.

Session 2A — Monitoring, Inventory and Research Needs, Regency B

Group Discussion: Common needs, approach, priorities for research and monitoring.

12:00 – 1:00: Lunch, Garden Court

1:00 – 1:15: Plenary

Introduction and context for afternoon sessions — *Paul Zorn*

1:15 – 3:15: Breakout Groups

Case Studies

Case Study 1: Rondeau Provincial Park
Case Study 2: St. Lawrence Islands National Park
Case Study 3: Neyes Provincial Park
Case Study 4: Bruce Peninsula National Park

3:15 – 3:45: Refreshment Break

3:45 – 4:45: Plenary Breakout groups report back

Day 3 – Thursday, January 13th, 2005, Garden Court

8:30 – 8:45: Plenary Introduction and context for morning sessions.

8:45 – 10:00: Breakout groups Prioritizing needs and setting actions.

Participants return to their assigned breakout groups to prioritise the top six monitoring needs identified during the afternoon session on Day 2. Groups will identify appropriate actions for responding to each need to guide work planning.

10:00 – 10:15: Refreshment Break

10:15 – 11:15: Plenary Breakout groups report back.

A participant from each of the breakout groups will report their group's top six priorities for future monitoring needs. Facilitators will summarize the results from each group to determine an overall top six needs from the workshop.

11:15 – 11:45: Summary Remarks *Ontario Parks and Parks Canada*

A discussion of the results of the workshop. Will addressing these needs help us in achieving adaptive management?

11:45 – 12:00: Closing Remarks

12:00: Workshop Adjourned

Workshop Participant List

Ontario Parks

Burke Korol
Dan Mulrooney
Karen Hartley
Steve Kingston
John Fisher
Graham Cameron
Jennie Aikman
Bill Crins
Dan Paleczny
Mike McMurty
Sue Grigg
Erin Mosely
Roel Teunissen
Clement Reid
Ed Morris
Paul Gray
Tim Bellhouse
Brian Kutas
Brandan Woodward
Corina Brdar
Jim Murphy
Rob Davis
Will Kershaw
David Coulas
Stephanie Janetos

Parks Canada

Andrew Promaine
Lynn Parent
Gord Giffin
Paul Zorn
Donald McLennan
Gary Mouland
Jeff Leggo
John Taylor
Geordan Harvey
Angus McLeod
Keith Wade
Francois Marineau
Adrienne Shaw
Frank Burrows
Josh Van Wieren

Parks Research Forum of Ontario

J. Gordon Nelson

PRFO Publication Policy

As a core operating principle, the Parks Research Forum of Ontario (PRFO) places a high priority on the timely publication of quality proceedings from the Annual General Meetings (AGMs), state-of-the-art workshops, and other collaborative ventures with which it is involved. By design, the topical scope of PRFO publications is wide ranging and encompasses the natural sciences, cultural and social sciences, economics and other related disciplinary endeavours associated with conserving, planning, managing, and decision-making for parks and other protected areas. This wide sweep derives from the goals and objectives, and the operating principles of PRFO, which recognize that 'conservation research' must be viewed in a very comprehensive fashion to address fully the needs for protected area planning and management.

Since its inception in 1996, PRFO has published more than 500 papers. Many report on work in Ontario, and are of direct relevance to Ontario's needs for protected area research, planning and management. Publication standards have evolved, with continual refinement and improvement being an objective of the PRFO Steering Committee.

Ongoing improvement has been motivated by principles and accepted standards for scientific reporting, academic excellence and regular feedback from contributors, editors and the larger PRFO audience, many of whom have called for adding rigour to PRFO publications. Current style and content standards for PRFO publications are posted on the PRFO website (www.prfo.ca). Adherence to these standards provides consistency in style and reporting, and facilitates the editorial process, which is substantial when dealing with volumes such as this one. Adherence to these standards establishes a high level of discipline for contributors, especially the many student and agency-based contributors who gain valuable experience in professional reporting. However, in striving for excellence, there is the reality of time and resources coupled with colloquial expression and style, which not uncommonly appear in conference and workshop proceedings. One inevitable result is some deviations in style and format among the papers. To the extent possible, within these constraints, PRFO strives to generate a high quality product in a timely fashion. In this respect, the publications are normally subject to external or peer review.