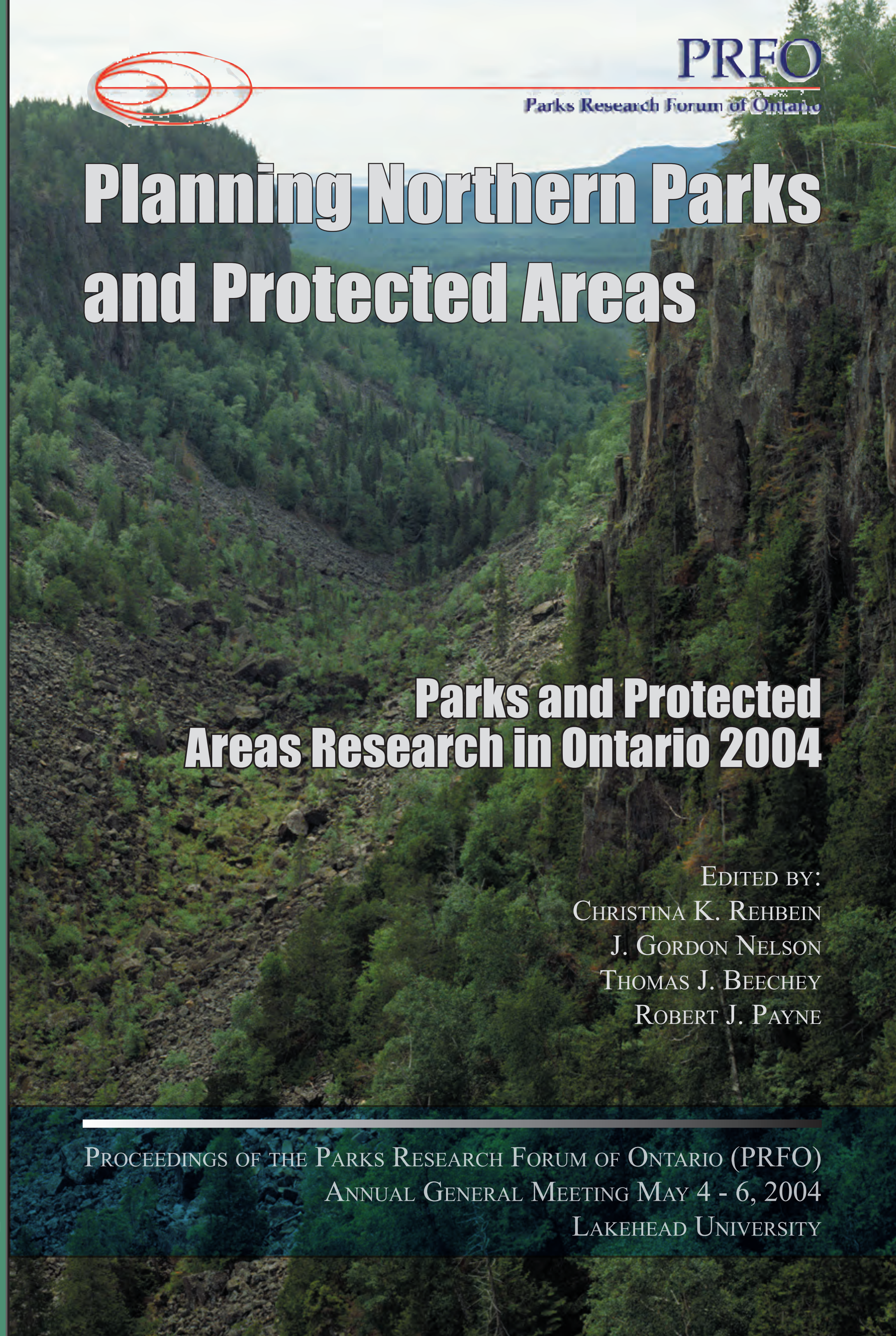

PRFO

Parks Research Forum of Ontario

Planning Northern Parks and Protected Areas

Parks and Protected Areas Research in Ontario 2004

Edited by:
Christina K. Rehbein
J. Gordon Nelson
Thomas J. Beechey
Robert J. Payne

Proceedings of the Parks Research Forum of Ontario (PRFO)
Annual General Meeting May 4 - 6, 2004
Lakehead University

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Overview
The Parks Research Forum of Ontario (PRFO)

The Parks Research Forum of Ontario (PRFO) encourages research applying to parks and protected areas. The objectives of PRFO are to:

- promote research to improve understanding, planning, management and decision making for parks and protected areas;
- encourage related educational and training activities;
- facilitate more cooperation in parks and protected areas research;
- encourage regular exchange of information on parks and protected areas research; and,
- monitor and report on such research.

The aims of the PRFO 2004 conference, *Planning Northern Parks and Protected Areas* were to:

- identify common challenges facing researchers, planners and managers working in parks and protected areas in Northern Ontario;
- identify and prioritize needs for social and ecological research in parks and protected areas in Northern Ontario;
- identify opportunities for collaboration; and,
- provide an opportunity for presentation and discussion of a wide range of research on parks and protected areas.

PRFO 2004 Steering Committee

Gordon Nelson - Chair, University of Waterloo

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Tom Beechey - Canadian Council on Ecological Areas

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John Marsh - Trent University

[1]Representative at time of 2004 meeting. New Ontario Parks representative is Rob Davis.

[2]Representative at time of 2004 meeting. New Parks Canada representative is Paul Zorn.

Acknowledgements

Sable Island Provincial Nature Reserve (T. Beechey)

We would like to thank all those people who helped make PRFO 2004 possible. This was the first PRFO meeting in the North so very special thanks are owed to Bob Payne and his colleagues and supporters at our host, Lakehead University. We also owe special thanks to Stephanie Janetos, then coordinator of PRFO for all her careful efforts to organize registrations, logistics, and other arrangements. And we owe many thanks to all the people who presented papers and attended the meeting. We also acknowledge the strong financial and general support of Ontario Parks and Parks Canada for PRFO's program.

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Introduction
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The lakes and boreal forests of the province's North have attracted a variety of people: First Nations; industry; energy developers; wilderness-seekers. Looking beyond the majesty of the pine, spruce and fir reveals an ecosystem both resilient and fragile. Constantly battered by wind, fire and insect predation, the boreal forest has grown up tough. However, new challenges are being introduced: climate change; fragmentation by forestry; and mining proposals. The resulting loss of species integral to the forest ecosystem is revealing the underlying vulnerability of the system. Developing a functional system of parks and protected areas in the North is central to the persistence of this unique environment, of which Ontario is an important steward.

The past five years have seen a surge of interest in the province's North. *Ontario's Living Legacy* (OLL) identified several northern "signature areas" such as Lake Nipigon. Another spinoff of the Living Legacy discussions was the creation of the *Great Lakes Heritage Coast*, which is focused on protection and management of the shorelines of Lake Superior, Lake Huron's North Channel and Georgian Bay. The Canadian Parks and Wilderness Society's Boreal Campaign raises awareness of the ecological importance of the boreal forest system not only in Ontario, but across northern Canada. PRFO 2004 draws on experience from many different park and protected area initiatives taking place in northern Ontario in order to identify significant research opportunities and challenges for parks and protected areas in the North.

Planning Northern Parks and Protected Areas, the theme of this year's annual conference, also reflects a growing concern among the international community. Canada's boreal forest is one of the largest intact forests left on the planet; much of this ecosystem lies within Ontario's boundaries.

Since the PRFO 2004 meeting at Lakehead, this interest in the northern forests has not abated; rather, it has grown stronger. A resolution was passed at the World Conservation Congress in Bangkok in November 2004, urging the Canadian government to take greater action to protect its boreal region. This includes both the creation of more protected areas as well as improved management of these areas. Calls for more protected areas must be answered by educated decisions regarding the size and location of the new areas, while management strategies can be improved through shared experience and research.

Achieving parks and protected area goals cannot be achieved without both ecological and social research. Physical science is important: research into fire management reveals new strategies for park managers learning to deal with sucessional processes. Climate change researchers can add to knowledge about the ecological and socio-economic dimensions of this challenge. Examining past species distributions can help develop management plans for the future. Social research is imperative: awareness is building that governments cannot protect areas without the support and combined knowledge of community, industry, and indigenous peoples.

Many of these concerns were suggested to potential speakers at the PRFO 2004 conference, under the headings of: 'Climate Change'; 'International Perspectives'; 'Monitoring'; 'Implications and Approaches to Disturbances'; 'Integrative Approaches'; 'Fire and Management'; and, 'People and Protected Areas'. At the conference, a set of related themes emerged: 'Disturbance Processes'; 'Climate Change'; 'Species Protection and Conservation'; 'Monitoring, Assessment and Planning'; and, 'Human Dimensions'.

Disturbance Processes are critical for maintenance of boreal ecosystems, but forced adaptation to new and human-induced disturbances creates some threats. *Climate Change* is seen as a disturbance process accelerated by human actitivies and as having a very high impact on the North. Research on *Species Protection and Conservation* involves efforts to curb the loss of species across Ontario, such as amphibians, reptiles, and disturbance-sensitive or wide-ranging mammals. *Monitoring, Assessment and Planning* involves research which basically provides knowledge of the past and guidance for the future. *Human Dimensions* research includes studies on interpretation, the integration of social science into park planning, First Nations, and fire policy. All of these papers are relevant not only to the North, but to parks generally in Ontario.

A special *Workshop on Social and Economic Benefits of Provincial Parks* was offered in the concluding session of the PRFO 2004 conference. This workshop essentially involved a summary and evaluation of socio-economic research which had been organized by Ontario Parks. In general, the commentators and the participants in the workshop saw much value in the study, although a number of their comments undoubtedly will be used to improve the results and their application in Ontario.

To conclude, it seems that the set of papers in this volume represent another significant indication of the importance of research to understanding, planning, management and decision-making for provincial, national and other parks and protected areas in Ontario as well as their contribution to environmental conservation and sustainable development generally. The experiences of leading professionals in the protected area field can aid others struggling with similar problems, whether in the boreal or elsewhere. Conferences such as this can build networks among researchers, planners, managers, educators, NGOs and the people working on the ground. Such conferences can disseminate innovative solutions, identify research needs, and promote useful collaboration among stakeholders.

Christina Rehbein, for the Editors and Steering Committee
Parks Research Forum of Ontario (PRFO)

Theme Papers

Planning Northern Parks and Protected Areas

~~Agawa Valley, Lake Superior Provincial Park (T. Beechey)~~

Three Protected Areas Divided by a Common History: Management and Research in Quetico Provincial Park, the Boundary Waters Canoe Area Wilderness and Voyageurs National Park

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[1]School of Planning, University of Waterloo
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Abstract

Two hundred years ago, when explorer David Thompson travelled through what is now Quetico Provincial Park, fur traders from Lower Canada and the U.S.A. were informally defining a future international border that would divide a natural forest region. Seven decades after the 1829 border treaty, conservationists would begin to lever pieces of the landscape from the extractive matrix to create the contiguous oases of Quetico Provincial Park, the Boundary Waters Canoe Area Wilderness (BWCA), and Voyageurs National Park. They comprise almost 1 million ha, arguably the largest such area in North America outside of the far North. Though these three areas share a biophysical region, the international border bisects them, and a province, a state, and several agencies administer them. However, there is active formal and informal co-operation between managers of the three. The parks and their dependent communities vary distinctly. For instance, Ely in the BWCA, and Atikokan near Quetico have radically different economic needs, and government budgets for research are much larger for the US parks than for Quetico. Thus, in an era of prolonged Canadian government fiscal restraint, Quetico's research requirements are being augmented by a vibrant informal coalition of interests that includes the Quetico Foundation, the Friends of Quetico, Ontario Nature, the Legacy Forest centred on Lakehead University, and the University of Waterloo. These complement a thriving American NGO sector serving the needs of the BWCA and Voyageurs National Park. In this

climate there are growing needs and opportunities for co-operation across a border that is, to nature at least, a human artifice.

Three Parks in Two Countries, Under Three Agencies and Two Levels of Government

The frontier between Canada's province of Ontario and America's state of Minnesota is a fascinating and challenging place in which to manage protected areas. This geographic centre of North America encompasses a cluster of protected areas on both sides of the Canada-U.S. border: Canada's Quetico Provincial Park, and the Boundary Waters Canoe Area Wilderness (BWCAW or BWCA) and Voyageurs National Park in the U.S.A. We shall argue that they share sufficient similarities to be considered as a single region, but they also exhibit differences that might be more easily resolved if they were managed in a more co-ordinated fashion. Important management and research activities can be enhanced by recognizing this natural unity.

Quetico Provincial Park, a huge designated wilderness, abuts the Boundary Waters Canoe Area Wilderness (BWCA) to the south, situated on U.S. federal land (Figure 1). The BWCA is embedded in the Superior National Forest, and the United States Department of Agriculture Forest Service runs both of these. To the west of the BWCA lies the Voyageurs National Park, run by the U.S. National Parks Service of the Department of the Interior. The core of this huge contiguous protected area totals nearly 1 million ha in aggregate, thus encompassing two nations, a provincial government, a state government, and several management agencies (Table 1). The greater area including the Quetico Superior National Forest is more than 2.5 million ha, arguably the largest such area in North America outside of the far North. Kutas *et al.* (2002) have termed this shared area the Northwoods Wilderness Frontier.

Anybody living here before European contact must have perceived this area not as a frontier between nations, but as a single region. Throughout the area, hard, ancient Laurentian Shield rock has been reduced to a peneplain by quaternary glaciations, and smeared with eskers and moraines. Glacial Lake Agassiz once flooded most of the area, and a myriad of modern deep lakes and shallow wetlands is seen throughout. The soils are mostly thin, light, and podzolic with a surface layer of loess on the uplands, and organic soil in any wet hollow. The climate is universally continental, with frigid winters and relatively cool summers, but there is a gradual increase in warmth to the south and increased pre-

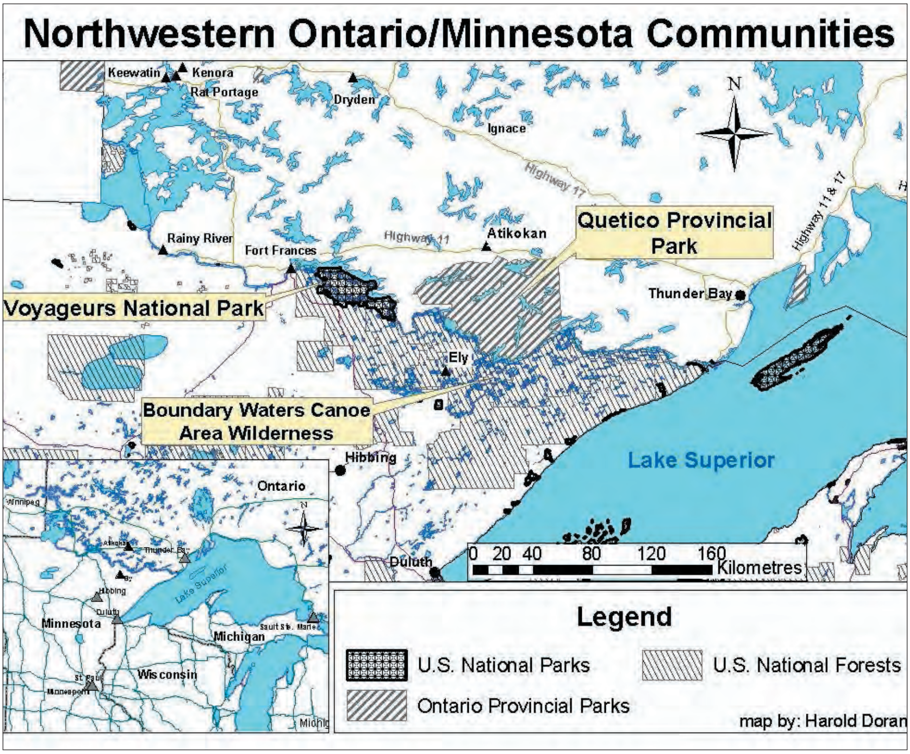

Figure 1. *The Northwoods Wilderness Frontier.*

Table 1. *Jurisdictional framework of the Northwoods Wilderness Frontier protected areas.*

Protected Area	Area (ha)	Nation	Province/State	Managing Agency	Level of Agency
Quetico Provincial Park	475 782	Canada	Ontario	Ontario Parks (Ontario Ministry of Natural Resources)	Provincial
Boundary Waters Canoe Area Wilderness (BWCA)	327 957	U.S.A.	Minnesota	U.S. Forest Service (USDA)	Federal
Voyageurs National Park	88 371	U.S.A.	Minnesota	U.S. Department of the Interior (National Parks Service)	Federal
Aggregate area	892 110				

cipitation towards the east. Likewise the vegetation grades imperceptibly from boreal forest in the North to Great Lakes mixed forest in the south, with prairie remnants in the southwest reflecting a drier climate. The singular biophysical nature of the frontier area has been examined by Kronberg *et al.* (1998).

Within this broadly uniform biophysical matrix, it was natural that one group of pre-Columbian people, the Ojibwa (Chippewa), should inhabit most of the area and follow a single hunting and gathering lifestyle. By using canoes on the network of lakes and rivers, they moved freely throughout the area, and often far beyond. However, with the exception of the Rainy River, none of the above remotely informs or influences the modern international boundary.

When explorer and mapmaker David Thompson charted the waterways on both sides of the present border in 1804, fur traders from Lower Canada (Quebec), Britain and the U.S.A. were already competing to dominate this natural region. The Hudson's Bay Company fur traders from Britain were accessing the area from the arctic coast of modern Ontario. More important in this context, Thompson's Northwest Company in Montreal depended on controlling this area. Every spring, their heavily laden canoes laboured west along the newly thawed shores of the upper Great Lakes to the head of Lake Superior. Other brigades loaded with furs paddled east from numerous posts in the far interior, converging along the Rainy River before arriving at Grand Marais or, in later years, at Fort William (Thunder Bay). This halfway point on Lake Superior was the site of the great 'Rendezvous', the social pivot around which the otherwise tedious year revolved, and where the furs and manufactured goods were exchanged.

From the upper reaches of the Mississippi, Jacob Astor's American Fur Company and other American fur traders were also penetrating the region, intent on establishing a north-south axis (Haeger, 1991). Thus Americans and future Canadians contended for boundary waters that were key both to fur trade wealth and to access much of the western continent. The eventual border treaty of 1818 shared the Rainy River, setting the stage for today's divided ecological region. However, the border situation remained ill-defined until the 1842 *Webster-Ashburn Treaty* which permitted citizens of both countries to cross the border and use portages on both sides without limits or duties. This provision, designed to facilitate travel along the length of the border, unwittingly set the framework for today's north-south cross-border recreational canoeing.

Several towns on Lake Superior grew from early fur trading posts. Fort William and Port Arthur (memorialised at Old Fort William in Thunder Bay) became the entrepot for the Canadian trade, while Grand Marais in Minnesota (Grand Portage National Monument) was the parallel American centre.

From the 1890s the focus of the economy changed from gathering furs to extraction of timber. The original water routes were eventually replaced by rail lines, laid in nationalistic fashion, and thus reinforcing the east-west border effect. Development was further accelerated by development of iron ore deposits on both sides of the border, with production exported through Lake Superior to the east. After World War II in particular, a new paved road network paralleled the previous rail connections (e.g., Ontario's Highway 11 which follows the CNR rail line). All the new institutions, from native treaties to timber berths to rail lines, tended to reflect and reinforce trade and national influences that had created the border. In later years, the presence of the three protected areas obliged the road network to go around them rather than directly across the border and this, too, reinforces the east-west border effect.

Seven decades after the 1842 treaty, conservationists began to lever fragments of landscape from the extractive matrix to create the oases of Quetico (1913), the BWCA (Superior National Forest 1909, BWCA 1978), and Voyaguers National Park (1971). New pieces are still being added such as La Verendrye Provincial Park Reserve (18 280 ha) and a recent Nature Conservancy purchase on the Pigeon River. Likewise, Grand Portage State Park in Minnesota (113 ha) was added in 1989. In addition the boundary waters were declared a heritage waterway in 1996 by the Canadian government (CHRS, nd.).

Differences Between the Three Protected Areas

The three protected areas and their dependent communities vary distinctly, and this is nowhere better illustrated than by Ely in the BWCA and Atikokan near Quetico.

Ely, a former mining town, has been economically re-invigorated in the last decade by outfitters, outdoor stores, artisans, restaurants and hotels. This community has been dramatically successful in its transition from mining to a vibrant tourism economy, which is aided by its proximity to the conurbation of Minneapolis-St. Paul. Ely services the Boundary Waters, Quetico and a growing market of local cottages and retirement homes.

Atikokan, the equivalent service point for the northern edge of Quetico Park, also suffered after its two iron mines closed by the early 1980s (Suffling, 2003), and currently faces serious challenges in the forest industry as well as the threatened closure of its coal-fired power plant. Atikokan is much further from major cities than is Ely and it has a much smaller cottage/retirement home catchment. All of these pressures shrank the population from 4,043 in 1996 to 3,632 in 2001 (Statistics Canada census figures). Though Atikokan has worked diligently to promote itself as the 'Canoeing Capital of Canada', support for tourism is not universal and the town's efforts have not proven as successful as those of Ely. For some residents, the park is still a negative presence that prohibits most motor boats and restricts logging.

Principal among numerous factors contributing to this economic situation are the logistics of tourist access (Suffling, 2003). Between 75 and 78% of Quetico visitors were non-residents in the years 2001-2004 and the vast majority of these were Americans. Likewise, in the same period, between 56 and 59% of visitors entered the park form the Prairie Portage and Cache Bay entry points on the U.S. border (Quetico Park, 2004). Those who do enter Quetico through Canada are obliged to undertake a long drive around Quetico. Many of these are so called 'Pork and Beaners' who bring their supplies with them, spend most of their time wilderness tripping in Quetico Park, and buy little in town. Further, Atikokan faces severe challenges relating to lack of infrastructure, such as a scheduled air service, and dearth of capital. Options to limit Quetico camping permits to Canadian outfitters are also severely constrained by provisions of the *North American Free Trade Agreement*, so that most of the tourism revenue attributable to the park accrues to entrepreneurs on the American side of the border.

The conservation milieu also varies distinctly in the three parks. Because most usage of these areas comes from the U.S., the environmental pressures are much more severe on that side of the border. Consequently one sees recurring political tussles on the U.S. side concerning permissible types, locations and intensities of activity (Duncan and Proescholdt, 1999). The management challenge here is to regulate the number of visitors in the face of overwhelming demand, and to prevent the area from being 'loved to death'. However, Voyageur and Boundary Waters have vastly more staff, money and resources than Quetico, and so they can be much more active in addressing environmental deterioration. For instance, hardened campsites are common in the BWCA and Voyaguers but absent in Quetico. Similarly, Voyageur and Boundary Waters have been active in maintaining and restoring early cabins and warden patrol huts whereas Quetico has knocked most of these down in an effort to enhance and maintain wilderness conditions. Thus conservationists jealously guard the relatively pristine nature of Quetico, but the challenge for the Canadian tourist industry is to increase regional economic activity. Current efforts focus on stimulating shoulder season visitation in spring and especially fall, as well as developing the winter activities that are so popular in the two U.S. areas.

The three parks are staffed and supported differently. Quetico, with the smallest number of visitors (Table 2), is unique in having a financial surplus that reflects a small payroll dictated by a small budget, as well as much higher user fees.

Table 2. *Visitation in the Northwoods Wilderness Frontier protected areas.*

Protected Area	Visitation
BWCA	ca. 200,000[1]
Quetico Provincial Park	17,971 (2001)[2]
Voyageurs National Park	249,853 (2001)[3]

[1]Boston, pers. com., 2004. Total annual users.

[2]Quetico Park (2004). This statistic is for backcountry users and does not include roadside campers at the French Lake Camp Ground.

[3]Uhler (2003)

Likewise, BWCA and Voyageurs have substantial research budgets whereas Quetico has virtually none. All three areas have active organisations looking out for their conservation interests – The Quetico Foundation and The Friends of Quetico Provincial Park in Canada, and The Friends of the BWCA, the Quetico-Superior Foundation and The Friends of Voyageurs National Park in the U.S.A.). The style of these organizations has been distinctly affected by their histories. The Quetico Foundation, established in 1954, has been closely involved with promoting wilderness designation and controlling timber extraction. In contrast, recreational activities (including motor boat use) were already entrenched in 1978 when the BWCA was declared. As a result the focus on the Canadian side has been on retaining true wilderness while, south of the border, the issue has been to re-establish wild areas. As with government funding, the budgets of the conservation organisations differ by orders of magnitude between Quetico and the American protected areas.

The activities and tourist economy of Voyageurs National Park differ from the other two areas. While Voyageurs National Park shares snowmobiling popularity with parts of the Superior National Forest, it is a centre for house boat rentals on Rainy Lake and it has less canoe tripping activity. As with the BWCA and Quetico, it draws most of its visitors from the United States, especially from the Minneapolis-St. Paul area. The park is picturesque, has first class facilities, operates on a no fee basis, and is relatively little known and used by the public.

A final important difference between the three protected areas is that Ontario Parks has a much stronger political direction to earn revenue. As a result, fees are much higher and, arguably, lower income people are discouraged both by fees and remote location. In the U.S., access to wilderness tends to be regarded more as a national birthright. This sacred trust in the U.S.A. results in lower fees and higher tax revenue support. The government model for Quetico is to charge U.S. visitors a substantial fee to generate profit. The Ontario resident is welcome to use the park too, and Ontario benefits from the conservation value, which is increasingly being defined as the primary goal (e.g., Ontario Parks, 2004). Tourism and related revenue seem irrelevant to the U.S. areas. For instance, Canadians could use Voyageurs National Park at no cost, but virtually none do so.

Common Management Interests

Though these protected areas are divided between two national governments, a province, a state, and several agencies, there is active formal and informal co-operation between them.

The so-called 'Independence Day Blowdown' of July 4, 1999 serves as an interesting illustration. This violent cold front disrupted about 193 000 ha of forest in Minnesota (Superior National Forest, 2004) and also substantially affected the southern interior of Quetico. The storm left huge fuel loads arising from blow-down in forests on both sides of the border with consequent mutual concerns about fire. Current management thinking indicates a series of prescribed fires to reduce fuel, to promote desirable forest regeneration and to generate regional scale impediments to fire spread. The difficulty for the BWCA lay in the legislated demands of the environmental assessment (EIA) process as well as the complications posed by inholdings of private land (USDA, 2001). The Canadian regulatory environment was more flexible in this respect, allowing the first prescribed burn, at Emerald Lake, to proceed in October 2002. This, in effect, served as a demonstration project for the U.S. authorities and interest groups, enabling their EIA process to proceed with more certitude.

Conversely, much larger budgets in the U.S. areas have allowed considerable research on the blow-down (e.g., see list in Gilmore, 2004), with benefits for managers on both sides of the border. The smaller volume of Canadian material was concentrated on the prescribed burn sites alluded to above (e.g., Beverly and Martell, 2003).

Similarly, dogsledding could benefit the Atikokan tourist economy, but it has impacts. Little research has been conducted on the environmental impact of this activity but dogs do create volumes of faeces and require hay bedding. Sledding has been popular for years in the U.S. parks but almost unknown in Quetico, so that the Canadian park can benefit from U.S. experience.

Managers in each jurisdiction try to reach beyond the silos of their respective organisations. During 2003 and 2004, for example, they undertook to share GIS data despite technical and administrative barriers. Fire management is well integrated. Water levels on impounded major border lakes are set through the International Joint Commission. This body has recently been considering combining the International Lake of the Woods Board of Water Level Control, International Rainy/Namakan Lake Board of Water Level Control and the International Rainy River Pollution Board into one regulatory body (Minnesota Pollution Control Agency, 2001).

Most BWCA users also visit Quetico, and differing rules can prove confusing for these folk. For instance, aircraft cannot fly below 4,000 feet over the BWCA while, over Quetico, altitude is unregulated but planes cannot land. Thus efforts are being made to co-ordinate otherwise confusing regulations. The BWCA and Quetico already have the same canoe party size limit, so that no one has to be left behind at the border.

The three protected areas share another common interest in tourism, yet, until recently, they have marketed their products quite separately. Efforts are now under way to co-ordinate activities, as in the ‘MOMs way’ (Anon., nd.) circle route through Minnesota, Ontario and Manitoba. Nevertheless, differences remain, because BWCA has less interest in tourism, and this area has enough resident users, whereas Quetico has a strong interest in promoting the industry. The differing perspective on tourism is perhaps what most separates Voyageur and Quetico Parks from the Boundary Waters Wilderness Area. In the U.S. context, managers do not have to be as concerned about wilderness area usage.

Much more research has been conducted on the American side of the border, for reasons of accessibility, national focus, and especially funding. Some of these studies have proven to be classic works that have pervaded the North American research community generally (e.g., Heinselman, 1973). Quetico has benefited substantially from this adjacent research but lacks a critical mass of researchers to contribute a comparable body of ideas and information. There are no research stations in Quetico like the Wilderness Research Foundation station in Ely, and there is a general dearth of information that will stimulate further research activity. For instance, there has been no good set of GIS information until recently, and up-to-date vegetation maps are still in preparation.

Ontario Parks has primary responsibility for government funded research in Quetico but a loose coalition of other agencies has an interest in this park as a 'control' landscape to compare with commercially exploited forests. These interests include the Science and Technology Transfer units of the Ontario Ministry of Natural Resources, and the Canadian Forestry Service. However, such activities are characteristically episodic, as with the burst of activity following the large *Fire 141* of 1995.

The modest government funding for basic monitoring and research on Quetico has been augmented for several decades, and especially in the last ten years, by the Quetico Foundation. This small, non-profit group has an interest in wilderness and particularly in Quetico. It established the Ridley Library in Quetico, published a number of monographs on the park, and has sponsored archaeological and vegetation monitoring activities. The Friends of Quetico organisation has also supported research in the park, particularly on archaeology. The University of Waterloo has directed many students toward projects in Quetico, and Atikokan High School's innovative program in GIS has undertaken many projects. Ontario Nature (The Federation of Ontario Naturalists) *Volunteer for Nature Program* has also begun to support research in Quetico.

From the U.S. side, the Wilderness Research Foundation has contributed to research in both Boundary Waters and Quetico, while the Nature Conservancy of Minnesota has a major research project that models fire behaviour and vegetation change. Quetico is also a key park of the Border Lakes Study Area for the *Joint Fire Studies* network (see list of work in Gilmore, 2004). A further major research initiative, *The Legacy Forest*, has been co-ordinated by Lakehead University of Thunder Bay and over a dozen other partners. This project seeks to answer how the commercial forest east of Quetico responds to harvest, but it uses unlogged Quetico as a control area. This activity includes acquisition of high-resolution remote sensing data for the whole of Quetico, which may encourage integration of a range of research.

Some non-government initiatives on the Canadian side of the border are beginning to elicit considerable interest in the U.S. as cost-effective programs with potential for engaging the general public. In particular, the youth-based *Quetico Foundation Summer Program* is being examined as a model for U.S. educational programs.

Discussion

The concept of managing protected areas across boundaries is hardly new (Breymeyer *et al*., 1996; Hamilton, 1996; Danby, 1997). In fact, the notion of shared national interests in this area dates to the late 1930s or early 1940s when Quetico-Superior Foundation members in Minnesota promoted an international treaty that would have seen BWCA and Quetico managed as a single international park. The idea ran into political problems, mostly with the Canadian government.

With more intensive research and management, the shared interests and differences along the border are more relevant than ever, but the institutional and political climate for co-operation is doubly complex. Not only must managers and researchers contend with the vagaries of political fashion on both sides of the border, but issues like the *North American Free Trade Agreement* complicate the administration of fees and tourism activities. Further, the ‘war on terrorism’ and its implications for border security tend to have a chilling effect on radically innovative approaches to formal co-operation.

Thus, for the foreseeable future, we have two nationally based park systems that are used and funded to substantially differing extents. During prolonged government fiscal restraint in Canada, Quetico’s research requirements are being addressed, not only by Ontario Parks, but also by an informal coalition of interests that includes the Quetico Foundation, the Friends of Quetico, the Federation of Ontario Naturalists, the Legacy Forest at Lakehead University, and the University of Waterloo. The current discussions about new parks legislation for Ontario imply that the research and monitoring role of the Ontario government may be strengthened in future (Ontario Parks, 2004). These Ontario activities complement thriving U.S. government programs and the American NGO sector serving the needs of the BWCA and Voyageurs National Park. However, research output has been overwhelmingly nationally based, and relatively little activity bridges the U.S.-Canada border. Thus the way forward seems to be in:

1) developing common information bases for the three areas, particularly in GIS but also in metadata;
2) informal and low-level management co-operation to identify and tackle shared interests, challenges and tensions;
3) development of shared research programs and funding; and,
4) monitoring, fund raising and lobbying involvement by an international public that uses, shares and loves all three areas indiscriminately.

In this climate there are growing needs and promising opportunities for co-operation across a border that is, to nature at least, a human artifice!

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Protected Areas and the Conservation of the Boreal Forest: Contributions of Research in the Past, Present and Future

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Abstract

This paper examines the role of research in establishing and managing parks and protected areas in the past, the present and the future in the boreal zone of northern Ontario through a series of case studies. Scientific research has co-existed in an uneasy relationship with politics as bases for making decisions concerning parks and protected areas for some time. What has changed recently is the wider use of research by both public parks agencies and NGOs. Aboriginal people, specifically First Nations, have begun to assert themselves in northern Ontario and are using research to build cases in establishing parks and protected areas in their traditional territories. Future research efforts will shift from establishing parks and protected areas to a focus on how effective they are in meeting their set goals and objectives. The concern with assessing the effectiveness of parks and protected areas will be complicated by the fact that different actors will demand different things from the establishment and management of parks and protected areas.

Introduction

Although the boreal forest is receiving attention today as a significant ecosystem worthy of protection, both the Canadian federal and the Ontario governments have been involved in establishing parks and protected areas in this landscape for many years. Pukaskwa National Park was established in 1983 to protect a section of boreal forest toward the eastern end of Lake Superior. Wilderness-class provincial parks such as Woodland Caribou and Wabakimi were established in northwestern Ontario in 1983 as part of a large-scale land-use planning initiative. The *Ontario's Living Legacy* initiative identified additional parks and protected areas in the boreal forest, arguably putting Ontario in the forefront of protection initiatives across the Canadian boreal zone.

In this paper, the past and present role of research in building this system of parks and protected areas is examined. Suggestions are made concerning the future research focus that will be required if the boreal forest is to receive the level of protection that it warrants (Canadian Boreal Initiative, 2004).

Underlying the discussion here is the assumption that research in the natural, physical and social sciences will provide the basis for good decisions in establishing and managing parks and protected areas in the boreal zone. Decisions based upon sound research should be transparent and understandable. However, research that supports the establishment and management of parks and protected areas has existed in competition with politics in northern Ontario. While it can be shown that research certainly played a role in establishing and managing parks and protected areas in northern Ontario, it is also clear that politics has orchestrated a good deal of the protection initiatives. By 'politics' here, I refer to the interests of particular parties involved. In the past, representatives of the forest industry in northern Ontario have played a disproportionate role in decisions concerning park establishment. Similarly, some would argue that a coalition of environmental organizations influenced the outcome of the *Lands for Life* process (that led to *Ontario's Living Legacy*), resulting in far more protected areas than might otherwise have been the case. Politics, then, affects the perceived or real 'fairness' of the decision. For every actor perceived to have a stronger influence, there is another who feels that its concerns have been disregarded. In northern Ontario, local residents and aboriginal people have often felt that their particular interests have not been well served by decisions taken by senior governments. Political considerations will never be absent from the sort of decision making examined here, but scientific research will provide a reliable window on the process through which those decisions are taken.

In the material that follows, I examine the roles of research and politics in establishing and managing parks and protected areas in northern Ontario, and, especially, in the boreal zone. Case studies are employed to conduct this examination in the past, in the present and projected into the future.

The Role of Research in the Past

Expanding Wabakimi Provincial Park

Wabakimi Provincial Park was created in 1983, as part of Ontario's land-use planning initiative in northern Ontario. At its inception, Wabakimi encompassed 155 000 ha of boreal forest northwest of Lake Nipigon (Figure 1). The boundaries of the new wilderness class provincial park did little to ensure that its ecological integrity would be maintained. In fact, one would be hard pressed to conceive of boundaries less likely to protect natural conditions in the park. Many life and earth science features identified by the Ontario Ministry of Natural Resources' (OMNR) planners had not been included when Wabakimi was originally established. Moreover, at 155 000 ha, Wabakimi was relatively small. Forest fires of greater than 300 000 ha have been recorded in this part of northern Ontario: Wabakimi might have been burned over twice in such a fire.

It seemed that politics had been largely responsible for the shape and size of Wabakimi in 1983. Forest industry interests were reluctant to give up commercial timber areas within the proposed boundaries and were able to achieve boundaries that respected their demands.

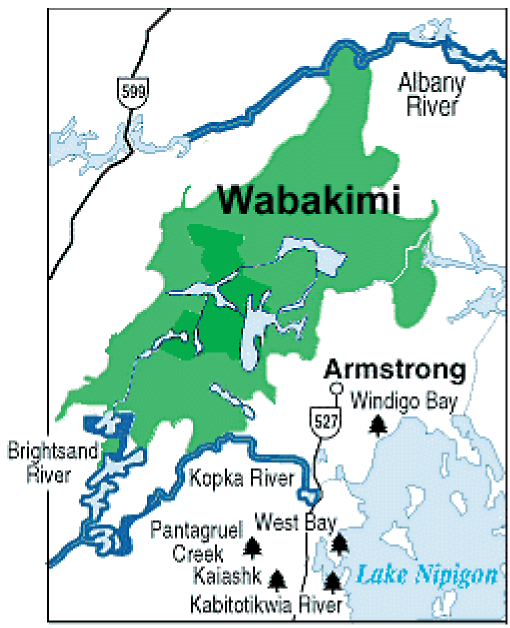

Figure 1. *Wabakimi, old and new (Source: Ontario Parks).*

Nine years later, the OMNR convened a regional committee of stakeholders to re-examine the Wabakimi boundaries. The committee was charged with the task of expanding Wabakimi's boundaries in response to the various criticisms since its establishment. Stakeholders included the forest industry, anglers and hunters, remote tourism operators, environmentalists, prospectors and local people from Armstrong, a neighbouring community. Representatives from local First Nations were invited but declined to participate, arguing that their interests went well beyond the description ‘stakeholder’.

The OMNR sought to include valuable life and earth science features in new boundaries for Wabakimi. Committee members, some of whom possessed both experience in the area and advanced levels of formal education, wanted to see the size of the park increased substantially. They proposed that prospective additional areas be rated on the basis of remoteness, watershed integrity and community (i.e., Armstrong) impact. Using these means, in 1994 the committee proposed an expanded Wabakimi Provincial Park that totalled nearly 1 million ha and connected Wabakimi to waterway class parks in the south (Kopka River and Brightsands River) and in the north (Albany River).

Science played an important role in this expansion, a more important role than it had in the park’s origins in 1983. While committee members made contributions, most of the science supporting the initiative came from the Ministry of Natural Resources. The eventual expansion of the provincial park was based upon consensus among all participants – something that is usually difficult to achieve.

Understanding Wildlife Interactions in Pukaskwa National Park

In the early 1990s, Pukaskwa National Park undertook a study on relationships among wolves (*Canis lupus*), moose (*Alces alces*) and woodland caribou (*Rangifer tarandus caribou*) (Figure 2). The research, which came to be known as the *Pukaskwa Predator-Prey Process Project* (5Ps), was a response to changing conditions outside the national park’s boundaries, especially on the north and southeast where timber removal activities, mineral exploration and the associated road-building were fragmenting the forest. The relationship between forestry activities and moose populations had long been understood, as had that between moose and wolves. However, little was known about the interactions of wolf, moose and caribou in the greater park ecosystem.

Woodland caribou are an indicator species in the boreal forest (Schaefer, 2003). They do not react well to disturbance from humans or their activities. While once they occupied much of the territory that is now Pukaskwa National Park, woodland caribou numbers have declined as timber and mining activities have increased around the park. The 5P study sought to determine what proportion

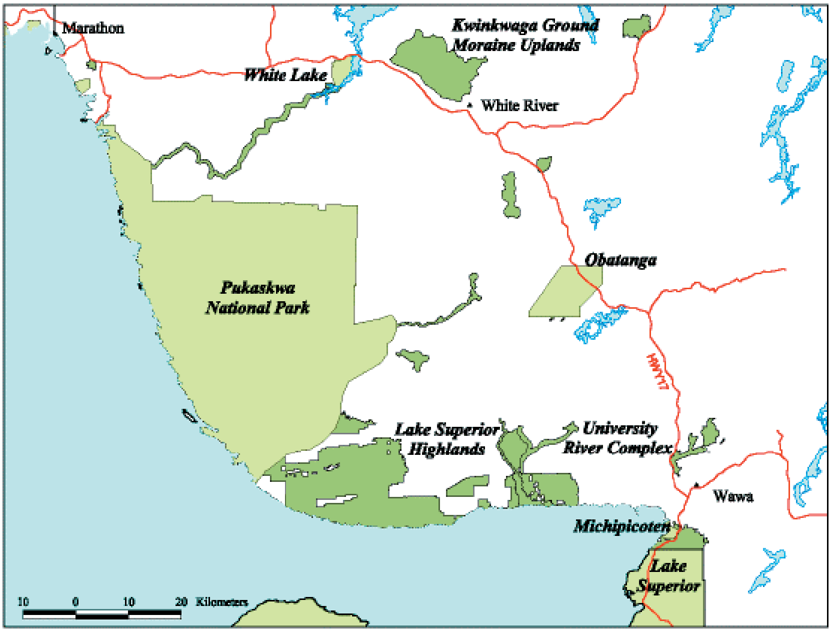

Figure 2. *Pukaskwa National Park Region (Source: Partnership for Public Lands).*

of the decline in caribou numbers might be attributed to predation by wolves. By collaring and tracking moose, wolves and caribou, researchers were able to determine that caribou travelled up to 70 km beyond the park's boundaries, thus putting them in contact not only with cut-over areas but also with wolves that prey upon moose in such areas.

Researchers in the national park worked with MNR foresters and representatives of forest companies in executing this research, identifying to them the chief agents of ecological change in the areas beyond Pukaskwa's boundaries. The research led directly to a better appreciation for the regional context of the national park and to a shift in practice on the part of park managers to attempt to influence activities occurring outside park boundaries with ecological effects within the national park.

Political realities cannot be ignored in this apparent co-operation among agencies and industry. Despite developing a better understanding of prey-predator relationships in and around the national park, road-building and timber-cutting persist close to Pukaskwa's boundaries. Suggestions of a buffer area around

Pukaskwa National Park have been ignored by OMNR and the timber companies.

These examples illustrate that research has contributed significantly to the establishment and management of parks and protected areas in northern Ontario in the past. Much of this research was initiated by government agencies. Both examples also illustrate the continuing influence of differing valuations of nature (i.e., politics) in the boreal zone.

The Role of Research in the Present

Ontario's Living Legacy

Ontario's most recent large-scale land use planning exercise, *Lands for Life*, resulted in *Ontario's Living Legacy*. Among other things, *Ontario's Living Legacy* is intended to be a blueprint for parks and protected areas in northern Ontario south of the 51° parallel. From a parks and protected areas perspective, *Ontario's Living Legacy* has been highly successful, increasing the number of provincial parks from 216 to 332 and adding 200 'conservation reserves' (OMNR, 1999).

Scientific research played a major role in the *Lands for Life* process, but, as in any large-scale planning initiative, politics was never far below the surface of discussions. While research played, and continues to play, an important role in these new parks and protected areas, it does so in a novel way. The *Lands for Life* process saw the active participation of the 'Partnership for Public Lands', a coalition of Ontario environmental organizations including World Wildlife Fund (Canada), the Federation of Ontario Naturalists and the Wildlands League, the Ontario chapter of the Canadian Parks and Wilderness Society. Not only was the Partnership's participation integral to the outcome, but the group also utilized science as never before by Ontario environmental organizations in a land use planning process.

The Partnership employed science in several ways. Firstly, science played a role in identifying prospective new parks and additions to existing parks. The Partnership was then able to advocate the designation of the new parks or the revision of boundaries of existing parks where additions were proposed. The Partnership also focused on wildlife corridors, especially the corridor along the Nipigon River joining Lake Superior to Wabakimi Provincial Park, as mechanisms to afford protection to woodland caribou that range over large distances on the landscape.

Secondly, the Partnership made extensive use of GIS-based mapping, thus rivalling the capabilities of the MNR in this respect. During the *Lands for Life* process, this capability meant that the Partnership was able to convene its own meetings to consider proposed protected areas. At public meetings organized by the MNR, the Partnership was able to display its park proposals to the public in a highly effective manner.

The Partnership continues to be involved in discussions concerning the new parks and protected areas identified in the *Lands for Life* process. The results of its GIS-based mapping is available online, for educators, students, environmental organizations and the public (Partnership for Public Lands, 2004).

The *White Feather* Initiative

The *White Feather* initiative draws together four First Nations (including two from Manitoba), the Partnership for Public Lands, an NGO and Ontario Parks in an aboriginal-led coalition to promote forestry, parks and cultural history in an area of Ontario north of the 51° parallel (Figure 3). The roles of the participants are quite specific. The First Nations signed an accord concerning protected areas within their territories. One of the four, the Pikangikum First Nation, signed an agreement with the Partnership for Public Lands about protection and economic development of the Pikangikum traditional area as part of the *Northern Boreal Initiative*. Ontario Parks is seeking to identify a wilderness-class provincial park candidate in site region 3S.

One of the aspects of this initiative that makes it noteworthy is the fact that it has come from the First Nations. Both the Partnership for Public Lands and Ontario Parks became involved in response to the aboriginal initiative. Another aspect worthy of note is the importance of community-based land-use planning as the basis for action concerning both forestry and protected areas.

The initiative is instructive from a political point of view as it represents one of the few examples of First Nations engaging either NGOs or the Ontario government in discussions concerning large-scale land-use decisions. It is also important from a scientific point of view because the initiative will bring to-

Figure 3. *The* White Feather *area (Source: The* White Feather *initiative).*

gether aboriginal customary and traditional knowledge with scientific knowledge utilized in both forest and park management.

Science, traditional and non-traditional, will play an important role in establishing and managing this protected area. The challenge will be to utilize both forms of knowledge in ways that are acceptable to the parties and useful to the protection of the Boreal landscape.

The Role of Research in the Future

The Effectiveness of Parks and Protected Areas

The effectiveness of management efforts in parks and protected areas needs attention, according to parks agencies at the 2002 *World Parks Congress* in

South Africa. Hockings, an Australian academic who has written extensively on the issue, maintains that management effectiveness in parks and protected areas is composed of three aspects: the design of individual parks and of park systems; the appropriateness of management actions in response to park issues; and the attainment of park and protected area goals and objectives by parks agencies (Hockings *et al.*, 2000: 4) (Figure 4).

It is evident that much effort has been expended on establishing parks and protected areas in the boreal zone of northern Ontario. The large-scale land-use planning processes of 1983 and 2000 created a large number of new parks and protected areas at the provincial level. Much less work has been done to determine how effective these new parks are in protecting the boreal landscape. While the examples of the Wabakimi expansion and the 5P initiative at Pukaskwa National Park are indicative of some effectiveness work, they are unfortunately not the rule.

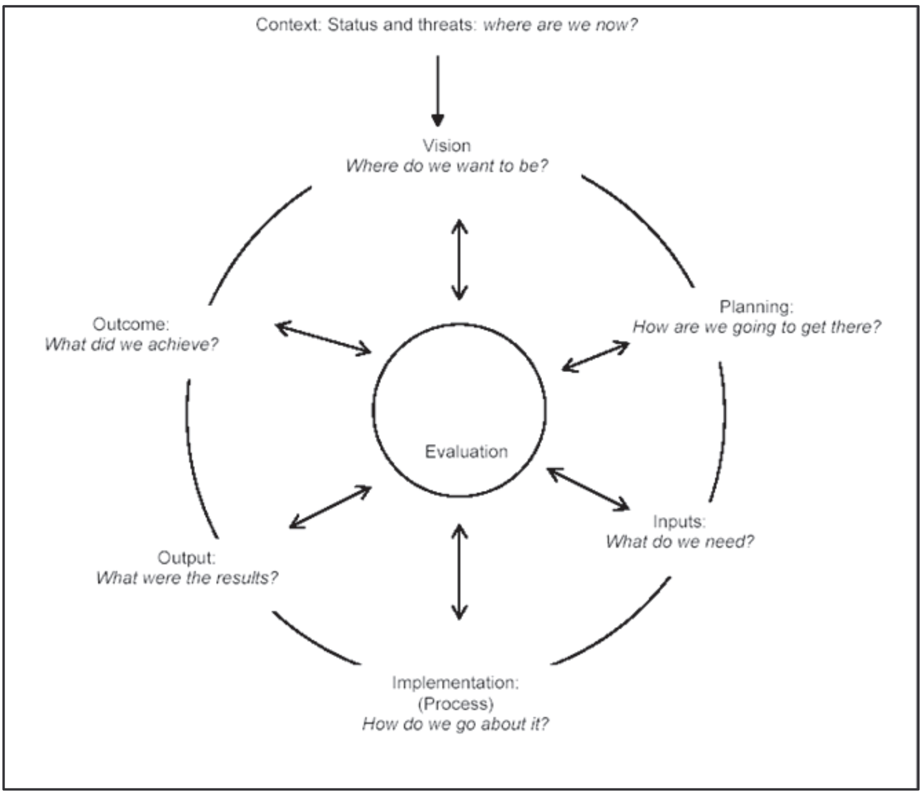

Figure 4. *Evaluating management effectiveness (Source: Hockings* et al.*, 2000).*

Ontario's Provincial Auditor examined the performance of the Ontario Provincial Parks program in 2002 and found it wanting in several significant ways. Only 117 of the 277 parks had management plans and 68 of these plans had not been revised in more than ten years. Many parks, both operating and non-operating, had yet to complete a biophysical inventory. Species at risk were poorly managed. Performance measures for parks in the system did not measure performance on ecological sustainability (Ontario Provincial Auditor, 2002: 210-211). In the future, park agencies operating in northern Ontario will need to do more to protect boreal species and landscapes, and they will need to conduct more research to determine the effectiveness of their actions.

The role of scientific research as a tool for managers is understood in Canadian national parks. If Ontario revises the legislation governing provincial parks, the requirement to conduct and utilize scientific research in establishing and management those parks may become a more entrenched part of management practice.

Different Perspectives on the Effectiveness of Parks and Protected Areas

It is highly likely that in the future it will be insufficient to conduct research on management effectiveness alone. When NGOs and First Nations are collaborating with public parks agencies, there are several dimensions to the question of effectiveness. Questions such as "are parks and protected areas effective in maintaining wildlife populations for aboriginal subsistence hunting?" or "do parks and protected areas provide employment for aboriginal and local people?" might not be priority questions for public parks agencies, but they might well be important for First Nations and non-native communities.

Just as the *White Feather* initiative provides an example of First Nations working with NGOs and public parks agencies, it also points to new roles of research in assessing the effectiveness of parks and protected areas from several, quite different, points of view. This kind of multi-faceted research suggests that the role of the researcher will change as well. Rather than being contracted solely by government, researchers may work for NGOs, local communities and First Nations, responding to research questions framed by these non-traditional research agents.

Conclusion

The nature, extent and role of research in parks and protected areas in the boreal zone of northern Ontario has changed dramatically in the last 30 years. From a situation where research capability was centred in parks agencies, it has gradually expanded to become part of the tool kit that NGOs bring to bear on park and protected area issues. The nature of research has changed to embracing not only park establishment issues, but increasingly, park and protected area management issues. With this latter change has come a more important role for research in gauging the effectiveness of park and protected area efforts in the boreal zone of northern Ontario.

A crucial development over the last 30 years has been the rising importance of First Nations. First Nations have moved beyond political manoeuvrings to become involved, at their initiative, in park and protected area establishment. As this movement gathers momentum, it will alter the nature of research for parks and protected areas in the boreal zone. The research agenda will come to better reflect First Nations' issues. In addition, determining the effectiveness of parks and protected areas will become a more multi-faceted endeavour.

In terms of parks and protected areas, research has begun to rival politics as a means of deciding establishment and management issues.

Acknowledgements

I am indebted to Ron Leekam of Ontario Parks for clarifying the sequence of actions surrounding the *White Feather* initiative.

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A National Marine Conservation Area Proposal for Lake Superior: Challenges, Opportunities and Research Needs

Gail Jackson

Parks Canada

Background

In 1997, the federal government of Canada signed a Memorandum of Understanding with the province of Ontario to explore the merits of a national marine conservation area (NMCA) in Lake Superior waters. This initiative has had its challenges — an NMCA must prove to be scientifically defensible, technically feasible, economically viable, and socially acceptable. No small feat for the 21st century! Success would accredit this area as the largest freshwater reserve in the world. This paper offers insight into some of the challenges and opportunities experienced during the feasibility study, forecasts future research needs and reveals some of the lessons learned in the process.

Coastal nations are becoming more aware and concerned about the protection and conservation of oceanic and large freshwater ecosystems. Canada has advanced its commitment to representing this nation's ocean and Great Lake environments through Parks Canada's *National Marine Conservation Area Program*. Unique to this program, and differentiating it from other marine protected area programs in Canada, is a focus on increasing public understanding, appreciation and enjoyment of this marine heritage for the benefit of future generations.

Canada's oceans and the Great Lakes have been divided into 29 marine regions (Figure 1). Presently, two of these marine regions are represented by the NMCA program — Georgian Bay Marine Region is represented by Fathom Five National Marine Park and the St. Lawrence River Estuary is represented by the Saguenay-St. Lawrence Marine Park.

The global significance of the Great Lakes is readily apparent. Collectively, they hold 20% of the world supply of freshwater and independently, each lake ranks within the top 15 largest lakes in the world. Lake Superior has the distinction of being the first on that list, and was recommended as a binational priority for restoration and protection by the International Joint Commission in 1989. Federal, state and provincial governments accepted the challenge and announced the *Lake Superior Binational Program* in 1991. It was this program that peaked Parks Canada's interest to explore the merits of a national marine conservation area for this Great Lake.

Work commenced on Lake Superior in 1993 with a data-gathering exercise. Geological, oceanographic and biological information was assembled to acquire a more comprehensive understanding of the diversity of this marine ecosystem. Four areas were selected for their naturalness and inherent ability to represent the Lake Superior marine region. One of the four areas popped up as exemplary — not only did this area best represent the marine region, but it also included some exceptional natural phenomena and cultural resources, and remained relatively undeveloped and pristine compared to the other sites.

On March 17, 1997, the federal and provincial governments signed a feasibility study to fully explore the merits of an NMCA in Superior waters through an extensive consultation process which included coastal communities and residents, stakeholders, First Nations, industry and others. A regional stakeholder committee was established the following year to help to develop the proposal and to advise the planning team. After three rounds of open houses and numerous discussions with their neighbours, stakeholders and governing bodies, the advisory committee gave a nod of approval for the initiative and submitted 100 recommendations on the establishment and management of a prospective NMCA.

A third party review of the committee's finding likewise concluded that there was support to proceed with an NMCA, clearing the way for Parks Canada to present its vision for the area. Parks Canada's vision, presented in 2002, was well received by local residents and area municipalities. Negotiations to establish the NMCA began in 2003 and are ongoing.

Challenges

The planning team that worked on this initiative has met many challenges. As with any new program, it commenced at ground zero. At the beginning of the process, there was no cohesive vision for the area under study and all the answers were not there — the NMCA program was young and was still in a

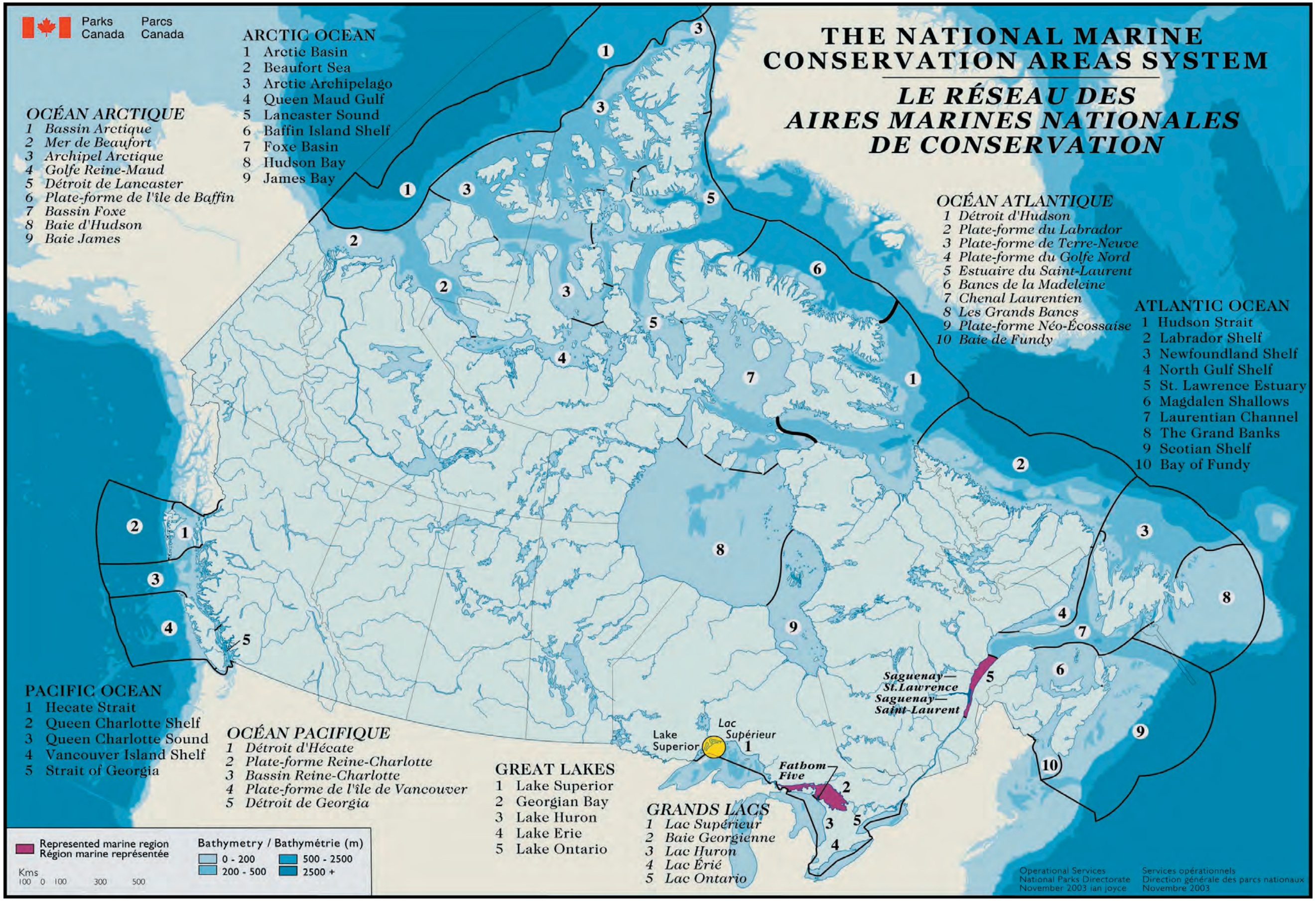


Figure 1. *The National Marine Conservation Area system.*

learning phase. In fact, the Lake Superior NMCA initiative was the first to test the 1994 *Guiding Principles and Operational Policies* and proved instrumental in helping to formulate the legislative component of Parks Canada's marine program. Legislation to establish and manage NMCAs received Royal Assent in 2002.

These challenges quickly became opportunities. The Lake Superior NMCA initiative was strongly committed to engaging local people and stakeholders in the program. A broad vision was developed with the local people who had been the stewards and custodians of this area; policy and practice were clarified; and a proposal was developed that had the strong support of area residents and local municipalities. The real strength of the program rests on the desire of local people to "keep things the way they are" and on their passion and commitment to this great inland sea.

Gaps in knowledge were quickly filled. Additional research which moved the Lake Superior national marine conservation area initiative forward included:

- a comprehensive and manageable GIS database;
- an understanding of the scope of human uses in the study area, including early aboriginal use, and impacts of human uses on the ecosystem;
- a consolidated history of the lighthouses and shipwrecks;
- a tourism assessment and economic impact projections; and,
- the public perspectives on the protection of this freshwater ecosystem.

Once a federal-provincial agreement is signed, an interim management structure will be prepared as a legislative requirement under the *Canada National Marine Conservation Areas Act, 2002*. A zoning plan will be an important component of the interim management plan.

National marine conservation area objectives will be defined in three core areas — the protection of the natural, self-regulating ecosystem, the visitor experience and public education and understanding. Future research needs will include the development of a comprehensive monitoring and research strategy, public education and outreach programming and identification of a suite of targets and indicators to measure success and ensure accountability.

Engaging local people and building a strong constituency of support has been the strength of the Lake Superior initiative to date and will contribute to the future success of this NMCA. Inherent in the design of marine protected areas is the need for partnerships including all levels of government (federal, provincial and municipal), First Nations, industry, private interests, non-government organizations and more.

Reflections

I would like to share with you some personal insights about parks and protected areas, and about establishing them from ground zero.

- *You cannot create any more wilderness*. This should be self-explanatory in a developing society where there are increasing more and diverse demands place on the land or seascape. Wilderness is a dwindling and non-renewable resource.

- "*Unless the hearts and minds of the local people are on the side of conservation, there is no hope that a protected area can achieve its purpose.*" This is a quote from the Duke of Edinburgh at the Ramsar Convention, 1987. This statement holds true on Lake Superior, and I rather suspect is universal for all new protected area designations.

- *Vision is a required element*. This is based on the premise that if you don't know where you are going, any path will take you there.

- *Action is also a required element*. Vision alone will not get you what you seek. There are many dreamers who do nothing more. The next step involves will and passion.

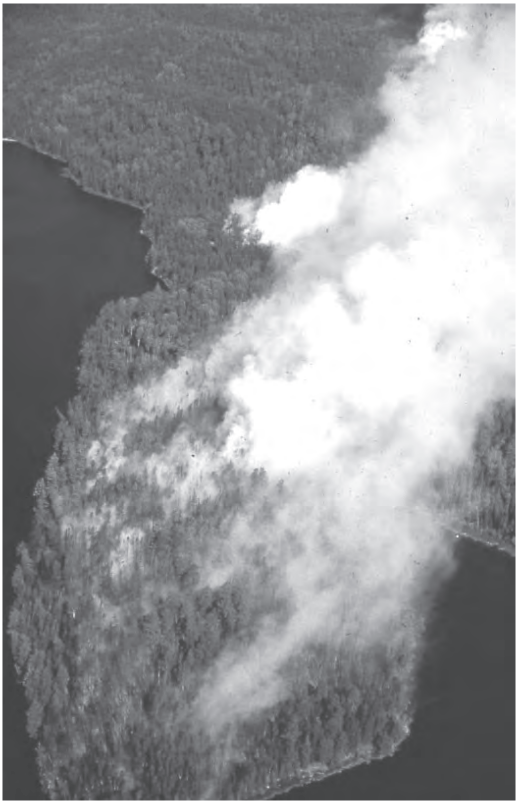
- *There is a certain amount of risk in moving forward*. You might fail. You cannot discover new oceans without losing sight of shore – just ask Christopher Columbus!

- *Communications is the key to success*. Communications is a two way street — both actively listening and actively expressing. The line down the middle is assimilation and understanding; it is critical for one side not to run into the other.

One final lesson prolongs the process — patience is a virtue. I am often asked how long it will take before the final federal-provincial agreement is signed. As the eternal optimist, my unwavering response has been “at least six months”. Four years later the response remains consistent. Social and economic paradigms combined with political realities offer no guarantees. Thank you for the opportunity to address this audience today.

Volunteered Papers

Disturbance Processes and Implications



Forest fire (T. Beechey)

Natural Successional Dynamics of Boreal Forests in Northeastern Ontario

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Abstract

*The dynamics of unmanaged boreal forest stands were examined in northeastern Ontario. The objective was to determine stand compositional development based on time since fire (TSF). We combined repeated field cruises with sequential aerial photographs taken from 1946 to 1990s at intervals of 8-15 years. In field measurements, stand composition and basal area were determined from ten prism stations along a 200 m cruise line in each stand. On the aerial photographs, a 2 ha plot centered on the cruise line was used to estimate stand composition and stocking. Time since fire was determined from fire history maps or estimated from trees when the fire history was unknown. All of the stand cover types showed changes in cover type over time except for white birch (*Betula papyrifera*) and white cedar (*Thuja occidentalis*). Multinomial response models indicated that these changes were significantly related to TSF, and predicted that most stands changed dominance from pioneer species to late successional species over time. More than one pathway was also apparent for all cover types. This may be explained by the variability of species composition within each stand cover type and non-stand-replacing disturbances such as spruce budworm (*Choristoneura fumifera*) outbreaks.*

Introduction

Under the paradigm of emulating natural disturbances and processes through forest management practices, it is crucial to understand the causes of these natural processes so that appropriate practices can be designed (OMNR, 1996). To maintain the composition and structure of forests within the range of natural variability (at landscape level), forest managers need to be able to predict how forest ecosystems change over time with or without disturbances. These predictions are also essential for estimating timber supply and wildlife habitat (Davis *et al*., 2000).

Natural succession is defined as the change in forest composition over time without stand-replacing disturbances such as fire (Vasiliauskas *et al*., 2004). Disturbances such as wind, insects and disease that remove part of the canopy are part of the successional process. In eastern Canada, particularly in Quebec, forest succession studies have advanced our understanding of the dynamics of fire-origin boreal mixedwood ecosystems on mesic sites (e.g., Bergeron, 2000). However, mixedwoods are part of the boreal forest, and a good understanding of the dynamics of other species is necessary for making management decisions (Chen and Popadiouk, 2002). Because of the lack of such understanding, forest managers currently rely on so-called 'expert opinion' models that are based primarily on anecdotal observations (e.g., Vasiliauskas *et al*., 2004).

The primary objective of this project was to develop natural successional pathways for forest units through adopting a robust sampling approach on naturally established stands in northeastern Ontario. This paper will focus on the pathways and probability of change in species dominance for jack pine (*Pinus banksiana*), poplar (*Populus* spp.), white birch (*Betula papyrifera*), black spruce (*Picea mariana*), balsam fir (*Abies balsamea*) and white cedar (*Thuja occidentalis*) in relation to time since fire (TSF).

Study Area

The study stands were located in Hills' Site Region 3E (Hills, 1959) in northeastern Ontario (47°45' − 49° 30' N, 80° 40' − 85° 00' W; Figure 1). The climate of the area is cool continental with short, warm summers and cold, long winters. Mean annual temperature is 1.3°C and mean annual precipitation 831 cm, of which 313 cm is snow (Canada Climate Normals, 1971-2000). This is a largely forested region, interspersed with lakes, rivers and wetlands and with little topographic relief. Forest soils originated from a variety of modes of glacial deposition and from organic deposits. The area is classified as southeastern boreal forest (Rowe, 1972). Dominant tree species in order of increasing shade tolerance (Baker, 1949) include jack pine, trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), white birch, black spruce, white spruce (*Picea glauca*), balsam fir, and white cedar. Other infrequently occurring species include tamarack (*Larix laricina*), willows (*Salix* spp.), red pine (*Pinus resinosa*), white pine (*Pinus strobus*), black ash (*Fraxinus nigra*), red maple (*Acer rubrum*), yellow birch (*Betula alleghaniensis*) and sugar maple (*Acer saccharum*).

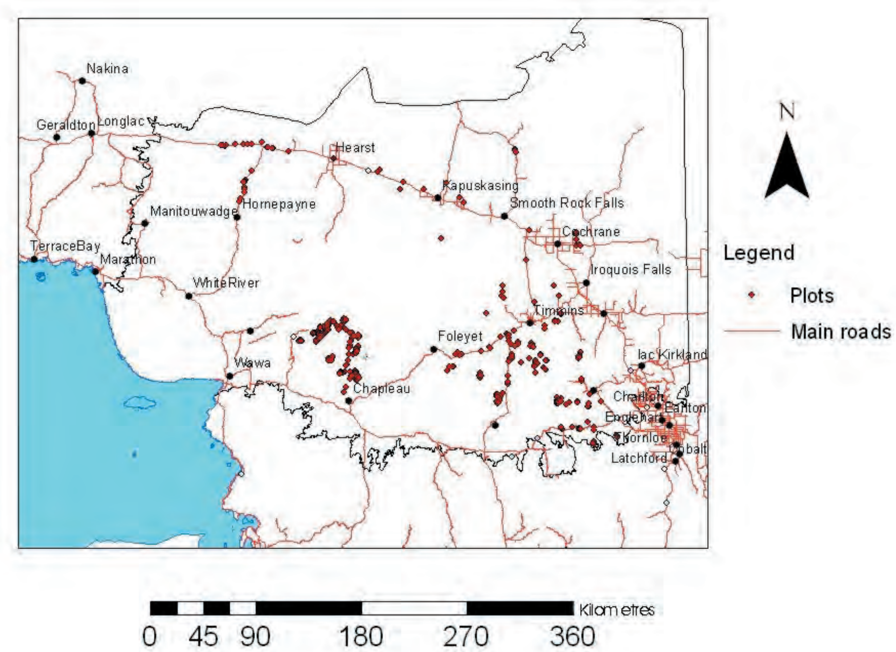

Figure 1. *Study region (Site Region 3E) and plot locations in northeastern Ontario.*

Fire is the dominant natural disturbance agent with a mean fire interval of 100 to 200 years in the study area (Bergeron, 1991; Perera *et al*., 1998). Other important natural disturbances include insect outbreaks. Spruce budworm (*Choristoneura fumiferana*) outbreaks defoliate balsam fir and white spruce, making them susceptible to mortality from *Tomentosus* root rot. These outbreaks occur on a 30-year cycle, with the latest infestation in the 1970s (Williams and Liebhold, 2000). Forest tent caterpillar (*Malacosoma disstria*) defoliates trembling aspen and balsam poplar trees, resulting in mortality if the defoliations are repeated over several years. Windstorms can level swaths of forest on an irregular basis. There has been logging in the area since the 1910s. Other anthropological disturbances include small-scale agricultural clearing, urbanization, and mining.

Methods

Two hundred ninety-seven stands were deliberately selected to cover a wide range of stand ages, forest cover types, and site conditions from timber cruise lines marked on *Forest Resource Inventory* (FRI) maps dating between 1961 and 1982 in the study area. Stands with a history of logging were not sampled. Each of the stands had four to six measurements: two from cruising, and two to four from aerial photo interpretation. One of the cruises was done between 1961 and 1982 and the other was in 2000, 2001 or 2003. Less than four aerial photo measurements were for young stands, as stand basal area cannot be estimated for stands less than 20 years old (Zsilinszky, 1963).

Aerial photos at a scale of 1:15,840 are available for the study area from the 1940s to the 1990s at eight to 15 year intervals. Aerial photographs taken since 1986 are at a scale of 1:20,000. The resurveyed cruise lines were relocated from the FRI maps onto these aerial photographs. A 2 ha plot (50 m each side of the 200 m cruise line) was centred on the cruise line and stand composition and stocking were interpreted for this plot according to Zsilinszky (1963).

During the summers of 2000, 2001 and 2003, selected cruise lines were relocated and remeasured using the same methodology as for the original cruise to determine current stand basal area, composition, age, height and site class (Plonski, 1974; OMNR, 1978). On each 200 m cruise line, ten point samples were established 20 m apart, and stems were counted by species using a wedge prism of basal area factor 2 (BAF 2). Stand composition is based on the percent contribution of each species to the total stem count. Stand basal area in m^2ha^{-1} is determined by multiplying the total stem count by two and dividing by ten. Stems had to be at least 10 cm in diameter at 1.3 m above the ground (DBH) to be considered as a part of the tree layer (Hayden *et al*., 1995). Stand basal areas from aerial photo interpretation were based on the dominant species, site class (from field data), age (corrected from field data to reflect year of photography) and estimated stocking based on canopy cover (Zsilinszky, 1963).

Time since fire (TSF) was determined from fire history maps when stands were located within documented fires since 1920 (Donnelly and Harrington, 1978). For other stands, we used tree ages to estimate the date of the last fire (Bergeron, 1991). A minimum of three canopy stems were used to determine TSF. The same trees used to determine site class were also used to determine TSF if they were from even-aged stands dominated by jack pine, aspen, white birch, tamarack and/or black spruce. Trees with fire scars were not sampled and were very rarely encountered. In stands that were uneven-aged and with more than one cohort(s), additional stems were selected that would better determine TSF. Trees from an earlier cohort were selected, and are identifiable by their larger size, larger branching or top dieback. Jack pine was the preferred species, as they rarely regenerate without fire. If jack pine was absent, poplar, white birch, white pine, red pine and black spruce were preferentially selected for dating the last major disturbance (Bergeron, 1991). In stands dominated by shade tolerant species such as black spruce, white spruce, balsam fir, or white cedar, the least shade-tolerant species was chosen. If the more shade-tolerant trees were older than the less shade-tolerant trees, we used the former to determine TSF. Cores were taken to the pith at breast-height and stored in labeled plastic straws for age determination in the laboratory using a binocular microscope. Tree ages were corrected to TSF using the model developed by Vasiliauskas and Chen (2002). TSF for previous measurements was derived by subtracting the TSF for the latest survey with the difference in sample years.

Data Analysis

We classified stand cover type by tree species dominance (He and Mladenoff, 1999; Yemshanov and Perera, 2002), based on percentage of basal area of each species in the stand. Stands dominated equally by two or more species were classified into the least shade tolerant species. Baker's (1949) shade tolerance classification was used with increasing shade tolerance: jack pine < *Populus* < white birch < *Picea* < balsam fir < white cedar. *Populus* includes stands dominated by trembling aspen and balsam poplar and are referred to as poplar in the paper. Most of the stands were dominated by trembling aspen. *Picea* includes stands dominated by black spruce or white spruce, and most of these were black spruce dominated. These groupings were made because it can be difficult to separate these species on aerial photographs (Zsilinszky, 1963).

For each stand, stand cover type was determined for each of the four to six repeated measurements through field cruising or aerial photo interpretation. Stands were then grouped according to the initial cover type. For each initial group of cover type, we tested if stand cover type change (πj) was significantly related to TSF.

The probability of stand cover type change was modeled using the following multinomial logit model (Agresti, 1990):

$$\pi_j = \frac{\exp(\alpha_j + \beta_j x)}{\sum_h \exp(\alpha_h + \beta_h x)}, \qquad J = 1,\ldots J\text{-}1$$

where $\sum_h \pi_j = 1$, α and ß are regression parameters to be estimated, and x is time since fire. We used the logit regression analysis procedure in SYSTAT 10 (SPSS Inc. 2000).

Results

Stands that were initially dominated by shade-intolerant species shifted significantly toward shade-tolerant cover types with TSF (Figure 2). Shade tolerant species either maintained their dominance, or in some cases shifted toward less shade-tolerant dominance. Jack pine dominated stands shifted towards-dominance by poplar, balsam fir or black spruce with TSF (Figure 2a). Poplar stands shifted significantly towards dominance by balsam fir, white birch, white cedar, and the change to domination by spruce was independent of TSF (Figure 2b). White birch stands shifted significantly toward dominance by balsam fir or white cedar with a shift toward spruce or poplar independent of TSF (Figure 2c). Spruce stands maintained their dominance and started to show a significant shift toward dominance by white cedar after 200 years of TSF. Shifts in dominance for spruce stands toward white birch, balsam fir or poplar were not related to TSF (Figure 2d). Balsam fir-dominated stands showed a significant shift toward dominance by black spruce or white cedar. The shift toward dominance by white birch or poplar was independent of TSF (Figure 2e). Cedar stands showed the most stability as dominance of white cedar did not change significantly towards any other cover type including black spruce (Figure 2f).

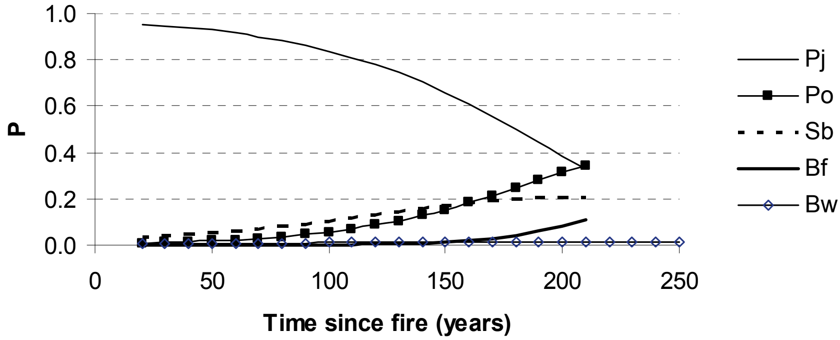

Figure 2a. *Probability (P) of change in species dominance for stands initially dominated by jack pine (Pj) in relation to time since fire (TSF).*

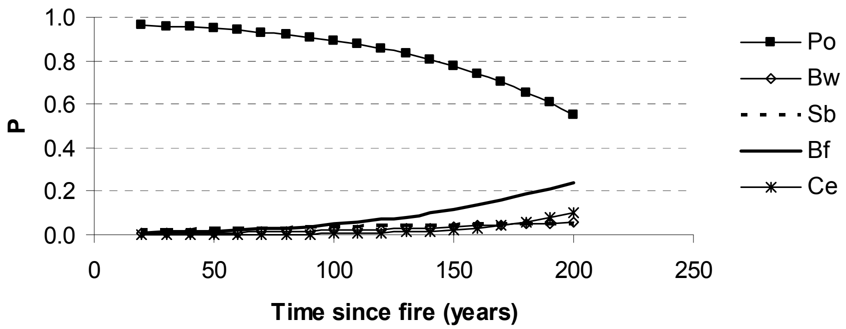

Figure 2b. *Probability (P) of change in species dominance for stands initially dominated by poplar (Po) in relation to time since fire (TSF).*

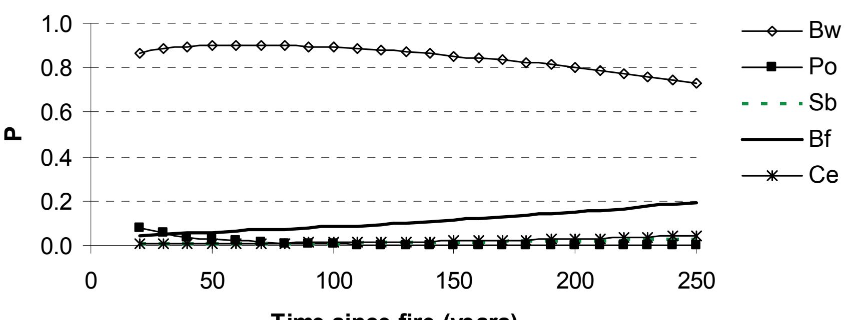

Figure 2c. *Probability (P) of change in species dominance for stands initially dominated by white birch (Bw) in relation to time since fire (TSF).*

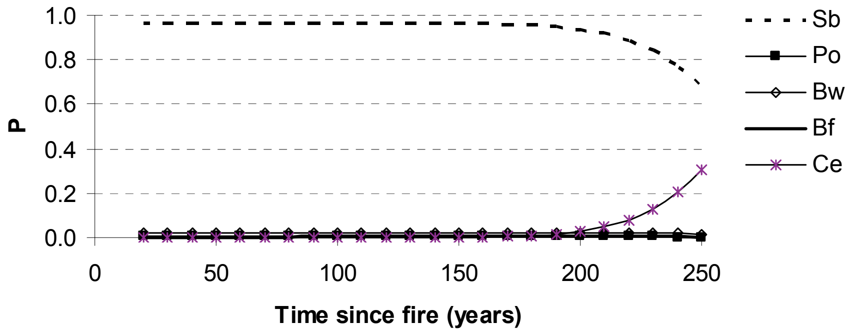

Figure 2d. *Probability (P) of change in species dominance for stands initially dominated by black spruce (Sb) in relation to time since fire (TSF).*

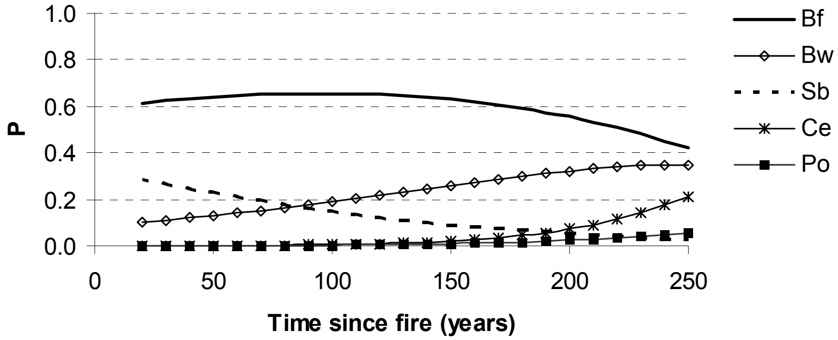

Figure 2e. *Probability (P) of change in species dominance for stands initially dominated by balsam fir (Bf) in relation to time since fire (TSF).*

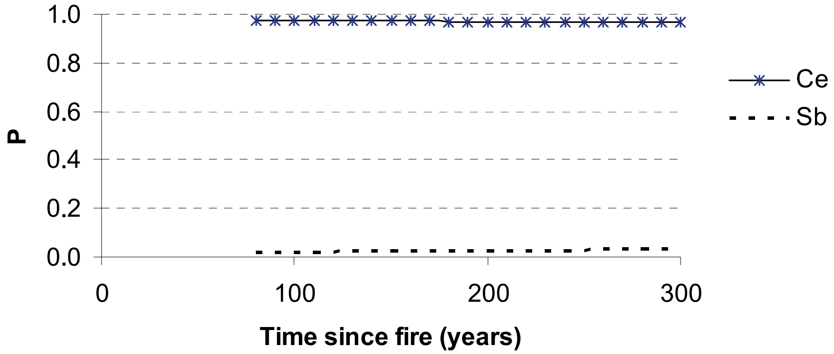

Figure 2f. *Probability (P) of change in species dominance for stands initially dominated by white cedar (Ce) in relation to time since fire (TSF).*

Discussion

Our work confirmed the trend of stand dominance shifting from shade-intolerant to shade-tolerant species (Bergeron, 2000; Chen and Popadiouk, 2002). Shade tolerant species maintained their dominance over time, with the probability of shifting towards other species not affected by TSF (Bergeron, 2000). We also found multiple pathways for the boreal species studied (Cattelino *et al*., 1979; Frelich and Reich, 1995; Chen and Popadiouk, 2002).

We found evidence to support four of the five directional models proposed by Frelich and Reich (1995) from the literature. These are the 1) convergent, 2) divergent, 3) parallel and 4) individualistic models. We found partial evidence for the cyclic model in the form of species A succeeding to species B. We did not find evidence for stands with species B returning to species A after disturbance, as this study did not investigate stand-replacing disturbances that would reset the successional trend.

Both white birch and balsam fir followed similar patterns in changes in dominance. Unlike jack pine and poplar which showed decreased dominance with age, white birch and balsam fir showed an initial increase in dominance followed by a gradual decrease. This suggests that white birch and balsam fir can maintain their dominance on a site with time and that changes in dominance are influenced by other factors in addition to TSF. Most likely this is due to spruce budworm. Balsam fir regenerates in the understories of stands and assumes dominance as the canopy breaks up (Frank, 1990). A budworm outbreak would remove some or all of the fir in the canopy (Baskerville, 1960; MacLean, 1984), and dominance would shift towards birch or another species (Frank, 1990), either through gap regeneration or through survival of canopy stems (depending on the time since the last outbreak). The longevity of birch relative to other boreal species and its dominance on the landscape has been previously noted (Bergeron and Dubuc, 1989; Bergeron, 2000).

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Post-fire Regeneration of Boreal Forests in Northeastern Ontario

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Abstract

*We examined the effects of pre-fire stand composition and season of fire on post-fire regeneration of the boreal forests in northeastern Ontario. One hundred twenty upland stands were surveyed in 2002 and 2003 from burns that occurred between 1983 and 1998. Prefire stand composition was determined from measurements of all stems > 9.5 cm DBH (at 1.3 m) in 400 m² plots. Post-fire regeneration density and composition were determined in three 25 m² subplots in each plot. Species-specific regeneration density was positively related to its pre-fire species percent basal area composition, for jack pine (*Pinus banksiana*), poplar (*Populus *spp.), white birch (*Betula papyrifera*), black spruce (*Picea mariana*) and late successional species, balsam fir (*Abies balsamea*), white spruce (*Picea glauca*) and white cedar (*Thuja occidentalis*). Poplar, white birch, and black spruce seedling densities were significantly higher on sites burned in the summer, but seedling densities did not differ between spring and summer burns for jack pine and late successional species. Jack pine and poplar densities were significantly higher in younger burns, but age of burn did not affect density of the other species.*

Introduction

Wildfire is the dominant natural stand-initiating disturbance in Canadian boreal forests (Rowe and Scotter, 1973; Van Wagner, 1983). Most boreal tree species have strategies to cope with fire and recolonize burns, either by seed or vegetative means. Jack pine (*Pinus banksiana*) and black spruce (*Picea mariana*) use serotinous or semi-serotinous cones to protect seeds and disperse them after fire (Greene *et al*., 1999). Trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*), and white birch (*Betula papyrifera*) regenerate vegetatively through root suckers or stump sprouts (Perala, 1990; Perala and Alm, 1990; Greene *et al*., 1999), or seed in from outside the burn (Greene and Johnson, 2000). Fire sensitive species such as tamarack (*Larix laricina*), white spruce (*Picea glauca*), white cedar (*Thuja occidentalis*) and balsam fir (*Abies balsamea*), however, can only seed into a burn from the unburned edges or residual patches within the burn (MacLean, 1960; Dix and Swan, 1971; Greene and Johnson, 2000). Seed dispersal is usually limited to about 300 m (Sims *et al*., 1990; Greene and Johnson, 2000) for most tree species except for poplars, which can disperse wind-borne seeds for several kilometres (Perala, 1990).

Post-fire stand composition has been reported proportional to pre-fire composition for stands dominated by jack pine, aspen, and black spruce while the sucker-originating trembling aspen has an advantage in initial regeneration densities (Dix and Swan, 1971; St. Pierre *et al*., 1992; Lavoie and Sirois, 1998; Greene and Johnson, 1999; Greene *et al*., 1999). Black spruce stands shift to jack pine dominated stands when both species were present in the pre-fire stand (Lavoie and Sirois, 1998; Nguyen-Xuan *et al*., 2000). Dispersal in black spruce can sometimes last several years and with a delay in germination for up to two years (Thomas and Wein, 1985). Post-fire regeneration of white birch, white spruce, balsam fir and white cedar is poorly documented in terms of timing and densities. The effects of season and age of burn on post-fire stand composition and density are also unknown.

The majority of boreal post-fire successional studies are from western Canada, including the Yukon (Johnston *et al*., 2004), Alberta (Peterson and Peterson, 1992), Saskatchewan (Dix and Swan, 1971), and in northern Quebec (Sirois and Payette, 1989; St. Pierre *et al*., 1992). Few studies have compared pre- and post-fire stand compositions (Wang, 2002; 2003) or examined the effects of fire season or age of burn on regeneration. These knowledge gaps need to be addressed to better understand their importance in regeneration of burned stands.

Specifically, our objectives will address the following questions:

1) How does prefire stand composition influence postfire regeneration on upland sites?

2) How do fire season and age of burn influence regeneration density?

Materials and Methods

Data Collection

One hundred twenty upland post-fire sites were sampled within Site Regions 3E and 3W (Hills, 1959) of northeastern Ontario (Figure 1). The area is classified as southeastern boreal forest within Rowe's (1972) Missinaibi-Cabonga forest section. Dominant tree species on uplands include jack pine, trembling aspen, balsam poplar, white birch, black spruce, white spruce, balsam fir and white cedar (Rowe, 1972).

Fire history information including burn locations, date and size was obtained from electronic databases maintained by the Air, Fire and Flood Management Branch of the Ontario Ministry of Natural Resources. Sampling was done between June and October in 2002 and 2003. We sampled 36 burns that had occurred between 1984 and 1998. Sites were sampled at least 5 years after the burn, allowing enough time for tree establishment, as the majority of trees are established within five years of a fire (St. Pierre *et al*., 1992; Johnston *et al*., 2004) (Table 1). Burn size ranged from 4 ha to 17 676 ha. Fire start dates ranged from April 28 to August 20. In each burn, one to 12 sites were sampled, depending on the variability of prefire stand conditions. Study sites were deliberately selected to represent stands previously dominated by jack pine, aspen, white birch, black spruce, and late successional species that included white spruce, balsam fir and white cedar. Soil moisture regime ranged from dry to moist and was determined for each site based on Taylor *et al*. (2000). Sites were treed prior to the burn and were not silviculturally treated after the burn.

Pre-fire stand basal area, species composition, and stand age were determined for each site with a 400 m^2 circular plot (radius 11.28 m) (Table 1). Diameter at breast height (DBH, 1.3 m) and species were recorded for all trees that were alive at the time of the fire and had a minimum diameter of 9.5 cm, using a similar method described by Wang (2002). Of the nine species found, tamarack occurred on one and balsam poplar on three sites.

Regeneration was assessed from three circular 25 m^2 subplots within each main plot (Hayden *et al*., 1995). The first plot direction was randomly selected and the other two were 120° apart. Distances from the plot centre were random. Within each subplot, all tree seedlings were recorded by species and height class. Height class data are not reported in this paper. Jack pine, aspen, white

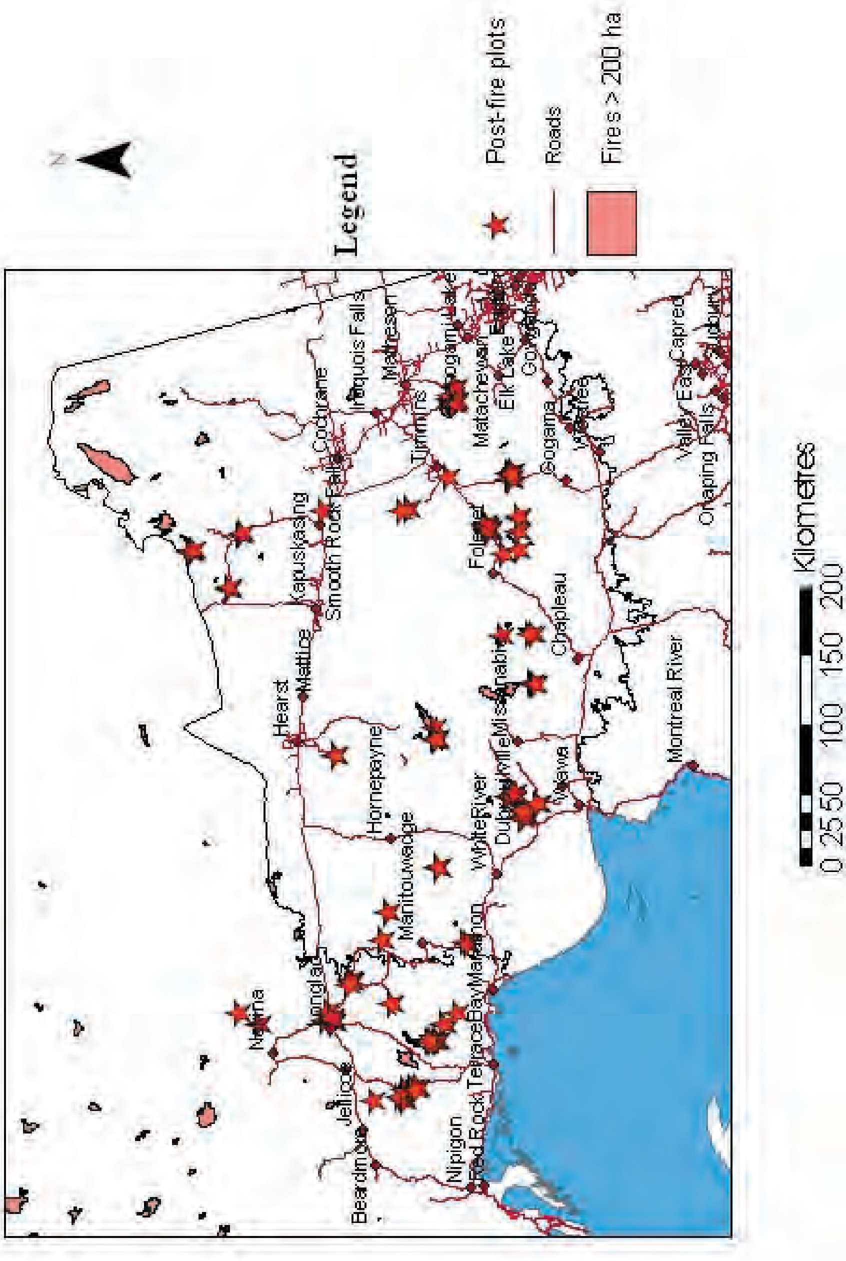

Figure 1. *Plot locations in Site Region 3E, northeastern Ontario. Burns > 200 ha between 1984 and 1998 are also shown.*

Dominance Type	Number of Burns	Number of Plots by Season		Age of Burn (yrs)	Pre-fire Basal Area (m^2/ha)	Prefire Percent Basal Area by Species*							
		Spring	Summer			Po	Bw	Pj	Sb	Sw	Bf	Ce	L
Jack pine	15	16	8	8.2	21.46	1.4	5.1	73.1	15.4	1.8	1.9	1.3	0
Aspen	14	14	6	7.9	25.61	69.5	10.5	2.1	6.9	6.2	4.8	0	0
White birch	10	8	8	8.0	16.76	11	64.8	2.8	6.8	6.6	8	0	0
Black spruce	22	23	18	10.1	16.65	0.7	6.4	8.2	74.9	1.9	7.5	0.2	0.1
Late successional	14	8	11	8.8	22.01	11.96	12.37	2.12	10.13	27.80	26.92	8.98	0

*Species codes: Po = trembling aspen and balsam poplar (combined), Bw = white birch, Pj = jack pine, Sb = black spruce, Sw = white spruce, Bf = balsam fir, Ce = white cedar, L = tamarack.

Table 1. *Summary of sampled postfire plots by stand type with number of burns sampled, number of plots by season of burn, age of burns and pre-burn stand basal area and percent basal area by species (N = 120).*

birch and black spruce constituted 96.2% of the regeneration. Tamarack, white spruce, balsam fir, white cedar, white pine (*Pinus strobus*), balsam poplar and red maple (*Acer rubrum*) were found on one to 23 sites and these species constituted 3.8 % of the regeneration.

Data Analysis

Pre-fire percent basal areas were determined for each species. White spruce, balsam fir and white cedar were combined into a late successional species group because of their similarity in post-fire regeneration characteristics (Greene *et al*., 1999). Balsam poplar was combined with trembling aspen in all analyses. Burns were classified as spring burns (May-June) or summer burns (July-August).

The effects of pre-fire species composition, measured by percent basal area (BA_i), season of burn (S_j, j = 1, 2), and age of burn (A_k, years since burn) as a covariant on species-specific regeneration density and species composition (Y_{ijkl}) were examined using the following model [1]:

$$Y_{ijkl} = \mu + BA_i + S_j + BA \times S_{ij} + A_k + \varepsilon_{l(ijk)}$$

where μ and ε are the overall mean and experimental error, respectively. To examine total seedling density, the BA_i and $BA \times S_{ij}$ were removed from model [1].

Data were tested for normality, linearity, and homogeneous variance (Neter *et al*., 1996). Square-root transformations were applied where necessary. Seedling densities were analyzed using stepwise linear regressions at a significance level of α=0.05 in the General Linear Model procedure (SYSTAT 10).

Results

Total seedling density was significantly affected by season and age of burn (Table 2). Seedling densities on sites of summer burn had four-fold higher densities than that of spring burns. Total seedling density also significantly decreased with age of burn.

Density of individual species including the late successional species was significantly positively related to the pre-fire percent basal area of the respective species (Table 2; Figure 2a-e). For poplar, white birch and black spruce, more seedlings were found in summer burns than spring burns (Figure 3). Post-fire seedling density decreased significantly with age of burn for jack pine and poplar (Table 2; Figure 4), but age of burn did not significantly affect seedling density for the other species. Season of burn interacted with percent basal area for all four species and the late successional species group (Table 2). Summer burns had a significantly greater increase in seedling density with increasing pre-burn percent basal area than spring burns for all species except poplar. For poplar, spring burns had a greater increase in density with percent basal than did summer burns (Figure 2c).

Discussion

Pre-fire species specific percent basal area had a significant effect on post-fire regeneration density of boreal tree species in northeastern Ontario. It explained the highest amount of variance in seedling density for jack pine (31.9%), white birch (18.2%) and black spruce (38.8%), and although significant, explained less of the variance for poplar (13.0%) than did season (20.8%). This reflected seed availability through aerial seedbanks for jack pine and black spruce (Dix and Swan, 1971; Sirois and Payette, 1989; Larsen and MacDonald, 1998; Charron and Greene, 2002), and the relationship between seedling density and basal area (Greene and Johnson, 1999). Late successional species regeneration had the least amount of variation explained by the model. More of the variation was explained by the interaction of basal area with season (9.0%) than by pre-fire percent basal area (6.8%).

The dual means used by hardwoods for colonizing burns (seed and vegetative regeneration), compared to conifers, can reduce the relationship between basal area and seedling density. Long-distance hardwood seed dispersal (Safford *et al*., 1990), especially for poplar (Perala, 1990), allows colonization of sites where these species were previously absent, reducing the relationship between seedling density and percent basal area and making it difficult to predict postfire poplar density (Heinselman, 1981; Perala, 1990; Johnston *et al*., 2004). This was reflected in the lower variance explained for poplar and white birch regeneration density compared to jack pine and black spruce. We found seed-origin poplar more often than the literature would suggest (Horton and Hopkins, 1966; McDonough, 1979; Peterson and Peterson, 1992). Almost half

Table 2. *Regeneration density in relation to its pre-fire percent basal area (BA), season of burn (S), and age of burn (A) for jack pine, poplar, white birch, black spruce, and late successional species (N = 120).*

Source*	df†	MS	F-ratio	P	% VE†
		Total regeneration density			
A	1	73462	14.22	<0.001	7.7
S	1	262674	50.83	<0.001	27.5
Error	117	5165			
		Jack pine regeneration density			
A	1	16961	6.26	0.014	3.1
BA	1	172193	63.59	<0.001	31.9
S*BA	1	24638	9.10	0.003	4.6
Error	116	2708			
		Poplar regeneration density			
BA	1	34496	27.53	<0.001	13.0
A	1	28399	22.66	<0.001	10.7
S	1	55098	43.97	<0.001	20.8
S*BA	1	13126	14.02	<0.001	4.96
Error	115	1253			
		White birch regeneration density			
BA	1	89445	19.96	<0.001	18.2
S	1	29528	6.6	0.012	6.0
S*BA	1	18929	4.22	0.042	3.8
Error	116	4480			
		Black spruce regeneration density			
BA	1	127926	71.7	<0.001	38.8
S	1	7236	4.06	0.046	2.2
S*BA	1	15299	8.58	0.004	4.6
Error	116	1784			
		Late successional species regeneration density			
BA	1	3083	7.02	0.009	6.8
S*BA	1	4263	9.71	0.002	9.5
Error	117	439.2			

*Seedling densities were square root transformed.

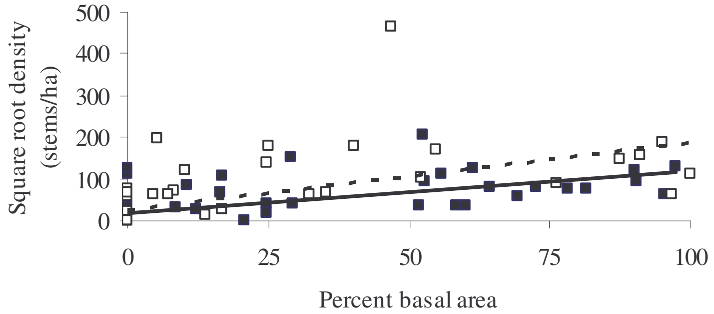

Figure 2a. *Scatterplots and fitted regression lines of percent basal area in relation to seedling density and season of burn (■ = spring burn, □= summer burn) for jack pine (spring: y = 0.97x + 18.46, R^2 = 0.4, P = 0.001, summer: y = 1.58x + 30.07, R^2 = 0.33, P < 0.001). Fitted regression lines are solid for spring burns and dashed for summer burns.*

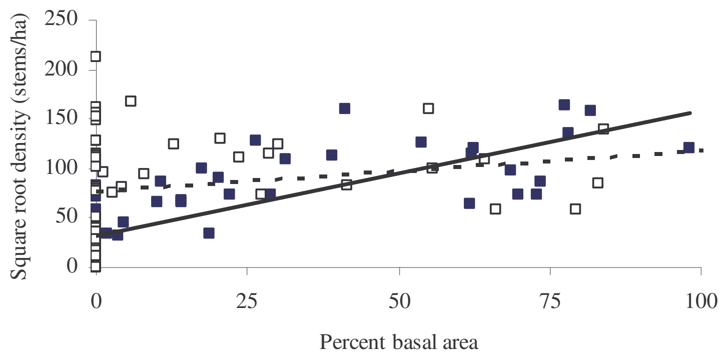

Figure 2b. *Poplar (spring: y = 1.19x + 29.54, R^2 = 0.586, P < 0.001, summer: y = 0.443x + 77.68, R^2 = 0.042, P = 0.15).*

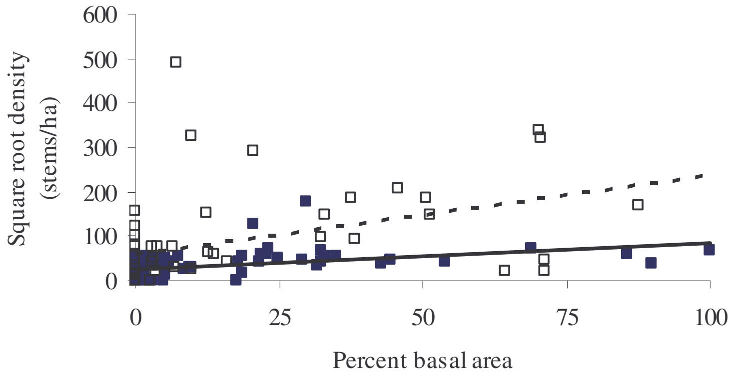

Figure 2c. *White birch (spring: y = 0.63x + 23.52, R^2 = 0.22, P < 0.001, summer: y = 1.71x + 61.7, R^2 = 0.162, P = 0.003).*

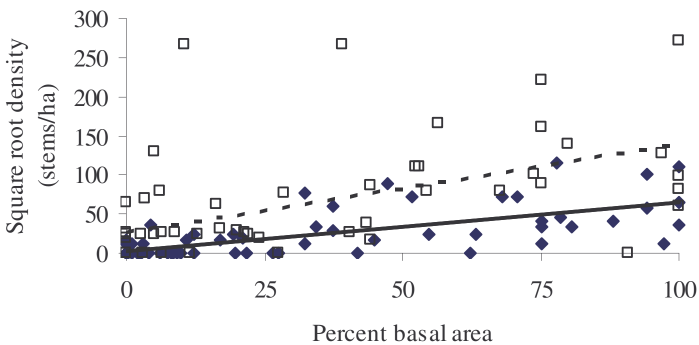

Figure 2d. *Black spruce (spring: y = 0.65x + 3.17, R^2 = 0.529, P < 0.001, summer: y = 1.33x + 24.79, R^2 = 0.348, P < 0.001).*

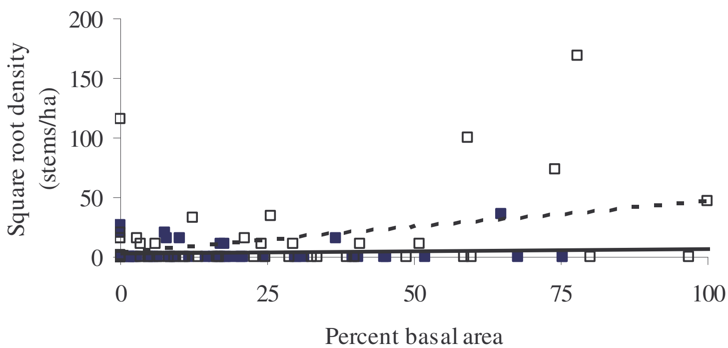

Figure 2e. *Late successional species (spring: y = 0.031x + 2.88, R^2 = 0.006, P = 0.5, summer: y = 0.41x + 4.75, R^2 = 0.121, P = 0.012).*

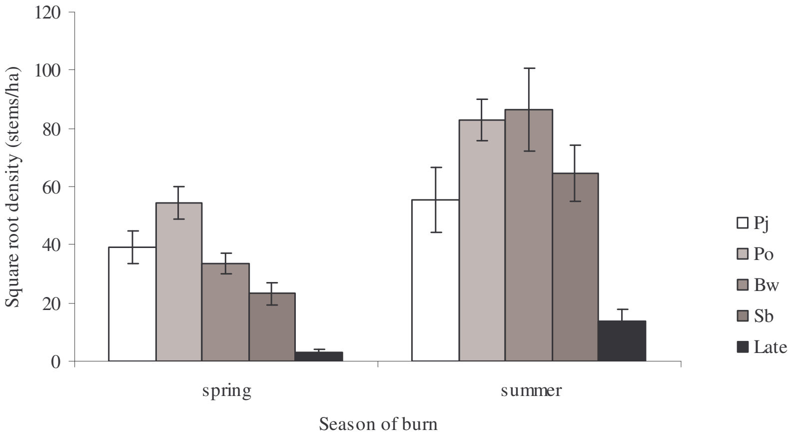

Figure 3. *Season of burn and mean seedling density for jack pine (Pj), poplar (Po), white birch (Bw), black spruce (Sb) and late successional species (Late).*

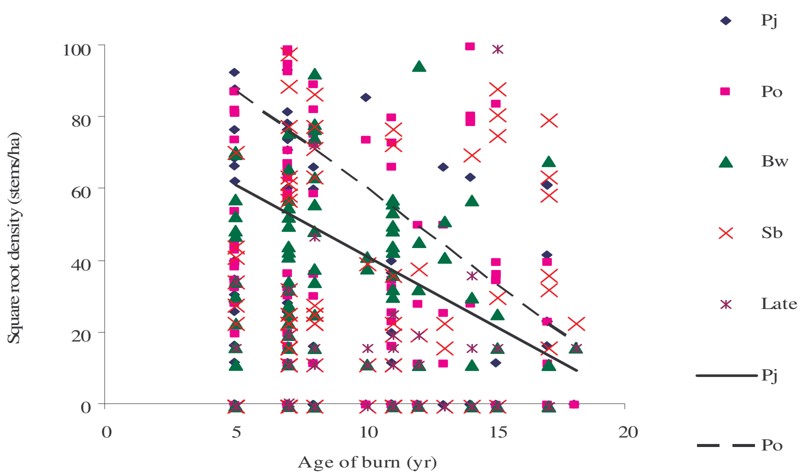

Figure 4. *Species-specific regeneration density in relation to age of burn for 120 post-fire plots in northeastern Ontario. Fitted regression lines for jack pine ($y = -3.93x + 81.3$, $R^2 = 0.043$) and poplar ($y = -5.05x + 109.6$, $R^2 = 0.13$) are significant ($P < 0.05$). Species codes are the same as for Figure 3.*

of the surveyed sites had seed-origin aspen and most of these sites did not have aspen before the burn (Vasiliauskas and Chen, unpublished data).

Late successional species formed a minor component of the total regeneration (< 3%), and were restricted to sites within 300 m of a live seed source (Heinselman, 1981; Greene and Johnson, 2000). They also had the least amount of variance explained by pre-fire percent basal area (6.8%). Their low abundance reflected the shift to dominance by pioneer species after fire and can also indicate the unsuitability of the site for these species immediately after a fire. Although untested, unburned stands and patches were observed to be broadly similar in composition to the adjacent burned plots (Vasiliauskas and Chen, unpublished data), so a higher percentage of late successional species in unburned patches would increase the likelihood of them seeding into burned areas soon after a fire. Our findings reflect the traditional concept of post fire succession, whereby sites are dominated by pioneer species after a fire (Bergeron, 2000), and late successional species do not start to dominate an area until several decades after a fire, originating from unburned patches within a stand (Galipeau *et al*., 1997; Popadiouk *et al*., 2003). This emphasizes the importance of unburned patches and edges within a burn in maintaining late successional species on the landscape (Galipeau *et al.,* 1997; Asselin *et al*., 2001).

Season of burn significantly affected total post-fire seedling density and density of poplar, white birch and black spruce. Higher white birch and black spruce stem densities on summer burns could give these species an advantage in stand dominance over others. However, poplar seedling density will be higher in summer burns where the pre-burn percent basal area was < 65%; otherwise, spring burns will have higher poplar densities. Deeper burns in summer fires can reduce aspen suckering due to root mortality (Horton and Hopkins, 1966; Wang, 2003). These same burns can also expose more mineral soil, providing more opportunities for poplar to establish by seed on new sites the following spring.

Age of burn was a poor predictor of regeneration density, explaining the least amount of variance in jack pine, poplar and total stem density. Most likely this is because the sites were at the stand initiation stage, and crown closure had not yet occurred. A decrease in density with age reflects self-thinning of post-fire stands, starting soon after the fire, especially of aspen suckers (Greene and Johnson, 1999; Wang, 2003).

Our study can contribute towards the understanding of boreal stand dynamics in northeastern Ontario. Four species (jack pine, poplar – primarily trembling aspen, white birch and black spruce) will dominate sites after fire, proportionate to their dominance before the fire (Greene and Johnson, 1999). Stands dominated by late successional species will shift to dominance by the abovementioned species, and the presence of late successional species is dependent on the proximity of a live seed source. Season of burn and age of burn are also important factors for several of the species tested.

Forest managers need to know stand compositions of burned areas before decisions are made regarding management interventions, such as planting. Before any interventions are done, surveys need to be conducted on stands where a desired future stand composition and density may differ from what will happen naturally.

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Ecological Restoration in Parks and Protected Areas: Using Protected Areas for Testing Methods of Restoring Forest Communities

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Abstract

*Severe disturbances usually denude an ecological community of its structure (based on its species composition) and function. Restoration requires that the community be re-assembled, but the question is what key aspects need attention and in what order or priority? Parks and protected areas offer some challenges but the opportunities offered by the existence of good, protected 'reference states' for comparison to degraded areas and restored areas are attractive to researchers. To begin to test methods of ecological restoration of forest communities, I compared four sites within a medium-sized municipality (Region of Waterloo, Ontario, Canada). Two sites were relatively undisturbed forest communities in protected areas; the other sites were disturbed by construction of housing developments. I compared the relative success of restoration on the disturbed sites by combinations of treatments: transplanting three different densities of two guilds of forest understory herbs – early spring guild of dog's-tooth-violet (*Erythronium americanum*), acute-lobed hepatica (*Hepatica acutiloba*), May-apple (*Podophyllum peltatum*), bloodroot (*Sanguinaria canadensis*), barren strawberry (*Waldsteinia fragarioides*); late spring/summer guild of red baneberry (*Actea rubra*), strawberry (*Fragaria virginiana*), avens (*Geum canadense*), pale touch-me-not (*Impatiens pallida*), American germander (*Teucrium canadense*); a guild of tree seedlings – sugar maple (*Acer saccharum*), white oak (*Quercus alba*), common elder (*Sambucus canadensis*); and adding soil harvested intact before housing developments began. After six years, analyses of variance with repeated measures have indicated that transplanting five plants m^{-2} of the early spring guild plus the pre-development* *soil, followed by transplanting tree species and the late spring/summer guild gave the best survivorship. The populations of herbs and tree seedlings that resulted produced an understorey comparable to the reference states of relatively undisturbed communities. The reasons for this are the ability of native species to outcompete invasive species, protection of transplants from desiccation, and increased presence of mycorrhizae and invertebrates.*

Introduction

In parks and protected areas, restoration ecology poses a challenge because of high visibility (fear of failure or waiting long periods for success), potential conflicts between conservation and recreation, and the scale of restoration, i.e. it transcends boundaries of parks and protected areas. However, these areas offer opportunities for experiments in restoration ecology because of the presence and support of experts committed to environmental issues, an ability to implement relative secure and long-term studies, and the availability of protected 'reference states' needed for experimental testing of the relative degradation of other sites versus the ecological restoration methods used to reverse this degradation. Probably the greatest impact in parks and protected areas in Ontario is the historical problem of habitat fragmentation making forest communities vulnerable to edge effects and further 'runaway' fragmentation.

Given that a key issue in restoration is how to reassemble communities or ecosystems, the challenge to restoration ecologists is to determine which critical structures or functions should be given attention and in what priority (Palmer *et al*., 1995; Pywell *et al*., 2002)? There tend to be recommendations on how to do this on a theoretical basis but there are few tests or applied examples, especially in the context of restoration ecology (e.g., Keddy and Drummond , 1996; Pyšek *et al*., 2001; Vallauri *et al*., 2002). One limitation is that there are so many structures and functions in an ecosystem, that it is difficult even to decide on where to begin. Since urbanization is a major reason why ecosystems have been disturbed (e.g., Pickett *et al*., 2001) and in need of restoration and, in the Great Lakes region, urbanization has been particularly destructive to mixed-woods forests, I chose to test the impact of restoring structural losses to see if this translates into restoration of both structure and function. I tested how best to restore different densities of two phenological guilds of understorey herbs, a guild of locally dominant tree species, and the soils that existed before housing developments began.

Methods

I chose four sites in Waterloo Region, Ontario, Canada (43.48 [N], -80.54 [W]). Of these sites, two were relatively undisturbed upland forests dominated by sugar maple (*Acer saccharum)*, white oak (*Quercus alba)*, and common elder (*Sambucus canadensis*) and two were similar forests that were denuded of most of the vegetation during housing development, leaving remnant edges. Plants and soils were rescued in autumn before development began near forest edges in winter 1996; the experiment began in spring 1998 as houses were now being built but earth-moving near the remnant edges of the forests had ceased. Potential (individual) treatments to be applied to a split-plot design (four replicates per site) were as follows:

- Transplanting three different densities (5, 7, or 9 plants m^{-2}) of an early spring guild of forest understory herbs: dog's tooth violet (*Erythronium americanum)*, acute-lobed hepatica (*Hepatica acutiloba)*, May-apple (*Podophyllum peltatum)*, bloodroot (*Sanguinaria canadensis)*, and barren strawberry (*Waldsteinia fragarioides*).

- Transplanting three different densities (5, 7, or 9 plants m^{-2}) of a late spring/summer guild of forest understory herbs: red baneberry (*Actea rubra)*, strawberry (*Fragaria virginiana)*, avens (*Geum canadense)*, pale touch-me-not (*Impatiens pallida)*, and American germander (*Teucrium canadense*).

- One density (one sapling [about 1 m high] of each species within a 10 m^2 area) of a guild of tree seedlings (sugar maple, white oak, common elder). The presence or absence of this tree guild was the split-factor.

- Adding soil harvested intact before housing developments began. This soil was removed with shovels, reflecting the typical working pace. The soil was dug to 20 cm with shovels (preserving the depth profile), preserved in 60 cm deep 'flats', transported to a growth room, watered with amounts mimicking local precipitation patterns, and planted with native herbs from the above guilds (random selection of species planted at 7 plants m^{-2}) in an attempt to allow key soil flora and fauna to remain intact.

- All plants used were rescued from the original sites before development began and allowed to grow in individual 10-50 cm diameter pots with 'promix'. Pots were watered with amounts mimicking local precipitation patterns. Photoperiod conditions also mimicked the local patterns from autumn 1998 through summer 2000.

- All possible combinations of the number and order of treatments (planting densities of the two guilds and 'pre-development' soil) were used. This meant that treatments ranged from control (no intervention) through to a treatment with 9 plants m^{-2} of both guilds and addition of pre-development soil in varying implementation orders. I transplanted mature individuals.

- The experiment has continued since 1998. Population and communities of plants in each replicate are monitored monthly and during critical phenological stages to measure leaf areas at flower bolting and seed production. Key responses are numbers of visible stems during the midpoint of the growing season, end-of-season population, and (where relevant) % survivorship of original transplants. Analyses of variance with repeated measures have been used to report on the first six years of results (Mauchly's tests for sphericity indicate no violations). When comparing individual combinations or orders of treatment, contrasts were used to test for differences.

Results

For this presentation to PRFO 2004, I focused on how well the guilds have done based on changes to the population demographics of species and whether any new species (native or exotic) have colonized the sites. In the longer term (once more data are collected), community analyses will be used to assess the progress of the various restoration treatments. Between-subjects, the significant factors are the sites ($F = 19.81$, $P < 0.01$), the treatments ($F = 22.31$, $P < 0.01$), and a site-treatment interaction ($F = 9.87$, $P < 0.05$). Within-subjects, time, treatment-time, and site-time all are significant (respectively: $F = 14.32$, $P < 0.01$; $F = 11.76$, $P < 0.01$; $F = 8.96$, $P < 0.05$). Despite the interaction effects, it was possible to generalize the ranking of success of treatments and their orders by using the contrasts from the analyses. Given the number of possible combinations, an abbreviated version is presented:

- The best combination and order was: trees with pre-development soil, then 5 plants m^{-2} of the early spring guild (with the pre-development soil), and finally late spring/summer guild at 7 plants m^{-2} (with pre-development soil). This resulted in populations that were not significantly different than the relatively undisturbed reference sites.

- Densities were critical for the late spring/early summer guild. When these were planted after early spring guilds or trees, higher densities were better (e.g., 7 and 9 plants m^{-2}; Figure 1).

- The order of assembly was critical: the best results were obtained by first planting the trees, then the early spring guild, and then the late spring guild (Figure 2).

- Use of pre-development soil was critical as treatments without it consistently fared worse (Figure 3).

- Failing to plant the early or late spring/early summer guilds encouraged invasions by exotic species (Figure 4).

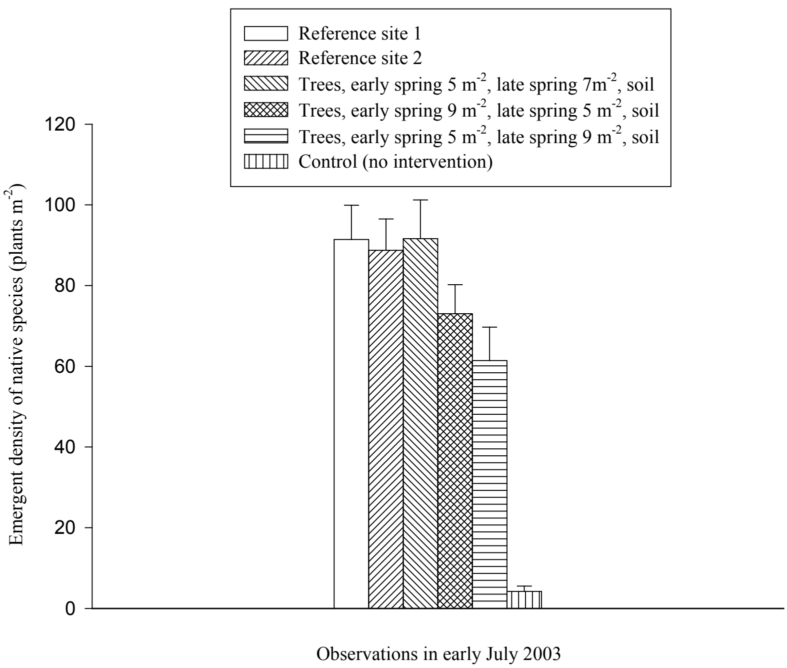

Figure 1. *Effect of selected densities of two understorey guilds on success of ecological restoration.*

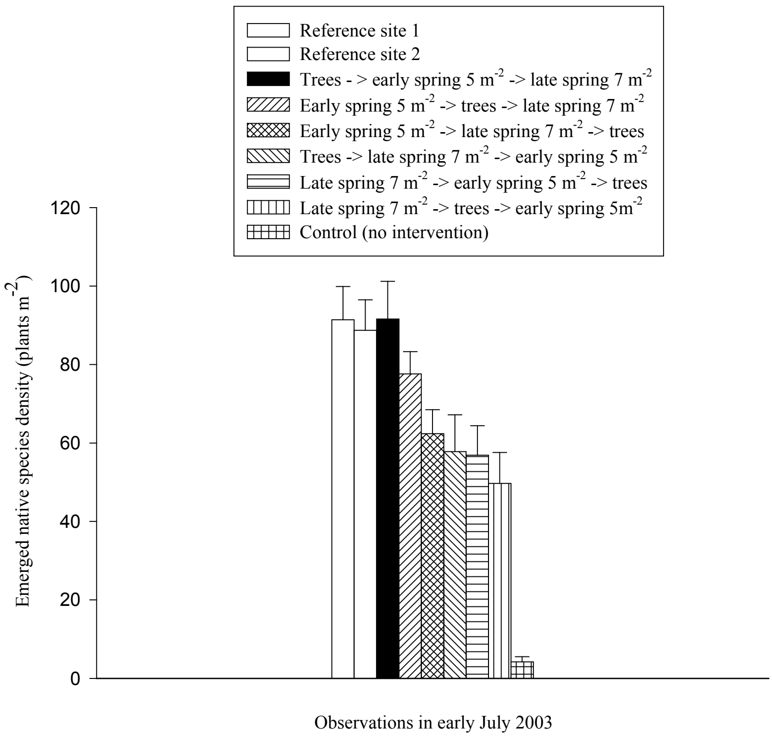

Figure 2. *Effect of assembly order on success of ecological restoration.*

- Transplanting trees was important – their presence significantly improved success (Figure 5).

- Control plots (no intervention) were significantly worse than all other combinations.

To provide relatively concise evidence for this summary, Figures 1-5 offer selected comparisons; the selection was based on clarity and represent results that were consistent with those from similar analyses.

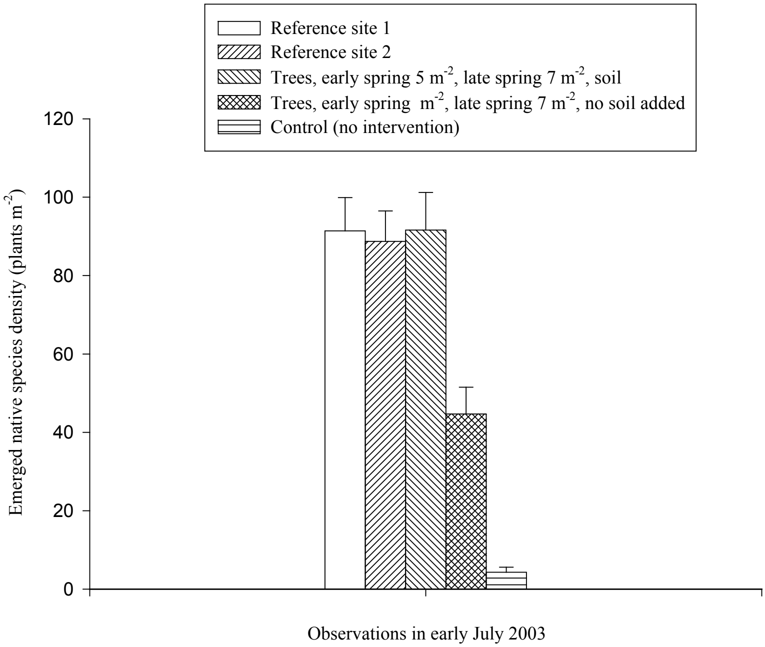

Figure 3. *Effect of addition of pre-development soil on success of ecological restoration.*

Discussion

The use of different densities (Figure 1), assembly order (Figure 2), and pre-development soil (Figure 3) contributed greatly to the success of the restoration efforts. In particular, Figure 3 indicates that the experiment is succeeding in preserving at least some of the key soil flora and fauna, e.g. mycorrhizae and invertebrates (see Kourtev *et al*., 2002; Richter and Stutz, 2002; De Deyn *et al*., 2003; Wardle *et al*., 2004). Focus on soils should be a priority for ecological restoration of the understorey community of upland mixed-woods/deciduous forests. The assembly order implies that planting saplings first in early spring has the effect of minimizing disturbance since other guilds were not yet planted, maximizing survivorship by reducing sapling root shock and related factors and offering increased shading (especially to suppress invasives – see Figure 4) and possibly 'nursing' guilds planted later, e.g., protect them from desiccation. The assembly order also indicates that planting early spring guilds probably reduces disturbance or competition between this guild and

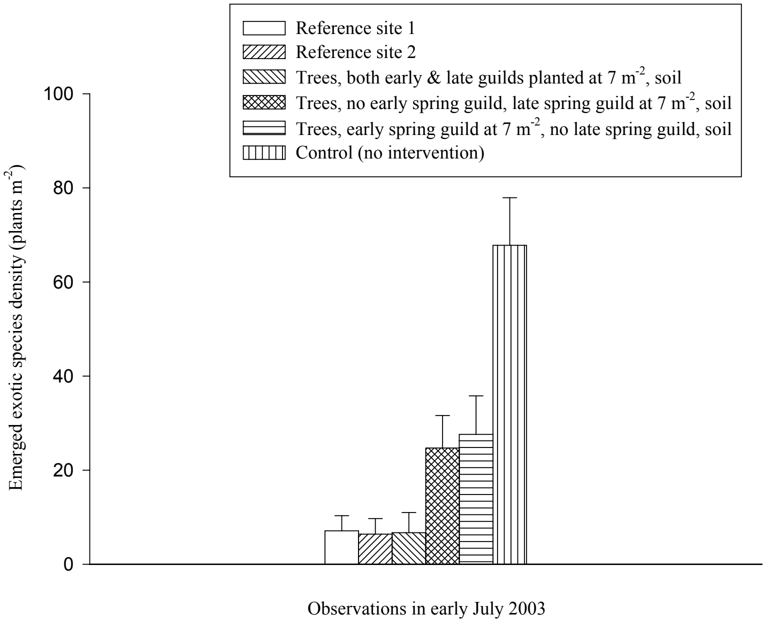

Figure 4. *Effect of planting early and late spring guilds on density of exotic species.*

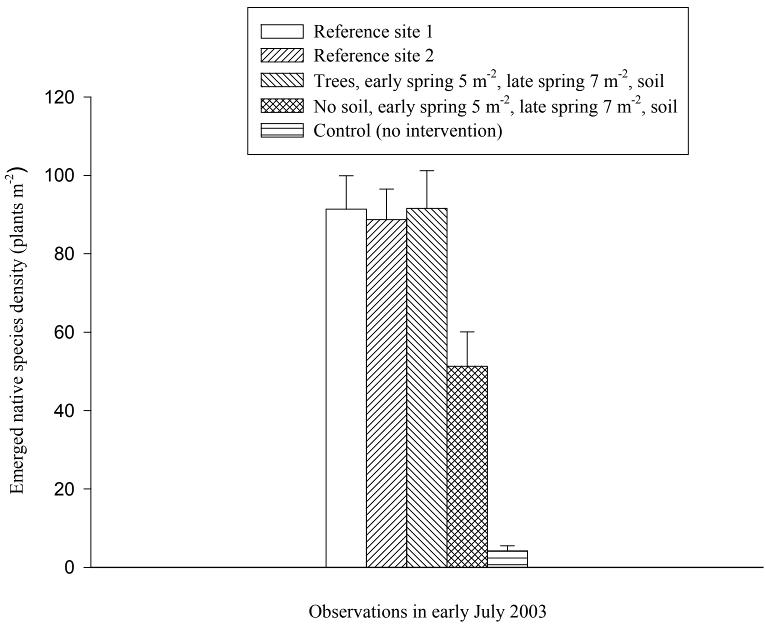

Figure 5. *Effect of planting trees on success of ecological restoration.*

the later spring/early summer guild. Density effects specifically indicate that the 5 plants m^{-2} for early spring guilds allows them to outcompete immediate invaders, e.g., garlic mustard (*Alliaria petiolata*), without promoting too much competition between guild members. When planted after the early spring guild and saplings, the later spring/early summer guild needed to be transplanted at higher densities, probably to compensate for lingering effects of competition. Most likely, competition was for light but it could exist for other resources, e.g., nutrients or water, and could occur amongst the understorey guilds, saplings, and any invasives (Booth *et al*., 2003; Meloche and Murphy, in press). There were some interaction effects involving the sites chosen, but this was that some of the marginal orders or combinations (e.g., no understorey guild and/or no pre-development soil) were significantly worse at one site and this was exacerbated over time.

The main implication is that for ecological restoration to work best (at least after six years under my sites' conditions), the assembly order and specific treatments are critical. Locally, it means that developers, municipal staff, and restoration ecologists should ensure that soil disturbance is minimized or repaired (often, soils are compacted or dug, inverted, carted, covered and replaced – in an effectively 'dead' condition). Trees and early spring understorey plant guilds should be transplanted first – perhaps this is expected given that this reflects the typical phenology of communities in the Waterloo area. In concurrent studies in my own research, it appears that the use of understorey species (especially bloodroot and May-apple) to outcompete early spring invasives for light and plantings with species of different heights are very useful (Murphy, accepted). In the latter case, the plantings act as 'structural buffers' by deflecting wind, conserving moisture, raising relative humidity and providing 'nursing' for other plants, animals, and (particularly) mycorrhizae and soil fungi. There are, of course, other scales, structures and processes that should be examined (e.g., spatially explicit processes, Robinson and Handel, 2000; herbivory, Ruhren and Handel, 2003). Relative new exotic threats to forests like emerald ash borer (*Agrilus planipennis*) and Asian longhorn beetle (*Anoplophora glabripennis*) will divert attention to other pest management strategies and cause restoration ecologists to re-think their species plantings lest they be destroyed but coming threats. The human dimension of planning and management of protected areas (vs. other land-uses) must be more collaborative at a landscape scale if ecological restoration is to succeed long-term at more than just local scales. Ultimately, my study indicates that restoration ecologists should test assembly order and the often-neglected soil community (even at a broad scale) rather than just the structure of the species composition being restored. This has particular relevance to parks and protected areas and their environs where there is more latitude and opportunity to test this and to truly restore ecological integrity in its functional sense.

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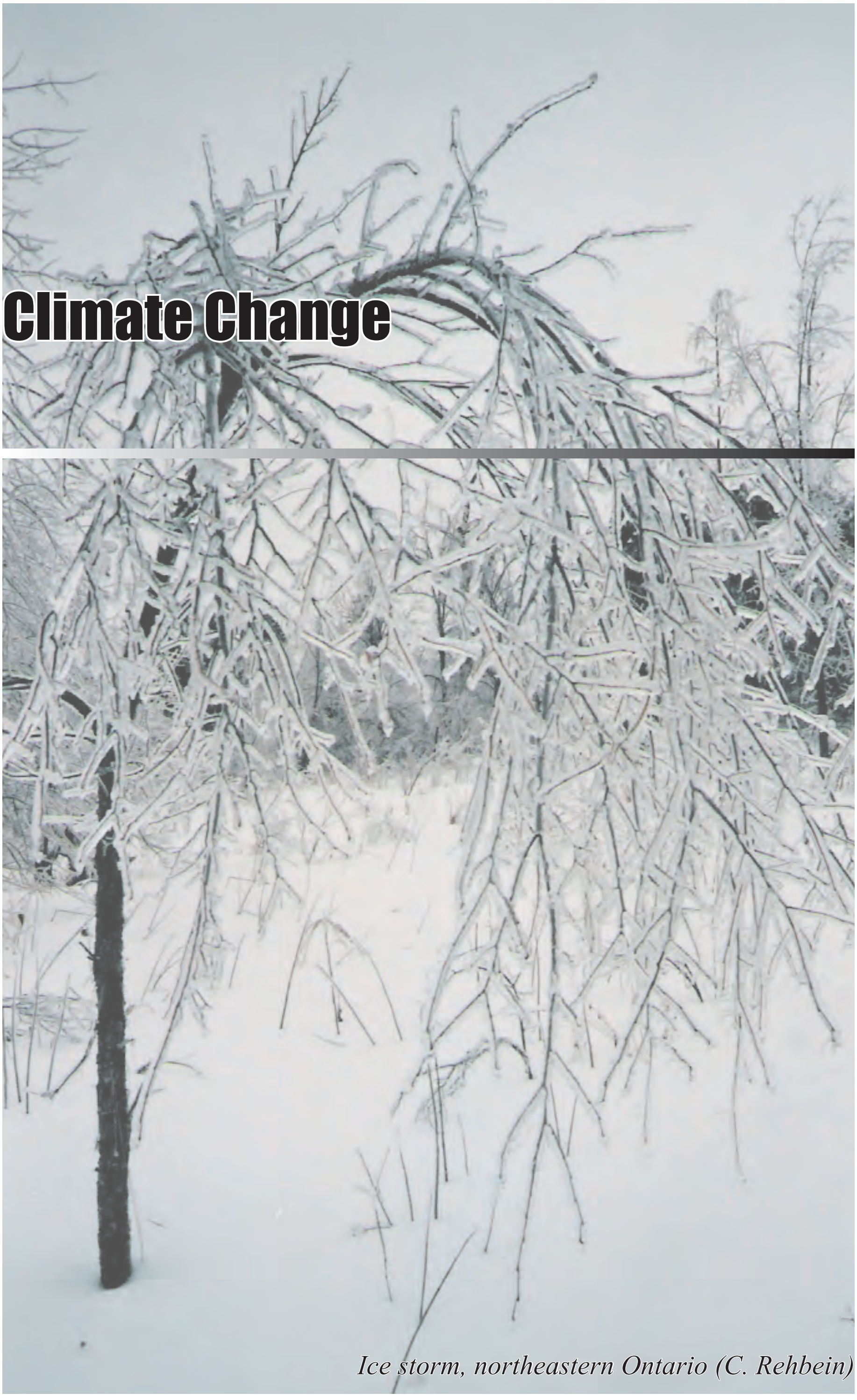
Climate Change



Ice storm, northeastern Ontario (C. Rehbein)

Climate Change and Ontario's Provincial Parks: A Preliminary Analysis of Potential Impacts and Implications for Policy, Planning and Management

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Abstract

In collaboration with Ontario Parks, the University of Waterloo and the Parks Research Forum of Ontario (PRFO), a preliminary analysis was completed on the impacts of climate change on Ontario's system of provincial parks. First, historical climate trend analyses illustrated mean temperature increases ranging from 0.26-1.2°C in a representative sample of provincial parks. Second, General Circulation Models (GCMs) projected increases in annual temperature of about 1.8-3.2°C in the 2020s, 1.8-7°C in the 2050s, and 2.5°C-10°C in the 2080s in the same representative sample of provincial parks. Third, results of the fire-severity change analysis generally indicated a considerable decrease in the 'low' fire severity rankings and increases in the 'high', 'very high' and 'severe' fire severity rankings for the majority of Ontario's provincial parks by the 2050s (ca. 2 x CO_2) and especially the 2090s (ca. 3 x CO_2). Finally, vegetation modeling results showed the potential for substantial change in biome-type in Ontario's provincial park system (64-93% depending on the scenario used). The study identified a number of park policy and planning sensitivities (notably, that the Ontario Parks system plan has been designed to protect specific natural features, species and communities in-situ*, and not take into account shifts in ecosystem structure and distribution that could be induced by global climatic change). Ultimately, however, the anticipated changes in ecosystem structure and composition expected under climatic change, coupled with some species' inability to genetically adapt to new climatic conditions or migrate to suitable climatic and vegetation zones, could hinder the ability of Ontario's*

protected area managers to maintain some habitats and species populations in the future.

Introduction

Recent reconstructions of global mean-surface temperature from both 'proxy' (e.g., tree rings, ice cores, and lake sediments) and modern (i.e., 1850-2000) instrumental temperature records indicate that global 20th century warming is unprecedented over the past two millennia (Houghton *et al.,* 2001; Mann *et al.,* 2003). Warming trends in Canada over the 20th century have averaged approximately 1^{o}C with regional variations ranging from about 1.5^{o}C in the western Northwest Territories (NWT) to 1^{o}C in southern portions of Canada. In contrast, a cooling of 0.8^{o}C has been recorded in Nunavut over roughly the same period (Environment Canada, 1998). Modeling and statistical studies indicate that such anomalous patterns cannot be fully explained by natural factors, but instead, require an anthropogenic forcing during the late-19th and 20th centuries (Mann *et al.,* 2003; Braganza *et al.,* 2004). Globally, the Intergovernmental Panel on Climate Change (IPCC) *Third Assessment Report* (TAR) has indicated that temperatures could rise between 1.4 and 5.8°C over the 21st century (Houghton *et al.,* 2001). As a northern country, Canada is projected to warm more than most other countries – in some areas, more than double the global average increase. Climate change of this magnitude, projected to occur over a relatively short period of time, would have significant consequences for Canadian ecosystems.

Climate plays a crucial role in determining the geographic distribution patterns of major biomes or vegetation communities (Holdridge, 1947; Woodward, 1987). An increasing number of empirical studies document the ecological effects (e.g., changes in phenology, distribution, and physiology) of recent climate change (Parmesan, 1999; Hughes, 2000; McCarty, 2001; Warren *et al.,* 2001; Walther *et al.,* 2002; Parmesan and Yohe, 2003; Root *et al.,* 2003; Thomas *et al.,* 2004; Parmesan and Galbraith, 2004), and climate change has been linked to several recent species extinctions (Pounds *et al.,* 1999; Thomas *et al.,* 2004; McLaughlin *et al.,* 2002). Compounding these impacts, projections of biome-type change indicate that the required migration rates of several Canadian species would need to be greater than 1000 m year^{-1} if they were to keep up with projected climatic warming and vegetation change anticipated in the 21st century (Malcolm *et al.,* 2002).

Taken collectively, these studies indicate that the implications of projected climate change and ecosystem change on global biodiversity conservation could be considerable. Most protected areas have been designed to protect specific natural features, species and communities *in-situ*, not taking into account shifts in ecosystem structures that could be induced by climatic change. A recent report by the World Wildlife Fund (WWF) emphasized that:

> "*…protected areas offer a limited defense against problems posed by rapid environmental change [and] protected areas will themselves need to be changed and adapted if they are to meet the challenges posed by global warming*." (WWF 2003: 1).

A number of authors (Peters and Darling, 1985; Scott and Suffling, 2000; Scott *et al.,* 2002; Hannah *et al.,* 2002; Lemieux and Scott, submitted) contend that climate change has the potential to undermine over a century of conservation efforts. Furthermore, the IPCC *Special Report on Climate Change and Biodiversity* states that:

> "*Despite the uncertainties… the overall conclusions … establish that anthropogenic climate warming at least ranks alongside other recognized threats to global biodiversity [and] contrary to previous projections, it is likely to be the greatest threat in many if not most regions*." (Thomas *et al.,* 2004: 147).

This paper examines the implications of climate change for Ontario's system of provincial parks. The objectives are four-fold: (i) review the evidence for recent climate change in a representative sample of provincial parks; (ii) assess projected vegetation change within the provincial park system utilizing outputs from global vegetation model (GVMs); (iii) assess projected fire severity change within the provincial park system utilizing outputs from global circulation models (GCMs); and, (iv) consider the implications these impacts have for park and protected areas management, policy and planning (at both the system and individual park levels). Due to space restrictions, the methods provided here consist of general descriptions only; sources containing more detailed descriptions of data sets and model methodologies are provided. The limitations associated with the use of instrumental temperature records, GCMs and GVMs are also noted in these sources.

Methods

Historical Climate Trend Analysis and Climate Change Projections

Using climate stations, a representative sample of provincial parks in each of the Ontario Ministry of Natural Resources (OMNR) Ontario Parks park management zones was utilized to examine recent climatic trends (departures from the 1961-1990 norm) in these parks over the historic record. The availability of continuous climatic data sets was a major determining factor in both park and station selection.

Monthly values of mean temperature and total annual precipitation were acquired for each station from Environment Canada (2003a; 2003b). The Environment Canada Historical Adjusted Climate Database (Environment Canada, 2003a) of homogenized and long-term temperature time series, which has been specifically designed for climate change analyses over Canada, was used for the majority of stations utilized in the study and the identifier (adj) is used in this paper to illustrate these data sets.

This study also examined the projected range of temperature and precipitation changes for the same representative sample of provincial parks for the 2020s, 2050s and 2080s utilizing the results of the Intergovernmental Panel on Climate Change's (IPCC) *Special Report on Emissions Scenarios* (SRES) family of Global Circulation Models (GCMs). The results from this analysis were derived from the Canadian Climate Impacts and Scenarios data centre (CICS, 2004).

Biome-type Change Analysis

The vegetation change scenarios for this analysis were based on modeling results developed for the IPCC-Working Group 2 (Neilson, 1998). The two Global Vegetation Models (GVMs) used were BIOME3 (Haxeltine and Prentice, 1996) and MAPSS (Neilson, 1995). A concise comparison of the vegetation discrimination criteria and ecophysiological processes modeled by BIOME3 and MAPSS is provided in Peng (2000: 43).

Fire Severity Change Analysis

The methodology of this analysis is based on the modeling results of Stocks *et al.* (1998) and Stocks *et al.* (2000). In these studies, fire weather data from the 1980s and the Second Generation Canadian Global Circulation Model (CGCM2) (Boer *et al.,* 1992; McFarlane *et al.,* 1992) were utilized to compare the intensity and spatial distribution of current and projected (2050s and 2090s) seasonal levels of fire weather severity across Canada. In this approach, values are used to provide an assessment of relative fire potential based solely on weather, independent of forest vegetation and fuel conditions.

Results

Historical Climate Trend Analysis

Historical climate analysis was completed for a representative sample of provincial parks to illustrate trends in mean annual temperature (MAT) and total annual precipitation (TAP) over the historical records (Figure 1). Results of this analysis are displayed as MAT (°C) and TAP (mm) relative to the average of the 1961-1990 period. All stations utilized in the analysis illustrated an increase in MAT over their respective historical records compared to the 1961-1990 period. Results showed that the greatest increase in MAT over the instrumental record occurred in Tidewater (Moosonee [adjusted] station – +1.2°C) and Quetico (Thunder Bay [adjusted] station – +1.14°C) Provincial Parks. Conversely, results illustrated that Rondeau Provincial Park has experienced the least temperature change over the historical record (Ridgetown ACS [adjusted] station – +.26°C). Interestingly, eight of the ten stations utilized in this analysis illustrated MAT trends greater than +0.8°C (two stations had increases greater than 1°C).

For the five-year grouped period of 1997-2001, eight of the ten climate stations analyzed for MAT experienced the warmest five-year mean temperatures on record (Table 1). However, it is important to note that the Parry Sound station used for Massasauga Provincial Park only contained data up to 1990, and 1986-1990 was the warmest five year period on record for this station. So, for nine of the ten stations utilized in this study, the last five years on record were the warmest. Interestingly, the 1997-2001 grouped record for Tidewater Provincial Park was the only five-year grouping to show a mean above 0°C

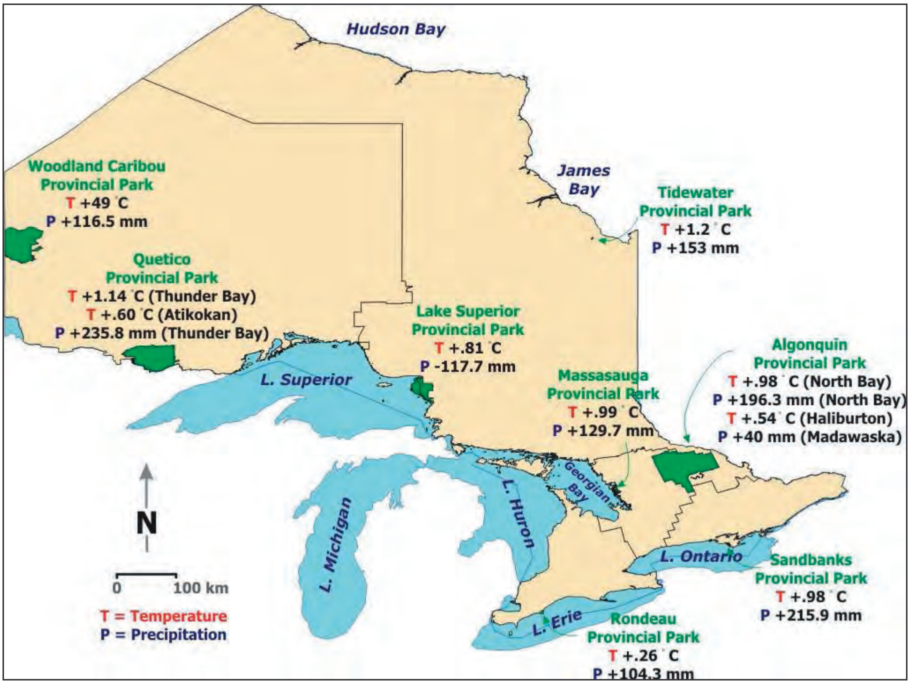

Figure 1. *Mean annual temperature (°C) and total annual precipitation (mm) trends over the historical records.*

(1.08°C). Rondeau Provincial Park was the only park to not display the warmest grouped five year MAT in the last five years of its respective historical record (1951-1955).

Climate Change Projections

Based on the outputs from the SRES scenarios utilized in this study, most parks are projected to experience annual temperature changes of about +1.8-3.2°C in the 2020s, +1.8-7°C in the 2050s and +2.5°C-10.0°C in the 2080s (Figure 2). The greatest changes in temperature were projected for the northern parks, including Tidewater Provincial Park and Woodland Caribou Provincial Park. The greatest change in precipitation was projected for Tidewater Provincial Park in the Northeast Zone and the least precipitation change was projected for Rondeau Provincial Park in the Southwest Zone (Figure 3).

Station	Warmest 5-year Period	Five Warmest Years	Coolest 5-year Period	Five Coolest Years
Rondeau Provincial Park (Southwest Zone)				
Ridgetown ACS (adj)	1951-1955	1998, 1987, 1949, 1953, 1951	1976-1980	1924, 1926, 1978, 1940, 1976
Algonquin Provincial Park (Central Zone)				
North Bay A (adj)	1997-2001	1998, 2001, 1999, 1987, 1953	1962-1956	1940, 1972, 1943, 1976, 1980
Haliburton (adj)	1997-2001	1932, 1931, 2001, 1999, 1998	1902-1906	1904, 1917, 1940, 1943, 1934
Sandbanks Provincial Park (Southeast Zone)				
Belleville (adj)	1997-2001	1998, 1999, 1953, 1991, 1987	1921-1925	1923, 1926, 1940, 1924, 1934
Massasauga Provincial Park (Central Zone)				
Parry Sound	1986-1990	1921, 1987, 1931, 1949, 1990	1884-1888	1885, 1883, 1888, 1904, 1926
Quetico Provincial Park (Northwest Zone)				
Thunder Bay A (adj)	1997-2001	1999, 2001, 1987, 1998, 1931	1912-1916	1917, 1912, 1950, 1907, 1936
Atikokan‡	1997-2001	1998, 2001, 1931, 1987, 1999	1978-1982	1972, 1979, 1957, 1985, 1929
Woodland Caribou Provincial Park (Northwest Zone)				
Red Lake A	1997-2001	1987, 1998, 2001, 1999, 1941	1992-1996	1950, 1979, 1955, 1972, 1996
Lake Superior Provincial Park (Northeast Zone)				
Wawa A (adj)	1997-2001	1991, 1999, 1987, 2001, 1998	1972-1976	1950, 1972, 1956, 1976, 1989
Tidewater Provincial Park (Northeast Zone)				
Moosonee (adj)	1997-2001*	2001, 1998, 1999, 1987, 1952	1932-1936	1917, 1933, 1936, 1912, 1972

‡ = joined record (adj) = adjusted

Table 1. *Warmest and coolest periods in historic climate records.*

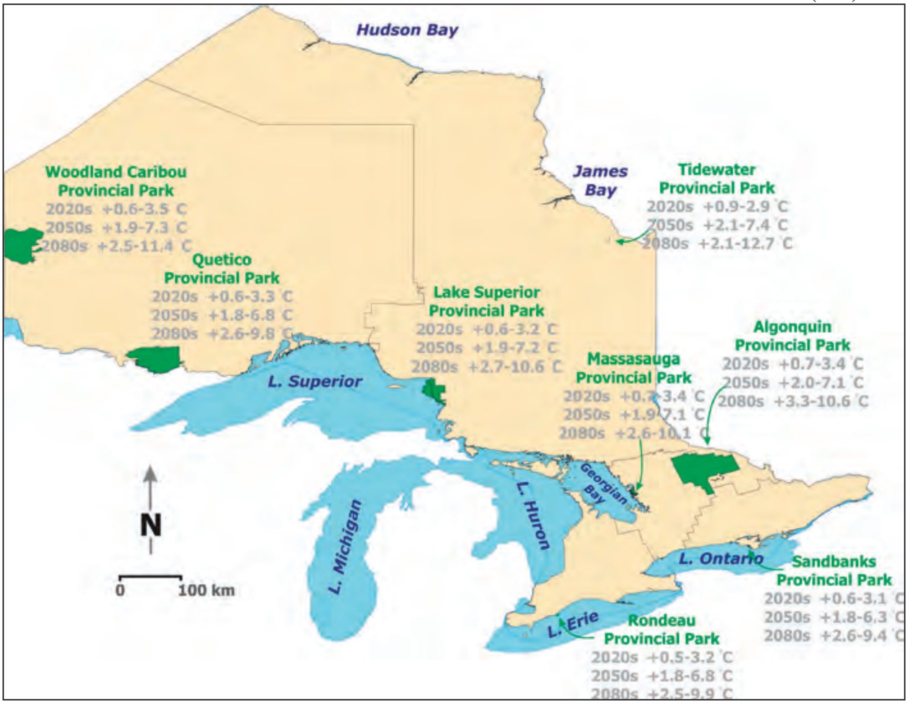

Figure 2. *Climate change projections – temperature (°C).*

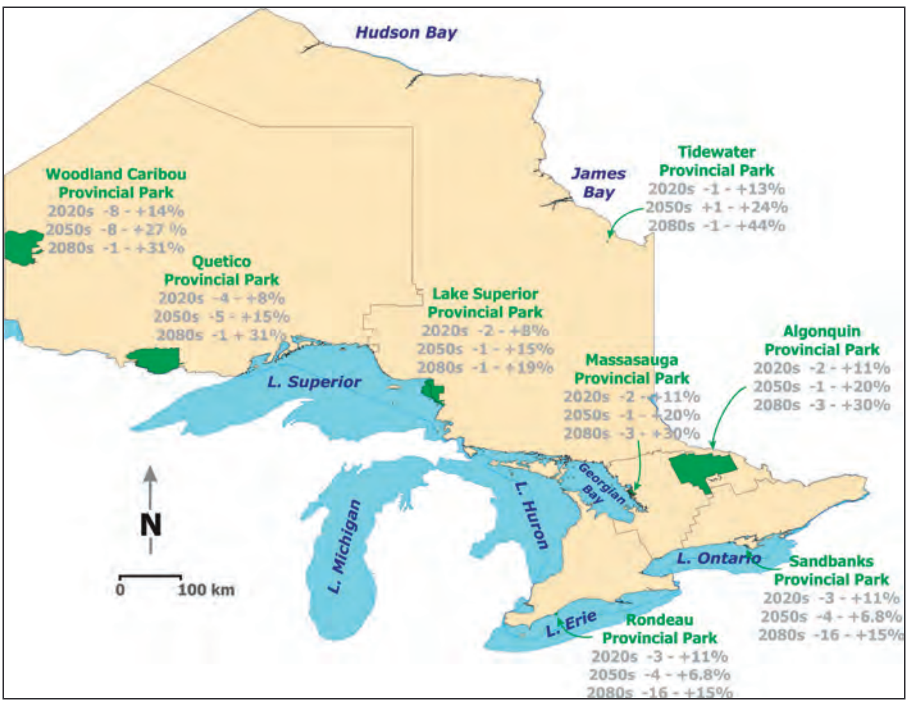

Figure 3. *Climate change projections – precipitation (%).*

Fire Severity Change Analysis

The results of the fire-severity change analysis generally indicated a considerable decrease in the 'low' fire severity rankings and increases in the 'high', 'very high' and 'severe' fire severity rankings for the majority of Ontario's provincial parks under the 2050s (ca. 2 x CO_2) and especially the 2090s (ca. 3 x CO_2) scenarios (Figure 4). The scale shown is relative, with values above six being extreme. A real value of zero is only possible in remote cold regions where no fire danger exists in the summer months. For the 1980-1990 baseline, 13% of Ontario's provincial parks are classified within the 'low' (<1) fire severity ranking. By the 2050s and 2090s respectively, it is projected that only 5% and 1% of Ontario's provincial parks will be classified within the 'low' (<1) fire severity ranking.

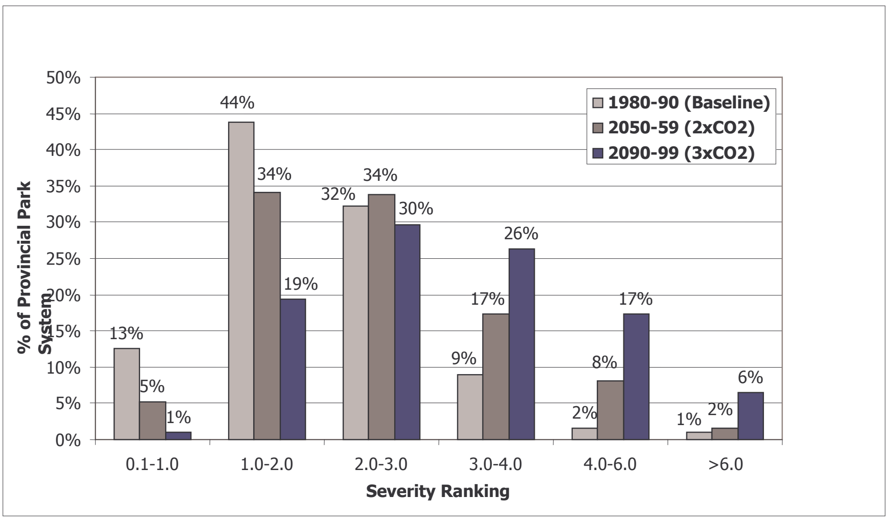

Figure 4. *Fire severity change in Ontario provincial parks for the 1980-1990 (baseline) and the 2050s (ca. 2 x CO_2) and 2080s (ca. 3 x CO_2) utilizing the CGCM2 GCM†.*

† Low severity ranking = <1.0, Moderate severity ranking = 1-3; High severity ranking = 3-4; Very high severity ranking = 4-6; Severe severity ranking = >6. The scale shown is relative, with values above 6 being extreme. A real value of zero is only possible in remote cold regions where no fire danger exists in the summer months.

Under the 1980-1990 baseline scenario, only 12% of Ontario's provincial parks fell into the 'high' (3-4), 'very high' (4-6) and 'extreme' (>6) fire severity ranking range. However, in the 2050s and 2090s scenarios, the number of provincial parks projected to experience these 'high' (>3) fire severity ratings increases considerably. The proportion of Ontario's provincial parks projected to be classified within the 'high', 'very high' and 'extreme' forest fire severity rankings is projected to increase to 27% by the 2050s and 49% by the 2090s.

Because of the high concentration of provincial parks in the south, a regional bias is evident – the majority of provincial parks utilized in this analysis are projected to experience 'moderate' levels (1-3) of fire severity under both the ca. 2 x CO_2 (68%) and ca. 3 x CO_2 (49%) scenarios. This is because the 'moderate' forest fire severity ranking is dominant throughout southern Ontario where a high number of relatively small provincial parks are located. Despite the relatively 'high' fire severity rankings projected for parks south of 46°N, wildfires in these forests will continue to be of negligible size under a warmer climate – this is a reflection of the relatively small forest patches which, in most instances, surround municipal infrastructures currently in place (e.g., roads, agriculture, telecommunication lines). Overall, the large numbers of provincial parks in southern Ontario comprise only a small proportion of the total protected area system area. However, many of these provincial parks are significant for biodiversity conservation as they protect many rare or endangered Carolinian species.

Biome-type Change Analysis

Regardless of the Global Vegetation Model (GVM) and climate change scenario used, the vegetation modeling results showed the potential for substantial change in biome-type and biome-representation in Ontario's provincial park system (Figures 5; Figure 6). The MAPSS GVM scenarios projected that the majority (72% HadCM2; 93% UKMO) of Ontario's provincial parks could experience a change in biome-type (Table 2). The BIOME3 GVM scenario showed only slightly fewer provincial parks with a change in biome-type (64% HadCM2).

With regards to biome representation change in the Ontario park system (Table 3; Table 4), there was general agreement among the scenarios. The GVM scenarios generally projected that Ontario provincial parks could experience increased representation of southern biome types, such as 'tree savanna decidu-

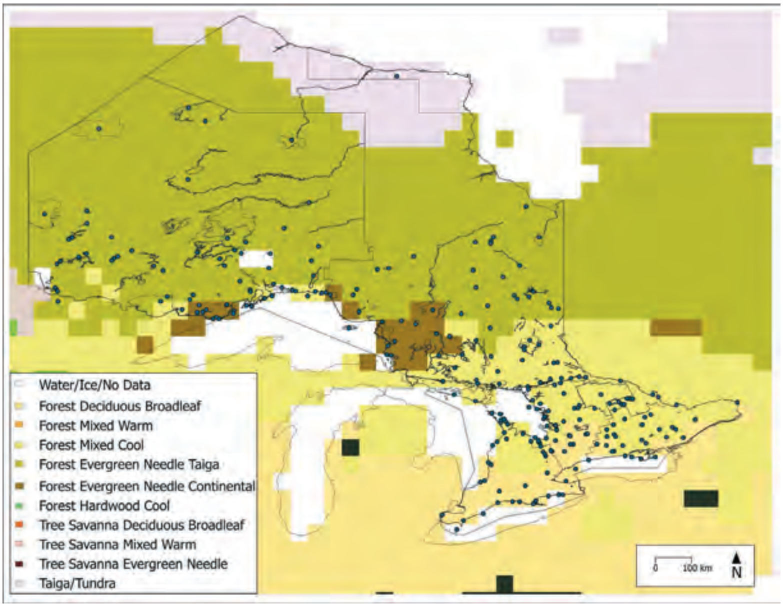

Figure 5. *Biome change in Ontario provincial parks – MAPSS current.*

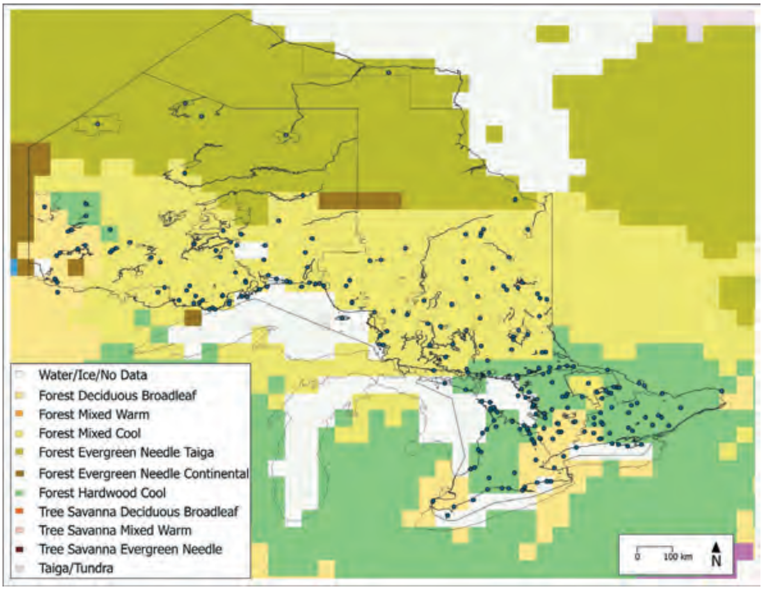

Figure 6. *Biome change in Ontario provincial parks – MAPSS HadCM2.*

Table 2. *Biome-type change within Ontario provincial parks.*

	MAPSS		BIOME3
	HadCM2	UKMO	HadCM2
Change	72%	93%	64%

Table 3. *Biome-type representation change of Ontario provincial parks – MAPSS.*

Classification	Number of Provincial Parks under MAPSS Current	Number of Provincial Parks under HadCM2	Number of Provincial Parks under UKMO
Water/error	28	28	24
Forest deciduous broadleaf	36	37	153
Forest mixed warm	0	0	15
Forest mixed cool	95	101	1
Forest evergreen needle taiga	73	6	0
Forest evergreen needle continental	20	0	0
Forest hardwood cool	0	81	0
Tree savanna deciduous broadleaf	0	0	15
Tree savanna mixed warm	0	0	41
Tree savanna evergreen needle continental	0	0	4
Taiga/tundra	1	0	0

Table 4. *Biome-type representation change of Ontario provincial parks – BIOME3.*

Classification	Number of Provincial Parks under BIOME3 Current	Number of Provincial Parks under HadCM2
Water/Error	40	32
Boreal Evergreen forest/woodland	29	1
Temperate conifer forest	125	101
Temperate/boreal mixed forest	32	0
Temperate deciduous forest	27	119

ous broadleaf' and 'tree savanna mixed warm'. Conversely, the more northern biome types, such as 'forest mixed cool', 'forest evergreen needle-taiga', and 'forest evergreen needle continental', could decrease considerably within the provincial park system. Both the MAPSS HadCM2 and UKMO scenarios projected that the 'forest evergreen continental needle' biome-type will experience a complete loss in representation. While both MAPSS scenarios (HadCM2 and UKMO) projected generally similar changes in biome representation for Ontario provincial parks, there were some discrepancies. For example, where the HadCM2 scenario projected an increase in the 'forest mixed cool' biome (+6%), the UKMO scenario projected a considerable decrease (-94%).

The BIOME3 HadCM2 scenario (Table 4) projected generally similar changes in biome representation to that of the MAPSS HadCM2 scenario, although it is acknowledged that different classification schemes were utilized between the two GVMs, thereby limiting a more detailed comparative analysis. Generally, the BIOME3 HadCM2 scenario projected losses of all of the northern biome types, including the 'boreal evergreen forest/woodland' biome-type (-97%). Conversely, because the BIOME3 HadCM2 scenario projected great expansion of the 'temperate deciduous forest' biome into Ontario, considerable increases in representation of this biome-type by Ontario provincial parks resulted (92 provincial parks). Under all GVM and GCM scenarios, the only provincial park located on the 'taiga/tundra' biome (Polar Bear Provincial Park) is projected to change biome type, leading to the loss of representation of this biome in the provincial park system.

Implications for Ontario Parks Policy, Planning and Management

On November 25, 1992, the Canadian Parks Ministers Council met jointly with the Canadian Council of Ministers of the Environment and Wildlife Ministers Council of Canada and signed a *Statement of Commitment to Complete Canada's Networks of Protected Areas* (FPPC, 2000). In so doing, the key commitment for Parks Ministers was to:

> *"make every effort to complete Canada's networks of protected areas representative of Canada's land-based natural regions by the year 2000 and accelerate the protection of areas representative of Canada's marine natural regions."* (FPPC, 2000: 5).

As a result, most jurisdictions in Canada have adopted some type of ecoregion or biogeoclimatic classification framework as the main system-planning tool for their terrestrial protected area system.

In response to the *Statement of Commitment*, the most recent planning and management policy adopted by Ontario Parks, *Ontario Provincial Parks – Planning and Management Policies* emphasized that:

> *"...provincial parks are established to ensure that features representing the most significant aspects of Ontario's natural and social history are protected, now and in the future."* (OMNR, 1992a: 2).

Each of Ontario's provincial parks makes a particular contribution to the system based on the resources it contains. Ecoregion representation is defined as one of nine principles utilized to guide the management of the Ontario provincial park system (in addition to the principles of 'permanence', 'distinctiveness', 'variety', 'accessibility', 'coordination', 'system', and 'classification'), and to achieve the system's overall objectives. The *Planning and Management Policy* document states that:

> *"Provincial Parks are established to secure for posterity representative features of Ontario's natural and cultural heritage. Wherever possible the best representations of our heritage will be included in the park system."* (OMNR, 1992a: 13).

Three classification schemes – one each for life science, earth science, and cultural resources – form the basis for the park program's representation targets (OMNR, 1992a: 12).

The potential impacts of climate change have important implications for Ontario Parks' current policy and planning frameworks. Ontario Parks' approach to protected areas establishment is based on the works of Hills (1952, 1959, 1960, 1961, 1976) and Hills and Pierpoint (1960) who recognized the fundamental importance of climate in the classification of forest sites. Hills (1952, 1959, 1960, 1961, 1976) and Hills and Pierpoint (1960) utilized what they referred to as 'normal', 'uniform', 'homogenous' or 'definite' reference points for the development of vegetation for the surrounding region. In a changing climate, conservation planning based on 'normal' or 'homogenous' reference points and protecting representative samples of natural areas as an *in-situ* entity will have to deal with many challenges. As Scott and Suffling (2000) emphasize, protected area system planners will have to attempt to 'hit a moving target' of ecological representativeness as current protected area system plans are based on current species assemblages. Moreover, because possible non-analogue assemblages are unknown, comprehensive representation in a system of protected areas could become an increasingly difficult objective (Scott and Suffling, 2000).

Provincial park management plans are prepared for each park, in accordance with the *Provincial Park Management Planning Manual* (OMNR, 1992b). A review of management plans for several Ontario provincial parks revealed additional climate change implications for the management of individual protected areas. These include park objective statements; fire management strategies: individual species management plans and species at risk; non-native species management programs; and visitor management plans. For example, the management plan of each individual park defines the purpose of the park. The *Quetico Provincial Park Management Plan* states that:

> *"Quetico Provincial Park will protect a representative portion of the ancient geological history, modern biological environments, and cultural features associated with site region 4W."* (OMNR, 1995a, emphasis added).

The emphasis on the protection of 'modern' biological environments in these management plans renders them sensitive to changing climatic and vegetative conditions. And, as a result, these parks may no longer represent the ecological communities they are mandated to protect. Again, the principles of 'representation' and 'modern biological environments' are problematic as they assume climatic and biogeographic stability. Similar sensitivities can be found in virtually all park management plans examined to date.

OMNR mandates at the species level are also sensitive when climate change impacts are considered. For example, Polar Bear Provincial Park, as the name implies, was established to protect one of the world's largest denning areas for polar bears. Under climate and vegetation change scenarios and future sea-ice projections, the park would no longer provide suitable habitat for the species it was originally designed to protect. Reduced ice-cover in Hudson and James Bay may force polar bears northward in search of more suitable habitat and where they can more effectively hunt ringed seal. Changing vegetative conditions would force woodland caribou northward to more suitable habitat in

Woodland Caribou Provincial Park, a park specifically set up to protect this keystone species. Similarly, a re-introduced population of Woodland Caribou in Lake Superior Provincial Park may be forced northward to more suitable habitat, largely undoing the value of this conservation initiative. As a final example, the objective of Pinery Provincial Park is:

> *"…to protect an extensive, provincially significant, freshwater dune system with associated representative floral, faunal and cultural features and to provide high quality educational and recreational experiences."* (OMNR, 1986: 1).

Moreover, the *Pinery Provincial Park Management Plan* states that the park will:

> *"…ensure that Pinery harbours the richest naturally occurring communities inherent to its unique microclimate and topography."* (OMNR, 1986: 4, emphasis added).

What is considered 'natural' will become more difficult to define as species ranges change, and new species, currently regarded as 'unnatural', may find suitable refuge within Pinery. As a consequence, the species requiring protection will increasingly be open to interpretation. In these cases, the ecological manifestations of climate change may be such that the established management objectives of the park are no longer viable.

Perhaps most important from a species conservation perspective are the potential effects that climate changes poses for rare or endangered species. Many species at risk have very restricted habitat requirements or habitat availability and are the most vulnerable to changes. Without active intervention (i.e., translocation), many significant species are likely to be lost. The *Canadian Species at Risk Act* defines a 'wildlife species' as a species 'native' to Canada and that has been present in Canada for at least 50 years (Government of Canada, 2002: 7). By this definition, species that have expanded (or will expand) their range into Canada under changing climate and ecological conditions, possibly classified as endangered in the United States, would not qualify as a species at risk under the *Canadian Species at Risk Act*, complicating the issue of endangered species conservation in Ontario and all Canadian jurisdictions.

Other OMNR strategies, such as those for control of invasive species, will also require review because of climate change. For example, the *Lake Supe-*

rior Provincial Park Management Plan (OMNR, 1995b) states that non-native plant species will be removed if they conflict with the representational values for which the park has been established. This statement does not allow for ecosystem change, and the very definition of a non-native species (a species beyond its historical range) is challenged under climate change and resultant biogeographic shifts. Other policies, such as the *Fire Management Policy for Provincial Parks and Conservation Reserves* (OMNR, 2004), may also be tested for their effectiveness in re-establishing ecological representation (one of the reasons why the policy was developed in the first place) under changing climate and fire severity conditions.

A New Approach

It is emphasized here that the traditional systematic approach to park system planning is indeed problematic; and, a new approach – one that incorporates ecosystem dynamics and change – is needed to safeguard against the fundamental flaws of *in-situ* representation and species loss in Ontario. Like the Canadian national park system plan, Ontario's provincial park planning frameworks were designed with the assumption of essentially static biogeography and will be challenged by the dynamic nature of ecosystem evolution brought about by projected climate change in the 21st century. Ultimately, the results of this study contribute to a growing body of research that questions the capacity of existing protected area networks to fulfill this objective in an era of global climate change.

Although there is much uncertainty over the timing, extent and manner in which ecosystems will respond to new climatic conditions, this does not negate the necessity of identifying and assessing adaptation strategies that might reduce the vulnerability of Ontario's system of protected areas to anticipated climate change. Recent discussions at a Parks Research Forum of Ontario (PRFO) workshop on climate change (Leslie Frost Research Centre, Dorset, Ontario, March, 2004) and an OMNR northwest zone climate change workshop (Quetico Centre, Atikokan, Ontario, December, 2004) revealed that incorporating climate change into protected area system planning and individual park management decision-making processes will be a complex and incremental process, but one that the majority of Ontario Parks' managers and planners strongly agreed was essential. Interestingly, all participants (approximately 30) who completed a survey distributed at the PRFO climate change workshop stated that they believed that either climate change is occurring or climate change is certain to occur. Results of the survey also indicated that the majority of respondents strongly agreed (67%) or somewhat agreed (22%) to the statement that climate change is going to substantially alter protected area policy and planning over the next 20 years. Finally, respondents strongly disagreed (67%) or somewhat disagreed (33%) with the statement that climate change is too far in the future to consider it in current planning activities.

The issues related to the strategic response of Ontario Parks to the challenges of climate change are very complex and will require significant input from many conservation stakeholders. Institutional financial commitment, capacity enhancement, cooperation, direction and communication are a number of facets that will be essential to the successful implementation of any climate change adaptation related strategies in Ontario.

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The Importance of Polar Bear Provincial Park to the Southern Hudson Bay Polar Bear Population in the Context of Future Climate Change

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Abstract

*Ontario's Polar Bear Provincial Park (PBPP) was established in 1970 as a 'primitive park'. The park protects two critical habitat elements for Southern Hudson Bay (SHB) polar bears (*Ursus maritimus*): coastal summer retreat habitat used by all classes of bears and inland maternity denning habitat used by pregnant females. Late-summer aerial surveys indicate that the park provides protection to 70% of the SHB population occupying summer retreat habitat; 23% of the population occupies the Ontario coast outside the park; and 7% occupies islands in James Bay. Winter aerial surveys indicate that 91% of dens were found in Ontario (36% within the park, and 55% outside), and 9% of dens were found on islands in James Bay. Preliminary data from satellite-collared bears and summer aerial surveys indicated bears selected treed areas, river banks, gravel ridges, and palsas to construct maternity dens. Gravel ridges were selected closer to James Bay where permafrost features were less common, whereas palsas were selected more often west of the Winisk River. If current trends continue, permafrost features such as palsas may disappear and polar bears will be forced to construct maternity dens in river banks and gravel ridges. These are more common inside the park suggesting that the park may be even more important to the SHB population as a maternity denning area in the future. Currently, PBPP provides protection for a high proportion of bears occupying summer retreat habitat, but for only about one-third of maternity dens. Nevertheless, PBPP performs a significant role in helping Canada to meet its obligations to protect polar bear habitat. If climate change models are correct, the importance of PBPP to the SHB polar bear population will increase in the future.*

Introduction

Ontario's Polar Bear Provincial Park, which occupies 24 000 km^2 in the Hudson Bay Lowlands (Figure 1), is among the world's largest parks and is three times the size of Algonquin Provincial Park (OMNR, 1980). The park was established in 1970 and classified as a 'primitive park' at that time (Ontario Department of Lands and Forests, 1967). Primitive parks were intended to protect representative areas of natural landscapes for posterity in "*natural, wild conditions*" (OMNR, 1977). The initial goals for PBPP were identified in the park master plan as threefold: (i) to protect its environment for the benefit of present and future generations from significant alteration by humans; (ii) to provide quality, low-intensity wilderness recreational opportunities; and, (iii) to provide opportunities for scientific research complementary to Ministry of Natural Resources' programs (OMNR, 1980: 1).

Throughout the 1950s and 1960s there was a rapid increase in the recorded harvest of polar bears (*Ursus maritimus*) throughout the circumpolar Arctic (Prestrud and Stirling, 1994). In response to this significant threat to the survival of polar bear populations, the five nations with jurisdiction over areas where polar bears occur (Canada, Denmark, Norway, USA, and USSR) entered into lengthy negotiations that culminated in the signing of the *International Agreement on the Conservation of Polar Bears and their Habitat* in 1973 (Prestrud and Stirling, 1994).

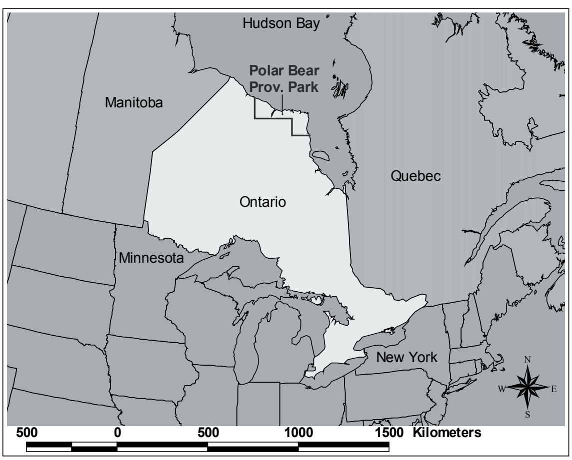

Figure 1. *Location of Polar Bear Provincial Park, Ontario.*

Article II of the Agreement states:

"*Each Contracting Party shall take appropriate action to protect the ecosystems of which polar bears are a part, with special attention to habitat components such as denning and feeding sites and migration pat-*

> *terns, and shall manage polar bear populations in accordance with sound conservation practices based on the best available scientific data.*" (IUCN/PBSG, 2002).

In the decades following the signing of the International Agreement, many polar bear populations recovered to former levels as harvests were controlled and closely monitored (Prestrud and Stirling, 1994). However, with the exception of some denning habitat, little progress has been made on the protection of habitat for polar bears (Prestrud and Stirling, 1994).

In Hudson Bay, where the sea ice melts annually, polar bears are forced ashore to fast and await the return of the ice (Stirling *et al*., 1977). Hudson Bay is ice-free for approximately four months each year, roughly from mid-July to late November or early December (Kolenosky *et al*., 1992; Stirling and Derocher, 1993; Stirling *et al*., 1999). During this time, polar bears of the Southern Hudson Bay (SHB) population can be found on many of the islands in James Bay, and along most of the mainland shore of Ontario from the James Bay shore north of Attawapiskat to the Manitoba border (Prevett and Kolenosky, 1982). During the onshore season both males and females tend to show strong site fidelity to local areas of the coast (Prevett and Kolenosky, 1982; Stirling *et al.*, 1999; Stirling *et al.*, 2004). In contrast, pregnant females move inland up to 80 km or more to construct maternity dens in which they give birth to their cubs (Kolenosky and Prevett, 1983; Derocher and Stirling, 1990; Clark and Stirling, 1998).

Although Polar Bear Provincial Park was created by Order-in-Council in April 1970 (OMNR, 1977), more than three years prior to the signing of the International Agreement, the master plan recognized that the park was of scientific importance particularly with regard to permafrost, arctic tundra, waterfowl, shore birds, and polar bears (OMNR, 1980). The classification of PBPP as a 'primitive park' in 1970 recognized the importance of protecting the landscape. This value was re-emphasised when the classification name was changed to 'wilderness park' in 1978 (OMNR, 1978). The purpose of this paper is to document use of PBPP by polar bears, and to evaluate the degree to which the park helps Canada to meet its obligations to protect critical polar bear habitat under Article II of the international agreement.

Methods

To document the use of PBPP by polar bears we examined two sources of data: results of annual late-summer aerial surveys conducted by Ontario Ministry of Natural Resources (OMNR) staff from 1963-1996 (e.g., Prevett and Kolenosky, 1982), and results of winter aerial surveys conducted periodically in the 1970s, 1980s and 1990s (Kolenosky and Prevett, 1983). Late-summer aerial surveys were flown along the Ontario coast to count bears within 0.5 km of the high tide mark, and on offshore spits and islands. In 22 of 34 years an aerial survey of Akimiski Island in James Bay was also conducted. In the late 1980s and 1990s the use of twin-engine aircraft enabled observers to survey other smaller islands in James Bay. However, few bears were generally seen on these islands and as these data are available for only six of 34 years they are not considered here. The count of bears on Akimiski Island is considered to represent the count of SHB bears in James Bay, but not on the Ontario coast.

Although effort varied somewhat between years (aircraft type, number of observers), late-summer surveys were generally flown as single continuous tracks at about the same time of year (mid-August to mid-September). The Ontario coast was divided into three areas for data analysis: Area 1 (Hook Point on James Bay to the Winisk River), Area 2 (Winisk River to the Severn River) and Area 3 (Severn River to the Manitoba–Ontario border) (Figure 2). Although the western boundary of PBPP is about 30 km east of the mouth of the Severn River, very few polar bears are seen in any year between the western boundary of the park and the Severn River (Obbard, unpublished data), and data from early years often do not include exact location coordinates. Therefore, we assumed that the total count of bears for Areas 1 and 2 represented the bears found within the boundaries of PBPP. Winter aerial surveys were flown by OMNR staff along pre-determined transects in late February and early March and were designed to intersect tracks of family groups on their journey to the sea ice. At that time of year, adult females with approximately three-month-old cubs are returning from maternity dens to the ice to resume seal hunting (Kolenosky and Prevett, 1983). On sighting of tracks, it was assumed that adult females had denned inland of that location. If tracks were deemed to be fresh they were followed forward to encounter the family group and verify the litter size, or followed backwards to locate the maternity den. Due to fuel limitations, few tracks were followed to the maternity den location. Therefore observations indicate the minimum inland distance to maternity dens.

To supplement information derived from winter aerial surveys, preliminary data on maternity den locations of satellite-collared bears were obtained by averaging late fall locations of presumed pregnant females from 2000-2002. Presumed den locations were visited the following summer to document den type and habitat selection. Preliminary data from summer aerial surveys searching for dens are also included.

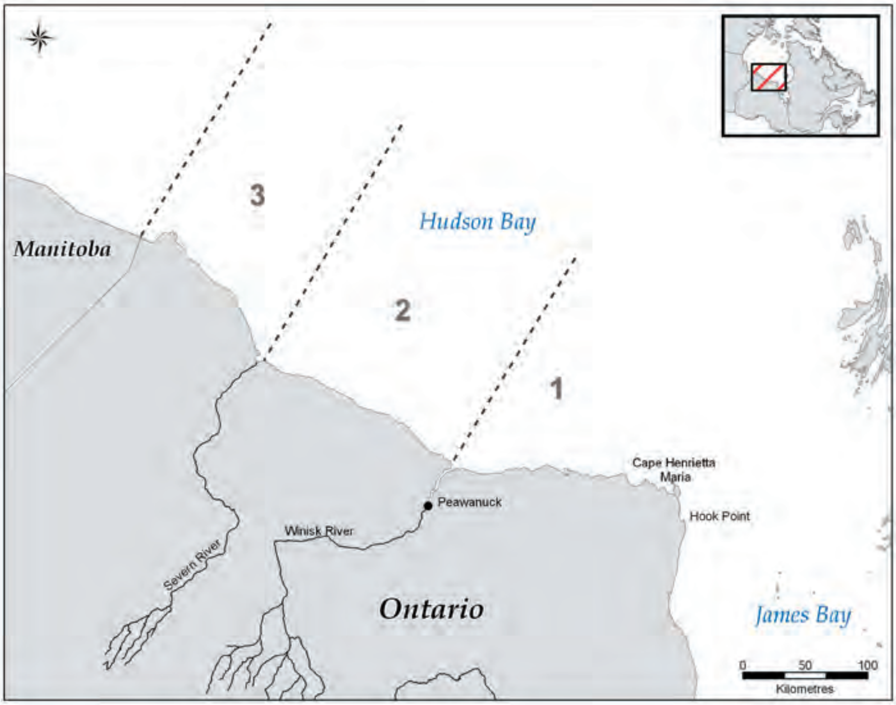

Figure 2. *Sampling areas for polar bear counts used in data analysis.*

Results

Late-summer Surveys

Though there was considerable variation in the number of bears observed over the years (Table 1), the largest proportion of bears was sighted in Areas 1 and 2 (i.e., within the boundaries of PBPP). On average, about 65-75% of bears seen along the Ontario coast in any one year were seen within PBPP. In recent

Table 1. *Number of polar bears counted during annual aerial surveys of the Ontario coastline from Hook Point, James Bay to the Manitoba border, 1963-1996.*

Year	Area 1	Area 2	Area 3	Total Area 1-3	Akimiski Island
1963	17	7	23	47	Not surveyed
1964	12	0	13	25	Not surveyed
1965	14	3	26	43	Not surveyed
1966	15	4	21	40	Not surveyed
1967	84	40	26	150	6
1968	35	22	34	91	15
1969	18	9	38	65	Not surveyed
1970	59	7	56	122	Not surveyed
1971	31	11	31	73	Not surveyed
1972	63	17	34	114	10
1973	29	16	26	71	12
1974	32	11	20	63	Not surveyed
1975	69	19	29	117	12
1976	35	7	24	66	13
1977	75	10	38	123	Not surveyed
1978	29	30	62	121	Not surveyed
1979	85	31	42	158	6
1980	93	21	59	173	17
1981	75	15	93	183	14
1982	78	11	47	136	9
1983	66	11	72	149	14
1984	89	25	20	134	5
1985	58	32	26	116	6
1986	57	11	33	101	15
1987	49	9	36	94	8
1988	45	23	75	143	Not surveyed
1989	59	36	66	161	6
1990	129	63	44	236	12
1991	87	27	45	159	6
1992	52	22	37	111	7
1993	103	54	Not surveyed	157	Not surveyed
1994	170	21	63	254	19
1995	171	22	47	240	28
1996	85	60	56	201	18

years (1990-1996), the survey was standardised using a de Havilland Twin Otter and three observers plus the pilot. For that period, the total number of bears observed averaged 216. The number of bears seen in Areas 1 and 2 averaged 152, the number seen in Area 3 averaged 49, and the number seen on Akimiski Island averaged 15. Therefore, on average, about 7% (15 of 216) of SHB bears were observed to summer on Akimiski Island, 23% (49 of 216) summered along the Ontario coast west of PBPP, and 70% (152 of 216) occupied summer retreat habitat within the boundaries of PBPP.

Winter Surveys

Systematic winter aerial surveys were conducted in February-March from 1974-1978 (Kolenosky and Prevett, 1983), 1984-86 (OMNR, unpublished reports), and 1994-95 (OMNR, unpublished reports). The number of family groups observed varied between years largely due to variation in dates females left maternity dens, but also due to variations in snow cover, weather, visibility, and possible synchrony of breeding females. The average number of family groups encountered was about 44 per year over all years (Table 2).

Results of a typical annual survey (1994) are shown in Figure 3. Tracks of some family groups were encountered more than 80 km inland from Hudson Bay, suggesting that females had denned inland of that point (Figure 3). On average, about 91% of family groups were observed on the mainland of Ontario, and 9% were observed on islands in James Bay. Of the 91% of family groups observed on the mainland in Ontario, 36% were observed within PBPP and 55% were observed outside the boundaries of PBPP to the south, west, or northwest. Within PBPP, a large number of family groups were generally observed in the western portion of the park between the Winisk River and the Shagamu River (Figure 3). This pattern was first noted by Kolenosky and Prevett (1983) for the surveys conducted from 1974-1978, and was evident during all subsequent surveys. From 40% to 55% of tracks recorded in any given year were found in the area between the Winisk River and the Shagamu River, though many originated south or west of the PBPP boundary (Figure 3).

Known Maternity Den Locations and Summer Surveys

Kolenosky and Prevett (1983) observed 19 maternity dens during aerial surveys from 1974-1978, and investigated seven of these on the ground. For 17 of

Table 2. *Observations of polar bear family groups during late-winter aerial surveys in Ontario.*

Year	Number of Family Groups[a]	Number of Litters[b]	Mean Litter Size[b]	Minimum Number of Cubs Produced[c]	Number of Family Groups Observed on Islands in James Bay
1974	20	12	2.1	41	4
1975	32	31	2.0	63	3
1976	40	36	1.9	80	1
1977	16	6	1.8	30	1
1978	53	43	1.9	102	1
1984	62	41	1.8	112	7
1985	23	16	1.6	37	-
1986	68	45	1.4	95	-
1987	65	56	1.8	117	-
1994	49	27	1.7	83	6
1995	53	42	1.6	86	10
Mean	43.7	32.3	1.8	76.9	4.1

[a]Includes visual observations and track counts.

[b]Derived from visual observations of family groups and unambiguous counts of tracks.

[c]Total number of family groups observed × mean litter size for visuals and unambiguous counts.

these dens located in mainland Ontario, distance inland averaged 61 km (range 29-118 km). Of the 17 dens located in Ontario, ten were located in treed areas including treed bogs, four were located at near the edge of small lakes, rivers, and creeks, and two were located at the base of an esker or rock outcrop.

Locations of maternity dens of satellite-collared bears were determined in fall from 2000-2002 for ten bears, and these sites were investigated during the following summer. Seven bears denned east of the Winisk River: of these, four denned in treed areas, one on an elevated gravel ridge, one in a river bank, and one on top of a palsa. Aerial surveys confirmed frequent use of elevated gravel ridges in the area east of the Brant River. Three satellite-collared bears denned west of the Winisk River: one in a treed area, one in a river bank, and one in a palsa. Aerial surveys confirmed frequent use of palsas for maternity dens west of the Winisk River (Obbard, unpublished data).

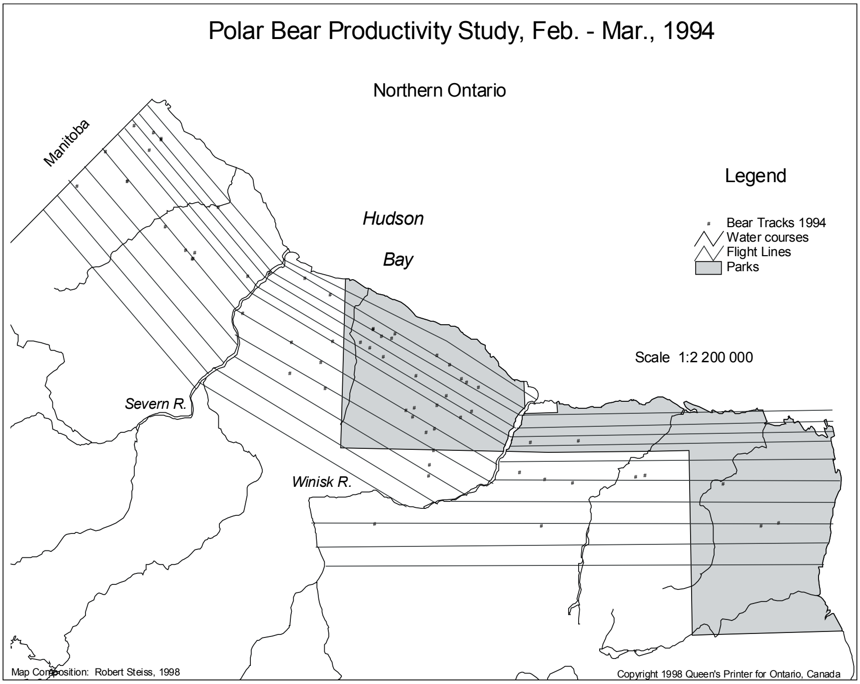

Figure 3. *Locations of tracks of family groups of polar bears encountered during winter aerial surveys, February-March 1994 (• tracks of family groups; some are multiple observations of the same family group).*

Discussion

A large proportion of the SHB population occupies summer retreat habitat within the boundaries of PBPP. Adult males often congregate on offshore islands and gravel bars and on spits and peninsulas, similar to the pattern documented in Manitoba (Stirling *et al.*, 1977; Stirling *et al.*, 2004). Areas of the coast with raised beaches where males can dig pits in which to rest during the off-ice period are also important concentration areas. Many family groups occupy the intervening coastal areas, but may be found near adult males, and some move inland — this is different from the general situation in Manitoba where most family groups tend to travel inland from the coast (Clark and Stirling, 1998). If current climate trends continue, the ice-free season in Hudson Bay will increase and polar bears will spend much longer periods on land occupying summer retreat habitat (Derocher *et al.*, 2004). The protection that PBPP provides to bears in summer retreat habitat will likely be even more important in the future, especially if declines in body condition continue (Stirling *et al*., 1999; Obbard and Cattet, unpublished data).

In Manitoba, pregnant females of the Western Hudson Bay (WHB) population occupy earth dens dug into frozen peat banks along the edges of lakes, streams, and hummocks (Clark *et al.*, 1997; Lunn *et al.*, 2004). In Ontario, high frozen peat banks do not form along the edges of lakes, though stream and river banks and palsas are available to polar bears. West of the Winisk River pregnant bears dig earth dens into palsas similar to the bears in Manitoba. However, east of the Winisk River palsas are absent or are unsuitable because they are less than 1 m in height. Here, bears more often den in treed areas (presumably in snowdrifts formed in the lee of tree cover), or dig shallow dens in elevated gravel ridges. Longitudinal data are not available on adult females of the SHB population; however, females in the WHB population show strong fidelity to the denning area, though not to specific den sites (Ramsay and Stirling, 1990; Scott and Stirling, 2002). It is likely that SHB females show similar behaviour. Therefore, if the predictions of climate modelling are correct and the amount of permafrost in the Hudson Bay Lowlands is reduced in the future (Gough and Wolfe, 2000; Gough and Leung, 2002), then the protection provided by PBPP to denning females will increase in importance.

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Climate Change and Recreation in Ontario Parks

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Abstract

There is increasing consensus among the scientific community that human induced climate change is a reality and now well underway. Climate change is expected to have extensive impacts on ecosystems and the people who live within them. Each year Ontario Parks provides millions of visitors with the opportunity to pursue a range of recreational opportunities. This presentation and supporting paper examines various climate change scenarios and the potential impacts on the park environment and some of the most popular recreational activities at Presqu'ile Provincial Park.

Introduction

On March 4, 2004, as part of the *Coastal Zone Climate Change and Adaptation Workshop* held at the Quinte Conservation, Belleville, Mr. Paul Gray (OMNR) and the author developed an electronic presentation regarding 'Recreation in Provincial Parks'. The focus of this work was on the potential impacts of climate change on recreation at a coastal provincial park: Presqu'ile. The findings presented in this paper are a continuation of the Presqu'ile Provincial Park case study. Bio-climate data for Trenton are used in conjuction with climate change scenarios to help identify impacts on the environment and recreation. Information is presented about climate change, provincial parks, visitation, climate change scenarios and the need for further research.

Climate Change

Changes in temperature, precipitation patterns, and sea-level rise have been observed at local, regional and global scales. The various levels of change that are projected to occur will have wide-ranging and potentially destructive impacts on natural environments, and the human societies that depend on them (IPCC, 2001).

Many aspects of the natural environment and humanity are impacted by climate change. The oceans, coastal areas, forests, freshwater resources, species and human health are all subject to the projected changes in our climate. Generally, for every small degree of global warming, there is a host of negative and positive impacts. The level of negative impact to natural environments and human societies is most pronounced at the higher projected temperature increases (Union of Concerned Scientists, 2004; UNFCCC, 2004).

Scientists around the world have made estimates of the potential direct impacts on our world and on societies. However, understanding the complex interactions between the mix of positive and negative impacts and among the various natural and human sectors involved is a great challenge for the scientific community. Our understanding of the full consequences of climate change is still evolving as new data and information become available (Union of Concerned Scientists, 2004).

An outcome of the worldwide scientific debate over whether global warming can be attributed to human activities, such as the burning of fossil fuels, was the formation of the Intergovernmental Panel on Climate Change (IPCC). In addition, the *United Nations Framework Convention on Climate Change* was created as an international policy framework to address the issue of climate change (Union of Concerned Scientists, 2004).

The Great Lakes and Provincial Parks

In 2003, there were 314 provincial parks in Ontario protecting over 7.5 million ha (OMNR, 2003a). Approximately 20% of all provincial parks are connected to the shores of the Great Lakes. In terms of area, Great Lakes provincial parks comprise only 5% of the area of all provincial parks. However, Great Lakes provincial parks account for 53% of the total visitation (OMNR, 2004b). Some of the reasons for this high level of visitation include close proximity to large urban centres, outstanding beaches and scenic vistas. Parks visitation continues to increase. A large percentage of operating parks show increases in visitation (OMNR, 2003b).

Presqu'ile Provincial Park and Climate Change Assessment

Presqu'ile Provincial Park is an ecologically diverse area located in the south-east of the province, forming part of the coastal area of Lake Ontario. The park is classed as a 'natural environment' park and preserves 937 ha. The predominant landform is a tombolo that supplies wetland habitat and beach recreation (OMNR, 2000a). Each year the park attracts over 200,000 visitors (OMNR, 2003a).

To assess the impact of climate change on recreation at Presqu'ile Provincial Park, the author used data and models publicly available through the *Canadian Climate Impacts Scenario Project*. The Project is designed as a non-technical introduction to climate change and is a collaborative venture of the *Canadian Climate Change Action Fund*, the Canadian Institute for Climate Studies and Environment Canada (CICS, 2004).

Climate change scenarios are constructed from the results of general circulation models (GCMs) (CICS, 2004). The author used the most recent Canadian Centre for Climate Modelling and Analysis (CCC) model CGCM1 that included the moderating effect of sulphate aerosols (GA1).

A bio-climate profile was not available for Presqu'ile; however, a small near-by community, Trenton, was selected as being representative of Presqu'ile's climate. Bio-climate profile data for Trenton and climate change scenarios (CGCM1-GA1) were used for three periods: 2020, 2050, and 2080.

One major challenge of applying GCM projections to regional impacts is the coarse spatial resolution. Presently, climate variables are bound to a network of grid cells with the distance between cell centroids typically reaching between 200 to 1000 km (CICS, 2004).

A short summary of the Trenton/Presqu'ile results from the CGCM1-GA1 assessment from 2020 to 2080 is provided below:

- annual average temp rise from -5.2°C to 3.3°C, a total rise of 8.5°C;
- average April to October rise from 14.2°C to 19.2° C, a total rise of 5°C;

- average November to December temperature rise from -0.9°C to 3.2°C, a total rise of 4.1°C; and,
- average January to March temperature rise form -5.2°C to 3.3°C, a total rise of 8.5°C.

The CGCM1-GA1 was also used to produce a water surplus and deficit profile for Trenton. At the extreme, annual precipitation may increase from 849 mm to 900 mm in the year 2080. Generally, the model assessments indicate more precipitation in the shoulder seasons. Most striking is the more intense period of water deficit, rising from the current 75 mm to near 100 mm in July of 2080.

A change in the water cycle also influences the conditions for forest fire. Much of the province, including Presqu'ile, may have a higher forest fire severity rating as a result of the predicted increases in the frequency and intensity of drought (McAlpine, 1998). Fire can help to renew the environment; however, park natural features as well as human life and property may be at higher risk.

Climate change may increase the frequency and intensity of extreme weather events (UNFCCC, 2004). The temperature profile chart for Trenton 2050 indicates extreme high temperatures of close to 40°C may be reached between April and October.

Climate Change Impacts on Recreation at Presqu'ile

What recreational activities do visitors engage in at Presqu'ile? The top three most popular activities are hiking, swimming, and viewing/photographing nature (OMNR, 2000b). These activities are most typical of Great Lakes parks and protected areas and may be impacted by changes in climate.

Some general impacts of climate change on recreation are thought to include longer seasons and increased visitation (IPCC, 2001). Ontario Parks has responded to the visitor demand for longer seasons with more electrical sites and interpretative programs in the non-peak season (OMNR, 2004a). For many southern Great Lakes parks, there has been a decline in cross-country skiing. Some parks, such as Presqu'ile, no longer groom trails as a result of a shorter season of reliable snow cover and falling participation (OMNR, 2004a). Finally, human health concerns such as the increased risk of Lyme Disease, West Nile virus, Malaria, Hantavirus and Dengue fever may deter participation and visitation to protected areas (Kling *et al*., 2003; Environment Canada, 2004).

Discomfort from higher temperatures and humidity may deter participation in some popular recreational activities (Kling *et al*., 2003). As mentioned previously, more severe weather events may also be an outcome of climate change (Kling *et al*., 2003). The threat of severe weather conditions may also deter some from outdoor recreation participation.

Potential visitors may also be deterred by a perceived loss or reduction in the quality of the recreation/tourism product. Loss of tree cover from high winds or poor beach conditions may also affect visitation and participation. The economic gains from higher participation and visitation may be offset by losses to the natural environment and infrastructure. The multi-billion dollar nature-based tourism industry may see a mix of gains and losses (IPCC, 2001). Recent severe weather events at Presqu'ile, Rondeau and Halfway Lake have had devastating effects on the park environment, visitation and perhaps on local economies.

There are also specific impacts on individual recreational activities. Hiking may have extended seasons and more people may participate as the temperatures increase. However, there may be greater risks associated with dehydration and heat stroke (Kling *et al*., 2003). Climate change may also result in more smog or poor air quality days. Will hikers go anyway or stay at home indoors and wait for better air quality? More people concentrated into a more comfortable temperature range, as might be expected in the shoulder seasons, may give rise to greater trail impacts and erosion. This 'constrained comfort season' might also lead to more trail encounters and a potential loss of enjoyment for some visitors.

Swimming may benefit from warmer waters, a longer season and more beach area (International Institute for Sustainable Development, 1997). This may be offset by higher beach temperatures and discomfort, poorer water quality, more blowing sand and loss of sand beach. Waterborne infectious disease may become more prevalent. The incidence of diseases such as cryptosporidiosis or giardiasis may be increased by more frequent rainstorms (Kling *et al*., 2003). More frequent rainstorms and the associated health risks may result in more beach closures at parks.

Viewing and photography may also benefit from a longer season. This could increase participation and visitation. The increase in visitation might also lead to more crowded viewing areas. However, lower lake levels are predicted for Lake Ontario (Kling *et al*., 2003). The loss of habitat and/or food sources for migratory songbirds, shorebirds and waterfowl may reduce overall viewing opportunities at costal parks such as Presqu'ile.

Southern Ontario's climate may become more like present-day northern Virginia. By 2080, summers in southern Ontario will feel more like the hot and humid summers of the southern U.S. (Kling *et al*., 2003). Some three-season activities may move to year-round activities while other activities such as cross-country skiing may greatly decline.

Further Research Needs

Relatively little research has been done on the impact of climate change on recreation. Generally, there is a need for more comprehensive tourism and recreation studies at various scales (Wall, in press). The following questions may be considered as potential research topics:

- What are the costs and benefits associated with extended seasons for Ontario Parks?
- How can we help park visitors mitigate and adapt to climate change?
- Are park users already adapting to climate change? If so, what are their new behaviors and the implications for visitor management?
- Will demand shift to 'cooler' parks?

Summary

Bio-climate profile data for Trenton and climate change scenarios (CGCM1-GA1) were used for three periods (2020, 2050, and 2080) to assess impacts at Presqu'ile. Climate changes for Trenton include increased temperatures, more total precipitation and a more intense period of water shortage. As a Great Lakes coastal park situated in highly urbanized southern Ontario, the park receives substantial visitation. The top three recreational activities include hiking, swimming and viewing/photographing nature. A range of negative and positive impacts of climate change on park environments and recreational activities were presented. Climate change may bring a mix of benefits and risks to both the environment and recreation at Presqu'ile Provincial Park. Finally, more research is needed on the impact of climate change on parks and protected areas, and on visitors and their associated recreational activities.

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Species Protection and Conservation

Grey wolf (C. Rehbein)

Losses of Amphibians and Reptiles at Point Pelee National Park

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Abstract

Habitat protection is the primary method of conserving biodiversity. However, establishing parks does not guarantee against species losses because small and isolated preserves remain vulnerable to continuing threats. Point Pelee National Park (PPNP) is positioned in the most diverse herpetofaunal region in Canada. Despite a century of protection, PPNP has lost six of 11 amphibian and ten of 21 reptile species. The park is a small isolated fragment of a formerly large contiguous marsh-forest ecosystem. Our goal was to determine the relative importance of 'area-reduction' versus 'isolation' hypotheses in explaining species losses. Species relaxation based on the species-area effect can only explain one to two amphibian and two to four reptile losses. However, distances to the nearest neighbouring populations were significantly greater for extirpated than extant species. Isolation exceeded reasonable dispersal capabilities of extirpated species.

Introduction

Protecting habitat by creating parks and preserves is the primary method used to conserve biodiversity. However, setting aside areas as preserves provides no guarantee that the biota they contain will be protected from species losses. By their very nature, parks are usually smaller and more isolated fragments of formerly larger areas of contiguous natural habitats. The species-area effect, which is almost a law of nature, indicates that smaller areas contain fewer species than large areas (Rosenzweig, 1995). Species richness increases with area because larger areas have more resources to sustain larger populations and the wider variety of habitats they contain can accommodate additional species. Risk of local extinction for individual species decreases as population size increases (Soulé, 1987). Conversely, if an area becomes reduced in size, theory and empirical evidence predict that a 'relaxation' of the biota will occur by local species extinctions until the richness reaches a level that can be supported in the new smaller fragment (Diamond, 1972; Willis, 1974). Besides reducing habitat area, fragmentation also results in increased isolation. As distance between fragments increases, movements decrease resulting in lower immigration and less potential for rescue effects (Brown and Lomolino, 1998). Extreme isolation forms barriers to movement as species' dispersal capabilities are exceeded. Isolation is also of concern in the metapopulation concept. Metapopulations are groups of populations that are interconnected by dispersal (Hanski, 1999). Species living in naturally or anthropogenically fragmented habitats often exhibit metapopulation dynamics. Many amphibian and reptile species appear to exist as metapopulations (e.g., Hecnar and M'Closkey, 1996) or at least a metapopulation framework is useful for understanding their spatial dynamics (Klemens, 2000; Marsh and Trenham, 2001). An important feature of metapopulations is that frequent extinctions of local populations can occur but species persist regionally because of recolonization. Thus, connectivity to other reserves or natural areas is vitally important. In terms of area and isolation, parks often function like islands (Shafer, 1990). However, they are also unlike islands because the matrix in which they are embedded often serves as a source for additional external threats (Janzen, 1983).

Point Pelee National Park (PPNP) is a small (16 km^2) natural area that forms the southernmost portion of Canada's mainland (Figure 1). The park's geographic position places it within the Carolinian zone which is Canada's most diverse region in terms of herpetofauna. In the middle to late 1800s massive deforestation and wetland drainage occurred as most of Essex County's land was converted to agriculture. PPNP was officially established in 1918 by protecting a fragment of the coastal marsh and its associated terrestrial habitat. Six major habitat types that occur in the park are beach, cedar savannah, dry forest, swamp forest, marsh, and pond (Hecnar and Hecnar, 2004). These habitats are further subdivided into 13 vegetation/land-use types but most are of limited area (Table 1). The park has remained through time as a highly isolated 'island' because it is surrounded by water on 80% of its perimeter (Figure 2) and by intensive agricultural land on the remaining 20% (Figure 3). It is also a heavily used park with 300,000 to 500,000 visitors annually. Despite a century of protection, PPNP has lost six of 11 amphibian and ten of 21 reptile species. Our goal was to determine the relative importance of 'area-reduction' versus 'isolation' in explaining species losses.

Figure 1. *Location of Point Pelee National Park in southwestern Ontario.*

Table 1. *Vegetation-land cover classification determined by GIS (Source: G. Harvey, PPNP).*

Name	Area (km^2)	Cover (%)
Unclassified	0.000007	0.000046
Upland forest (mature)	1.7690	11.8
Upland forest (immature)	0.6141	4.1
Old field (shrub-dominated)	0.1676	1.1
Old field (open)	0.2273	1.5
Beach	0.8626	5.7
Beach (human use)	0.1608	1.1
Human use	0.1604	1.1
Marsh	6.4882	43.2
Swamp thicket	0.5476	3.6
Swamp forest	0.2655	1.8
Wet meadow	0.0924	0.6
Pond	3.0454	20.3
Pond edges	0.6174	4.1

Figure 2. *Aerial view showing the insular nature of Point Pelee National Park. The Pelee Peninsula extends over 16 km from Ontario's mainland into Lake Erie and is mostly surrounded by water (Source: PPNP).*

Figure 3. *View from the dike which forms the northern boundary of Point Pelee National Park. The park is isolated along the northern boundary by intensively farmed land characteristic of Essex County (Source: C. Browne).*

Methods

To determine the role of area-reduction and tocalculate expected species losses, we constructed species area curves using known information on area (Figure 4) and species richness (Tables 2 and 3) to compare the present state with historical conditions. If species losses occurred primarily because of area-reduction we would expect the actual number of extirpations to closely concur with the predicted number of extirpations.

To determine the role of isolation we calculated the distance from the park to the nearest neighbouring extant population of each species. We located nearest neighbouring populations using the *Ontario Herpetofaunal Summary* maps (NHIC, 2004), personal records, or data from the Michigan and Ohio Departments of Natural Resources. Next, we compared the distances between 'extant' and 'extinct' species using *t*-tests. If isolation played a role in species loss, we would expect that isolation distance would be greater for 'extinct' than 'extant' species. If distance between neighbouring populations does not differ between extinct and extant species groups we can dismiss the isolation hypothesis. For individual extinct species, if distance to the nearest potential source population greatly exceeds dispersal capabilities, the isolation hypothesis is strongly supported.

Table 2. *Distances to the nearest potential source area for amphibian species recorded in the park. Park status is indicated as extant (E) or by year of last record for extinct species.*

Scientific Name	Common Name	Park Status	Distance (km)	Source
Acris crepitans	Northern cricket frog	1972	33	N.W. Ohio
Ambystoma tigrinum	Tiger salamander	1915	33	N.W. Ohio
Bufo americanus	American toad	E	0	Essex County
Bufo fowleri	Fowler's toad	1949	70	Rondeau P.P.
Hyla versicolor	Gray treefrog	1986	70	Rondeau P.P.
Necturus maculosus	Mudpuppy	E	0	Lake Erie
Pseudacris crucifer	Spring peeper	E	6	Hillman Marsh
Pseudacris triseriata	Western chorus frog	E	0	N. boundary
Rana catesbeiana	American bullfrog	1990	42	Holiday Beach
Rana clamitans	Green frog	E	0	N. boundary
Rana pipiens	Northern leopard frog	E	0	N. boundary

Figure 4. *Original extent of the Point Pelee Marsh ecosystem. The existing marsh extends south from the park's northern boundary (indicated between arrows). The marshland north of the boundary was drained and converted to agriculture (Source: adapted from H. Beldon and Co. map, ca. 1880-1881).*

Table 3. *Distances to the nearest potential source area for reptile species recorded in the park. Introduced species have been excluded. Park status is indicated as extant (E) or by year of last record for extinct species.*

Scientific Name	Common Name	Park Status	Distance (km)	Source
Apalone spinifera	Spiny softshell	E	0	Lake Erie
Chelydra serpentina	Snapping turtle	E	0	N. boundary
Chrysemys picta	Painted turtle	E	0	N. boundary
Clemmys guttata	Spotted turtle	E*	42	Holiday Beach
Coluber constrictor	Eastern racer	1960	14	Pelee Island
Crotalus horridus	Timber rattlesnake	1895	277	S. Ohio
Elaphe gloydi	Eastern foxsnake	E	0	N. boundary
Elaphe obsoleta	Eastern ratsnake	1920	532	E. Ontario
Emydoidea blandingii	Blanding's turtle	E	6	Hillman Marsh
Eumeces fasciatus	Five-lined skink	E	70	Rondeau P.P.
Graptemys geographica	Northern map turtle	E	35	St. Clair shores
Heterodon platirhinos	Eastern hognosed snake	1979	70	Rondeau P.P.
Lampropeltis triangulum	Milksnake	1920	57	Walpole Island
Nerodia sipedon	Northern watersnake	E	6	Hillman Marsh
Sistrurus catenatus	Massasauga	1920	53	LaSalle, ON
Sternotherus odoratus	Stinkpot	E	56	Rondeau
Storeria dekayi	Dekay's brownsnake	E	0	N. boundary
Thamnophis sirtalis	Common gartersnake	E	0	N. boundary

*Likely also extinct because not observed since 1994 (Hecnar and Hecnar, 2004).

Results

Habitat Loss

The standard form of the species area effect is a power function known as the Arrhenius equation (Rosenzweig, 1995):

(1) $$S = cA^{z}$$

Where: S= species richness
c= a system specific constant
A = area
z = slope of the linear form of the function

The linear form of the species area effect can be found by logarithmic transformation equation:

(2) $$\log S = \log c + z \log A$$

We know that PPNP historically had at least 11 amphibian species and 18 reptile species, but presently only five and 12 species respectively persist. We excluded three reptiles from our analyses because they are considered either introduced – pond slider (*Trachemys scripta*) and eastern box turtle (*Terrapene ornata*) – or are based on unsubstantiated reports – wood turtle (*Clemmys insculpta*) – at PPNP. We also know that prior to agricultural conversion of the land north of the park, the marsh ecosystem covered 3633 ha (Figure 4). Presently, the park contains an isolated fragment of 1620 ha. Thus we have estimates for S and A, but not c or z. However, the literature indicates that z ranges primarily between 0.13-0.39 (Rosenzweig, 1995) with z values for islands being greater than for equivalent mainland areas. King *et al*. (1997) recently studied the biogeography of the Lake Erie's herpetofauna. Using their data we calculated that z = 0.37 for amphibians and 0.29 for reptiles. Taking these values as the upper bound for z and using 0.13 as a lower bound, we can confidently assume that the actual z for PPNP lies somewhere between these values. We can then substitute z and calculate an estimate for c, the last unknown parameter. Having estimates for all parameters allows us to determine how well area reduction can explain species loss at PPNP.

For amphibians:

$$\begin{aligned} 11 &= c(3633)^{0.37} \\ c &= 0.530 \\ S &= 0.530A^{0.37} \\ &= 0.530(1620)^{0.37} \\ &= 8.2 \text{ species} \end{aligned} \qquad \begin{aligned} 11 &= c(3633)^{0.13} \\ c &= 3.789 \\ S &= 3.789A^{0.13} \\ &= 3.789(1620)^{0.13} \\ &= 9.9 \text{ species} \end{aligned}$$

Thus, the species-area effect predicts that the amphibian fauna should relax from 11 to eight or ten species. The area loss hypothesis can thus account for loss of one or two species. However, the park has lost six species.

Similarly for reptiles:

$18 = c(3633)^{0.29}$	$18 = c(3633)^{0.13}$
$c = 1.67$	$c = 6.20$
$S = 1.67A^{0.29}$	$S = 6.20A^{0.13}$
$= 1.67(1620)^{0.29}$	$= 6.20(1620)^{0.13}$
$= 14.2$ species	$= 16.2$ species

Thus, the species-area effect predicts that the reptile fauna should relax from 18 to 14 or 16 species. The area loss hypothesis can thus account for loss of two to four species. However, the park has lost six species. As with the amphibians, area reduction can account for some but not all of the reptile losses.

Isolation

For amphibians (Table 2), distance to the nearest potential source population for extant species ranges from 0-6 km with a mean of 1.0 ± 1.0 km. Distance for extinct species ranges from 14.1 to 70.0 km with a mean of 44 ± 11.1 km. The difference between the two groups is highly significant ($t = 7.53$, 9 *df*, $P<0.001$). Similarly for reptiles (Table 3), distance to the nearest potential source population for extant species ranges from 0-70 km with a mean of 17.9 ± 7.40 km. Distance for extinct species ranges from 14.1 to 532.0 km with a mean of 167.2 ± 82.30 km. The difference between the two groups is highly significant ($t = 3.40$, 16 *df*, $P = 0.004$). For both amphibians and reptiles, the isolation hypothesis is strongly supported.

Conclusions

Point Pelee National Park has been a highly isolated insular fragment for over a century. Assuming that sufficient time for faunal relaxation has passed, our calculations indicated that losses of one to two amphibians and two to four reptiles are expected due to area reduction. However, the park has lost six amphibian and six reptile species. Reptile losses climb to ten species if the spotted turtle (*Clemmys guttata*) and introduced species are included. We cannot entirely dismiss the area reduction hypothesis for losses of some of the species but some factor other than area loss has played a role in local extinctions. The average distances from the park to nearest neighbouring populations was significantly greater for extinct relative to extant species for both amphibians and reptiles. Considering that amphibian movements typically range from 100s of m to several km, and reptile movements range up to just over ten km (Pough *et al*., 2004), it is clear that the specific isolation distances to Point Pelee are several times farther than the reasonable maximum dispersal capabilities of the species that are now extinct. Furthermore, because of the degree of habitat loss that has occurred outside of the park, hostile matrix conditions would also make movements more difficult. Considering the vulnerability of small populations to local extinction, rescue from external populations is virtually impossible for many PPNP species, and that suitable habitat still remains in the park, our results strongly support the isolation hypothesis.

It would be naive to think that area and isolation are the only factors affecting persistence of species at PPNP. The amount of habitat in the park has not been reduced since the park was established, in fact it has increased slightly with recent reclamation of anthropogenic habitat. However, the park's habitats have changed over time through succession. Relative to historic accounts, the park now has less open habitat as the forest matures and encroaches on savanna (Smith and Bishop, 2002), and as the marsh ages (Hecnar and Hecnar, 2004). Canopy closure and reduction of open habitats would have negative consequences for species that require open habitats or basking sites (Hecnar and Hecnar, 2004). Other internal factors may also degrade habitat quality and perhaps increase the risk of extinction. Despite being a small park, Point Pelee has many visitors and there are always concerns regarding visitor disturbance (e.g., Hecnar and M'Closkey, 1998). The park also has elevated densities of subsidized mesopredators, e.g., raccoon (*Procyon lotor*), that are well-known predators of amphibians and reptiles (Browne, 2003; Browne and Hecnar, 2003). PPNP also has a history of chemical contamination and evidence exists for bioaccumulation in its herpetofauna (Russell *et al.*, 1995, 1999; Crowe, 1999).

Evaluating the relative importance of all these factors is outside the scope of this report, but these threats or other stochastic events may have acted as the ultimate mechanisms of extirpation. Regardless of the exact cause(s) of demise, extinction risk in small local populations is high and existence of source populations that can rescue or recolonize a isolated reserve is necessary for long-term population persistence. Point Pelee is a small highly isolated 'island'. For some of the remaining species, e.g., green frog (*Rana clamitans*), gartersnake (*Thamnophis sirtalis*), numerous populations exist outside the park which can potentially rescue or recolonize park populations. For other species such as the spring peeper (*Pseudacris crucifer*) few extant populations exist in Essex County and the species is now truly isolated and vulnerable to future loss. Species losses are inevitable, it is just a matter of when they will occur. The American bullfrog (*Rana catesbeiana*) was considered an extinct species in PPNP since 1990 (Hecnar and M'Closkey, 1997), but several individuals have been recently observed and captured in the park. It is unclear whether these individuals represent a naturally colonizing propagule or were introduced, but we suspect the latter.

Active management through reducing visitor disturbances, predator control, habitat restoration, or contaminant cleanup, may help reduce extinction risk for species that persist at PPNP. However, increasing the amount of natural habitat outside the park and connection with other protected areas are likely the only ways that long-term persistence of extant species can be achieved and is necessary before repatriation can be effective (Hecnar and Hecnar, 2004). Recent land acquisitions outside the park, reduction of anthropogenic habitat in the park, and preliminary discussions on increasing connectivity with other reserves in Essex County (e.g., Hillman Marsh Conservation Area) are encouraging.

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Back to the Future: Designing Protected Areas Using Data on Historical Species' Distributions

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Abstract

Design protocols for protected area networks typically consider representation before persistence, largely because appropriate metrics that might ensure persistence have been lacking. Nevertheless, without prior consideration of design criteria that enable persistence, reserve networks may not conserve what is represented over the long-term. Data on historical ranges of disturbance-sensitive mammals were used to develop empirical estimates of reserve sizes that might enable persistence of mammals. With plots of those sizes, we sampled the historical ranges of mammals throughout the three mammal 'provinces' that comprise Ontario, from which we selected minimum reserve networks using both richness- and rarity-based greedy heuristic algorithms. Full representation of disturbance-sensitive mammals was achieved with three to eight reserves on 5%-40% of the landbase, depending on region, plot size and algorithm. Most present-day reserves, larger than the minimum size, are not located where they would most efficiently conserve the full complement of mammals. Our results provide guidance for siting future reserves in the boreal region and/or for rationalizing existing reserve systems that may more efficiently represent and conserve species.

Introduction

Many protocols for the design of protected areas implicitly or explicitly begin with considerations of *representation* of features to be included in a network. These may be 'enduring' physical features (often assumed to be reasonable surrogates for ecological features, such as biodiversity), and/or ecological features (i.e., species or communities themselves). Regardless, reserve design is frequently based on recent information about the distribution and abundance of physical or ecological features of natural areas (Pressey *et al.,* 1993; Possingham *et al.,* 2000). Typically, reserve selection algorithms operate with such data to select the minimum combinations of potential reserves that will maximize the representation of physical and/or ecological features. Significantly, these approaches are often applied in circumstances where landscapes are highly altered by human land-uses, and where conservation is constrained to 'saving the best of the last'; less often, data from altered portions of the landscape are not considered as potentially part of a reserve system. These approaches to reserve selection emphasize *representation* first. Unfortunately, the most sobering lesson from MacArthur and Wilson (1967), who elaborated that high rates of extinction on isolated islands might apply to habitat patches as well, is that the mere presence of features, such as species' populations, in reserves is no guarantee of their future *persistence* there.

Less frequently, issues of size, shape and connectivity may be considered to attempt to address the persistence of species. By and large, these considerations are treated after-the-fact of reserve selection based on representation. Further, persistence is generally treated inadequately, in part, because appropriate metrics for minimum reserve size and connectivity that might ensure persistence have been lacking. Nevertheless, without prior consideration of the conditions that might ensure persistence, there is considerable risk that reserve networks are assembled from protected areas that are too small and/or disconnected to conserve what is represented.

Here, we provide an update on recent research into an alternative method for selecting among potential designs for reserve networks. Our approach also emphasizes reserve selection based on representation, but under constraints considered *a priori* to better ensure persistence of species. Efforts to design reserve systems based on persistence, rather than merely presence, are beginning to emerge (Cabeza and Moilanen, 2001). Often, however, these involve linking spatially-explicit demographic data with information on the distribution of habitats, and asking which reserve designs are predicted to minimize the risk of extinction for particular species (e.g., Carroll *et al.*, 2001). This approach relies on expensive data solely from a few well-studied 'focal' species. Further, the intent is that, by ensuring the persistence of 'focal' species, many other species persist as well, but it is seldom known whether, nor how many, other species might also be represented and persist in a reserve system designed for persistence of the 'focal' species.

We build on previous work (Glenn and Nudds, 1989; Gurd and Nudds, 1999; Gurd *et al.,* 2001) that used historical ranges of disturbance-sensitive mammals to estimate a minimum reserve size (5000 km^2; 95% C.L.: 2700-13 296 km^2) below which mammal extinctions have not been documented. These sizes are similar to those derived from a variety of demographic analyses of large, far-ranging species, including wolves (*Canis lupus*), cougars (*Felix concolor*), grizzly bears (*Ursus horribilis*) and woodland caribou (*Rangifer tarandus caribou*) (Gurd *et al.*, 2001; Lipsett-Moore *et al.*, 2003; Wiersma *et al.,* in press). We assume that mammals are an 'umbrella species group' because the distribution of mammals on isolated habitat fragments, relative to other taxa, suggests that, as homeothermic quadrupeds, they are at greater risk of extinction (Schmiegelow and Nudds, 1987; Hager and Nudds, 2001). It follows that if the mammal assemblage persists intact, so should a good deal of other species (Hager *et al.*, in prep). Subsequently, Wiersma *et al.* (in press) showed that mammal extinctions varied most with reserve size, with more extinctions in smaller reserves, and less when natural features of the landscapes remained intact around reserves.

In essence, we ask: "If we knew then what we know now about the effects of size and isolation on extinction risk in habitat fragments, would we have designed reserve networks the way they actually turned out, with respect to reserve sizes, numbers and locations?" Sufficient evidence exists to suggest that the answer is obvious: certainly not. However, by analyzing historical data, we can address how many reserves – each above an estimated minimum size threshold for persistence of the historical complement of mammals – would have been needed, and where they should have been located, to represent all of the species in a large ecological region. Here, we give the 'flavour' of this work with preliminary results summarized for three mammal 'provinces' in Ontario.

Methods

Using plots (reserves) corresponding to our estimate of minimum reserve size, and the upper and lower 95% confidence values of the estimate (2700, 5000 and 13 300 km^2), we sampled the historical ranges of disturbance-sensitive mammals (for sources of historical data, see Glenn and Nudds, 1989) in each of eight biogeographic 'mammal provinces' that span Canada (Figure 1), using ArcView™ with the Samples extension. We selected plots using both richness and rarity-based algorithms until all species were included in at least one reserve in a network of reserves for a particular mammal province. Here, we report results for those portions of three mammal provinces that span Ontario (the Alleghenian-Illinoian, the Western Canadian, and the Eastern Canadian).

Figure 1. *The mammal provinces of Canada (Source: Hagmeier, 1966). All analyses were conducted at the scale of whole mammal provinces. Here we report the results of the optimal number and location of reserves for those portions of three biological provinces within the political boundaries of Ontario.*

Results

Over all mammal provinces, 100% representation of disturbance-sensitive mammals could be achieved with three to eight minimum-sized reserves, depending on reserve size and region. Rarest-based algorithms were always more efficient than richness-based algorithms for selecting reserve networks, resulting in reserve networks of one to five fewer minimum-sized plots to achieve 100% representation of mammal species (Wiersma and Nudds, in prep). These reserve systems comprised 5-40% of the land base of the mammal provinces, further suggesting that rules of thumb, or data-independent targets (e.g., Solomon *et al.*, 2003) such as the '12% rule', are inappropriate as design criteria (Wiersma and Nudds, 2003; in prep).

Except for the western portion of the Alleghenian-Illinoian mammal province in Ontario, most present day reserves larger than the minimum size are not located where they should have been to most efficiently represent *and promote persistence* of mammal species diversity (Figure 2). Somewhat counter-intuitively, the most efficient allocation of reserves (i.e., the best locations to have sited reserves in the past to achieve the greatest representation with fewest reserves), did not vary with minimum reserve size. In other words, if we knew then what we know now, fewer but bigger, reserves could have been designed and sited to most efficiently conserve all of Ontario's historical complement of mammals in a reserve network.

Discussion

The history of protected area establishment in Canada and elsewhere might be divided into three eras: the Era of Default, the Era of Desperation, and the Era of Design. With some exceptions (such as parks created for scenic, wilderness values), during the Era of Default the sizes and locations of protected areas were based largely on convenience and or/compromise with competing land-uses (Runte, 1987; Pressey *et al*., 1993); generally speaking, siting of protected areas often defaulted to areas of high topographic relief, low productivity, or areas otherwise unsuitable for development.

The latter part of the 20th century saw two important developments that heralded the Era of Desperation. First, MacArthur's and Wilson's (1967) seminal work on island biogeography had an extraordinary influence in re-shaping thought about protected area design, and why policies in vogue then were inadequate to conserve species in many protected areas. Second, the rise of the 'biodiversity crisis' catalyzed political and social will to provide protected area networks of adequate size and distribution to conserve representative flora and fauna across various regions of the country. In Ontario, for example, the government's position that the *Lands for Life* (e.g., Riley, 1998) initiative would result in 'final' lines on a map delineating protected areas resulted in a desperate flurry of activity to set aside areas considered to be of significant ecological value. Much of current protected area planning and management may continue to be constrained to practise as in the Eras of Default and Desperation – so long as it appears that opportunities to save the 'best of the last' continue to erode.

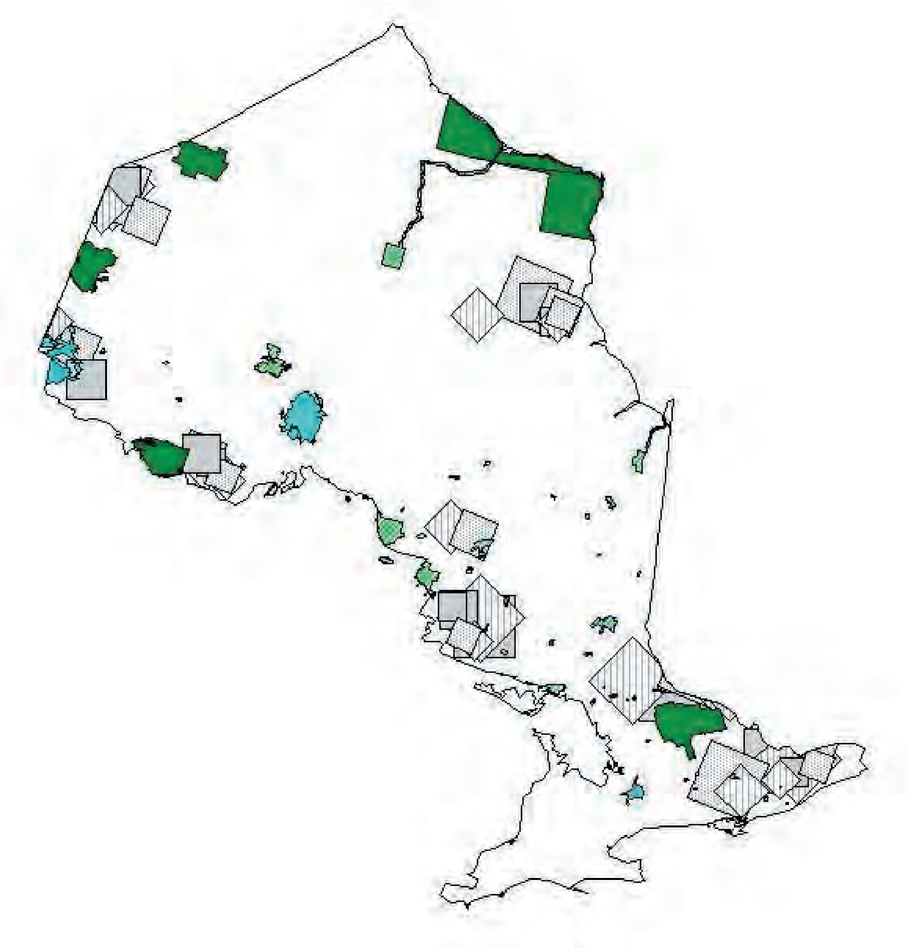

Figure 2. *The number, locations and sizes of reserves in Ontario, larger than the estimated minimum size to avoid mammal extinctions, and including all mammal species in at least one reserve, based on analysis of historical mammal distributions. Large squares, 13 300-km² reserves; medium squares, 5000-km² reserves; small squares, 2700-km² reserves. Differential shading of square plots represents results from different replications of the sampling and reserve selection algorithms. Present-day federal and provincial parks are shown dark if they exceed the estimated minimum size threshold, and cross-hatched if they are smaller. Other small parks do not represent an exhaustive inventory of parks in Ontario.*

However, we contend that approaches to selecting reserves that imply representation before persistence as design criteria put the 'cart before the horse'. The list of features to be represented is often derived by 'expert opinion' and compromise among sometimes competing interests. Further, a sense of urgency typically exacerbates the design and creation of protected area networks, particularly in highly altered landscapes. This may result in cobbling together collections of 'favourite places' for different reasons that may not, in fact, function to conserve biodiversity. Emphasis on conservation through representation of the best of the 'left-over bits' precludes an ability to rationalize protected area systems, and/or to target appropriate future expansion or restoration. Finally, emphasis on representation first, and persistence second, creates a quandary in the age of climate change, since what is chosen to be representative may be under- (or over-) represented in reserve networks in the future (Halpin, 1997; Hannah *et al*., 2002; Scott *et al*., 2002).

Parks and protected areas management is presently poised only on the threshold of the Era of (proactive) Design. The World Wildlife Fund has proposed to set aside significant natural areas in the north before the MacKenzie Valley pipeline is built; the Yukon Territory government has considered that each ecoregion might have at least one protected area; and the Canadian Council on Ecological Areas, in co-operation with federal, provincial and territorial agencies has initiated a project to assess planning and design for northern protected areas.

In Ontario, a coalition of Aboriginal and environmental non-government organizations and the forest industry announced in spring 2004, an agreement to plan to set aside 50% of boreal forest lands above 51^{o}N as protected areas prior to the expansion of industrial development. The *Northern Boreal Initiative* represents a significant opportunity to plan ahead of (apparently) inevitable development in the boreal forest. In these cases, where present conditions have not yet been too radically altered from the past, the application of design principles, and selection of reserves, such as we describe here may prevent a repeat of the past mistakes. However, even in southern settled landscapes, where most opportunities to expand/restore protected areas are severely constrained by existing alternative land uses, planning with persistence first, based on historical baselines, nevertheless may provide guidance about where to most effectively direct future acquisitions to reserve networks.

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Great Lakes Conservation Blueprint for Terrestrial Biodiversity on the Canadian Shield

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Abstract

The Nature Conservancy of Canada has partnered with the Ontario Ministry of Natural Resources to conduct a GIS-based analysis to identify areas on the landscape that, if conserved, would ensure the long-term success of the native species, habitats and ecosystems in the Great Lakes ecoregion. This project is the first entire watershed analysis of the landscape, biodiversity values, extent of natural heritage values and conservation priorities, undertaken to assess and to identify the gaps in representation of ecological systems and rare species in Ontario's protected areas. Although the southern Ontario landscape has been dramatically altered, the Canadian Shield portion of Ontario's Great Lakes ecoregion contains some of the largest and most intact natural landscapes. By incorporating our best scientific knowledge, repeatable methods and reasonable consensus, biodiversity targets and their conservation goals were applied to locate the areas that best meet these goals. We used digital Forest Resource Inventory *(FRI) data to create digital spatial mapping of ecological systems for the Canadian Shield portion of the Great Lakes ecoregion. A literature review of natural disturbance regimes and the habitat requirements of wide-ranging mammals informed the design of a spatial model to identify the best representative examples of these ecological systems within each ecodistrict.*

Introduction

The *Great Lakes Conservation Blueprint Project* is a partnership between the Nature Conservancy of Canada (NCC), the Ontario Natural Heritage Information Centre (NHIC) and other contributing partners including Ontario Parks. This project is the first-ever GIS-based landscape-level analysis of aquatic and terrestrial biodiversity in the Great Lakes ecoregion. This paper will focus on the terrestrial analysis, particularly the Canadian Shield portion. The Conservation Blueprint represents a significant conservation planning investment across the ecoregion, regardless of land tenure, that will identify or re-validate best representative areas across the Great Lakes to be shared among partners developing their own conservation priorities.

Some precursors to this project include the development of the U.S. Nature Conservancy (TNC) approach to conservation planning described in *Designing a Geography of Hope* (Groves *et al*., 2000), which resulted in detailed ecoregion planning strategies or conservation blueprints throughout the U.S. ecoregions. The NCC's approach to conservation planning is also based on sound ecological science with scientific consensus and partnerships. This approach is applied across southern Canada with similar conservation blueprint projects. The Ontario Ministry of Natural Resources (OMNR) has developed a gap analysis and representation framework for the selection of Areas of Natural and Scientific Interest (ANSIs) and *Ontario's Living Legacy* sites (Crins and Kor, 2000). The *Great Lakes Conservation Blueprint* has made deliberate efforts to develop a compatible approach within these frameworks, including the representation framework used to assess significant natural areas in Ontario over the past 20 years (Riley and Brodribb, 2003).

The goal of the Conservation Blueprint project is to identify a network of sites on the landscape that, if properly conserved, has the ability to sustain all elements of terrestrial biodiversity in the Great Lakes ecoregion. The project's GIS-based gap representation analysis provides a transparent methodology designed to use the best-available data and scientific consensus from a team of core scientists to provide a basis for selecting conservation priorities within natural, non-jurisdictional, ecoregional boundaries and to efficiently re-analyze, update and measure the conservation achievements over time.

There are fundamental differences in the landscapes and species of the Canadian Shield and the southern Ontario portion of the ecoregion. Therefore, the project methodology and analysis were separated into two distinct study areas (Figure 1).

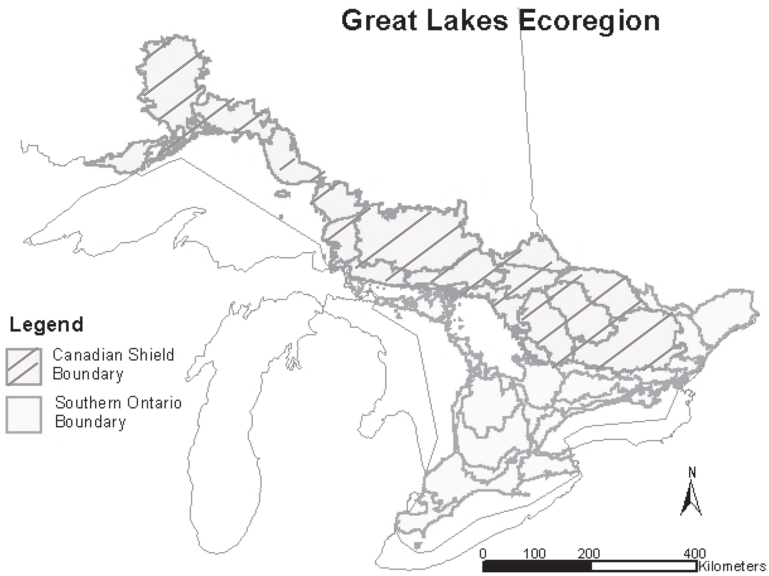

Figure 1. *Great Lakes Conservation Blueprint Project study area.*

Framework of the Conservation Blueprint

Although the Conservation Blueprint is at the scale of the Great Lakes ecoregion, the general methodology for the gap analysis was performed on an ecodistrict basis. The following section outlines the general framework of the *Great Lakes Conservation Blueprint*, while further details of the technical methodologies are described in Brodribb and Jahncke (2003) and Henson and Brodribb (2004).

There are six key design criteria for the Great Lakes Conservation Blueprint. They are as follows:

- It is important to account for the biodiversity targets that are being sustained by existing protected areas and conservation lands. By performing a gap analysis, a network of sites can be identified that will complement the existing protected areas.

- Sites that are identified as having high 'irreplaceability', such as sites that support extremely globally imperiled species, are given a high priority.

- Only viable occurrences of biodiversity targets were considered in the portfolio in order to select sites that support features with a probable level of sustainability.

- By weighting sites that contain multiple types of conservation targets, we can generate the most efficient portfolio. With the ability to produce multiple data layers in a GIS environment, an assigned weighting system allows outputs to be replicated several times with varying scores, additional datasets and the ability to modify the process over other landscapes.

- The Conservation Blueprint will map biodiversity at several spatial scales to achieve a portfolio consisting of a network of sites that address the conservation of biodiversity targets at coarse, intermediate and fine scales.

- The Conservation Blueprint attributes all remaining natural cover with natural heritage information and the entire land base is evaluated and analyzed, regardless of land ownership.

The standard selection and ranking criteria used in the Conservation Blueprint were representation, diversity, ecological function, site condition and special features. The representation of ecological systems (or landform-vegetation types) occurring in an ecodistrict is the core, coarse filter analysis on which all further analyses are based. Therefore, a classification and associated GIS layer of the ecological systems was created by intersecting the best available biotic and abiotic layers to identify unique combinations of landform and vegetation units. By targeting the representation of these landform-vegetation combinations in an area, we were able to provide the means to preserve the widest variety of species in conditions that support them best.

The primary sources of landform and vegetation data for the Canadian Shield were *Forest Resource Inventory* (FRI) data and quaternary geology. Other sources of vegetation information used to refine these main data sources included provincial landcover mapping (where FRI does not exist), vegetation community element occurrence data, Ontario peatland inventory data, OMNR evaluated wetlands, and Great Lakes shoreline data.

Assessing the relative importance of each representative ecological system is achieved by scoring conservation values for each ecological system polygon. All polygons are scored based on the complementary criteria (diversity, condition, ecological function and special features). On the Canadian Shield, an attempt was made to achieve minimum sizes for representation goals using a score layer based on natural disturbance regimes and information on the habitat requirements for some focal species. The cumulative scores of 24 GIS layers representing surrogates for the selection criteria were used to compare the total contribution of each ecological system polygon with other polygons of the same ecological system type. Table 1 illustrates the gap analysis approach used on the Canadian Shield portion of the Great Lakes ecoregion based on the five selection criteria.

Table 1. *Gap analysis approach in the Canadian Shield portion of the ecoregion.*

Criteria	Gap Analysis Approach and Some GIS Surrogates
Representation	Capture the best examples of each unique landform-vegetation (l-v) type. These l-v types will be the basis for the coarse filter gap analysis. Where several options for filling the gaps exist, then other criteria were applied.
Condition	Amount of natural area in adjacent landscapes
	Distance from roads, urban areas, croplands, mines, pits and quarries
	Distance from railways and transmission lines
Diversity	Wherever possible, when filling gaps we selected sites that contain many types of l-v combinations
Ecological function	Size
	Amount of core area
	Hydrologic functions (riparian areas, wetlands and Great Lakes shorelines)
	Coincidence with existing conservation lands
	Proximity to existing protected areas
Special features	NHIC Element Occurrence data for species and vegetation community targets
	Presence of other rare species and vegetation community types

Consistent stratification of representation goals was conducted to identify the suite of the most significant natural areas in an ecodistrict by searching for the highest-scoring polygons representing each ecological-system type. For example, on the Canadian Shield the *three* highest scoring sites representing each target ecological system were chosen for inclusion in the Conservation

Blueprint portfolio. These sites could be considered to be the most significant, or provincially significant. Because the Conservation Blueprint is GIS-based and automated, the stratification rule can be tested in relation to different stratification rules so that other high ranking sites (fourth and fifth highest) could be identified as the secondary, or regionally significant, sites.

The coarse filter approach does not necessarily address rare species representation. To ensure that all elements of biodiversity are included in the Conservation Blueprint, a fine filter biodiversity analysis was included to target known occurrences of species of conservation concern, including globally imperiled species, species at risk, endemic species and rare vegetation communities. This was achieved by using an efficiency model (C-Plan) to incorporate yet unrepresented 'irreplaceable' elements of biodiversity.

To be inclusive of past work and achievements on provincially significant conservation lands, the Conservation Blueprint also included all existing protected areas including conservation authority lands, all provincially significant life science ANSIs and all provincially significant wetlands. This approach attempts to conserve the continuity of Ontario's overall representation framework while incorporating new rule-based, GIS approaches that make it possible to handle the volume of natural area and species data available. The resulting outputs can be used by a variety of conservation partners in different ways and at different scales, to ask fundamental questions about the geography of Ontario's biodiversity.

Although the creation of a GIS-based analysis model will reduce uncertainty and human judgement biases it is still not a substitute for expert knowledge and in-field verification. These results are based on a GIS analysis of modelled data and therefore should be validated through detailed field survey prior to any conservation action. However, this GIS analysis will ultimately enhance the expert discussions surrounding natural heritage information and the conservation of species and communities.

Results of the Conservation Blueprint

There are 437 species targets and 172 vegetation community targets within the terrestrial Great Lakes Conservation Blueprint, of which there are 157 species targets and 63 vegetation community targets with occurrences known to be in the Canadian Shield portion. Over two-thirds of all extant biodiversity target occurrences in the Canadian Shield portion of the Great Lakes ecoregion occur within the Conservation Blueprint portfolio, of which two-thirds are within existing protected areas and conservation lands. A large portion of these biodiversity targets occurs within provincial parks and other protected area boundaries.

There are a total of 250 ecological systems on the Canadian Shield, of which 182 were targeted for representation in the analysis. These targets consist of 174 forested ecological systems and eight wetland systems. Those not targeted include water, anthropogenic systems and natural systems that were missing key descriptive information to attribute them to an appropriate system type. Approximately 70% of the total area of all targeted top-scoring ecological systems in the Canadian Shield portion of the Conservation Blueprint occur outside existing conservation lands. The top-scoring systems that are within conservation lands are generally found inside provincial parks and conservation reserves.

Overall, the Canadian Shield portion of the final Conservation Blueprint portfolio represents over 3 000 000 ha, or approximately 23% of the land base (Figure 2). Twenty-one percent of the total targeted forest systems and 22% of the wetland systems occurring on the Canadian Shield occur in the final Conservation Blueprint portfolio.

The digital layer in the Canadian Shield analysis that was largely influential for the assessment of ecological function was the fire disturbance layer. Approximately 94% of the amalgamated contiguous portfolio sites on the shield can be considered large enough to withstand an average fire disturbance.

On the Canadian Shield, over 80% of the Conservation Blueprint is identified as conservation lands (2 540 253 ha). Together, conservation lands represent approximately 19% of entire land base for the Canadian Shield portion of the ecoregion.

The Blueprint results for Southern Ontario were analysed using a similar methodology and results have been compiled for this area as well. Further information, results and mapping will be available in Henson and Brodribb (in prep).

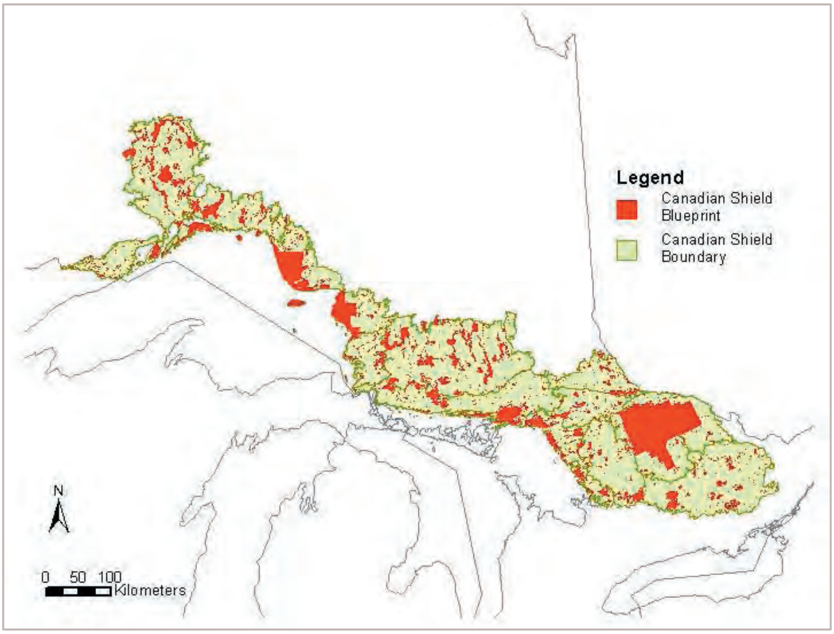

Figure 2. *Conservation Blueprint Results for the Canadian Shield.*

Summary and Future Direction

The *Great Lakes Conservation Blueprint* targets, goals and outputs are capable of assisting NCC, NHIC, Ontario Parks and their partners with the development and implementation of conservation initiatives and priorities. This can be achieved at a variety of scales such as the Great Lakes ecoregion (landscape scale), the ecodistrict scale, or for particular sites on the landscape. Opportunities can also be created to share the Conservation Blueprint's methodology and results with a diverse array of conservation practitioners in the Great Lakes, Ontario and beyond who are interested in similar conservation planning initiatives. As stated previously, the Conservation Blueprint results are based on a GIS analysis of modelled data and therefore must be validated through detailed field surveys prior to any conservation action.

The Conservation Blueprint consists of the most recent GIS coverages of protected areas and other conservation lands, and digital data compiled for the array of biodiversity features in the ecoregion including ecological systems, rare species and rare vegetation communities. The distribution of these biodiversity features has been mapped and the degree to which they are represented by existing conservation lands in the Great Lakes have been assessed. The Nature Conservancy of Canada intends to summarize this data for conservation planners to provide a gap analysis of existing conservation lands for various jurisdictions and planning authorities.

The Conservation Blueprint also underscores and validates the biological significance of key core areas on the landscape in southern Ontario and the Canadian Shield. The final Conservation Blueprint provides an updated, transparent and well-documented set of core areas in which conservation planners can consider existing natural corridors and potential connecting linkages. This analysis will also be valuable for informing the stewardship and securement of these core areas.

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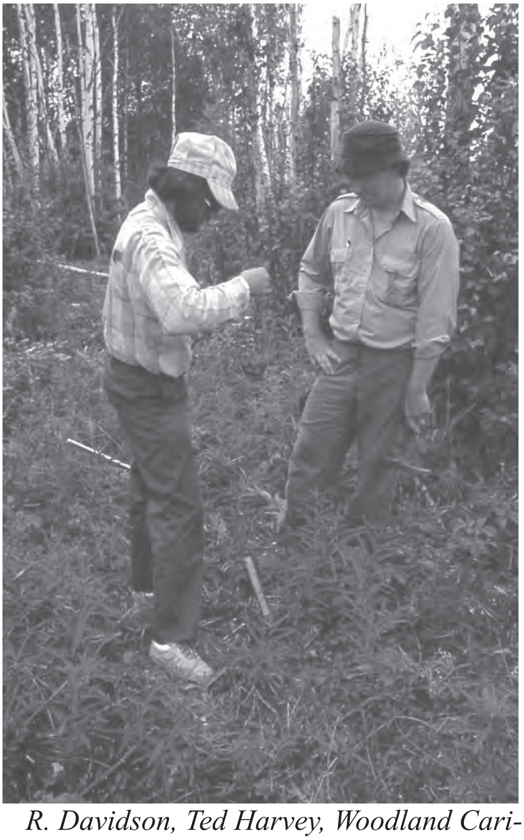
Monitoring, Assessment and Planning



R. Davidson, Ted Harvey, Woodland Caribou Park (T. Beechey)

The Ontario Benthos Biomonitoring Network

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Abstract

*The Ontario Ministry of the Environment and Environment Canada (*Ecological Monitoring and Assessment Network – *EMAN) have established a partnership to develop an aquatic, macro-invertebrate biomonitoring network for lakes, streams, and wetlands. The resultant* Ontario Benthos Biomonitoring Network *(OBBN) provides a framework for evaluating aquatic ecosystem condition using shallow-water benthos and the reference-condition approach. The OBBN is being developed on the principles of partnership, free data sharing, and standardization. The OBBN protocol outlines field, laboratory, and data-interpretation options which: 1) ensure standardization with proposed federal protocols; and 2), permit partners with varying financial and technical resources to participate. Biological criteria for evaluating aquatic ecosystem condition are generally not available. The OBBN uses a reference-condition approach to bioassessment in which samples from minimally impacted (or reference) sites are used to define the normal range of variation for a variety of indices that summarize biological community composition. Sites where biological health is in question can be evaluated by determining whether test site indices fall within the normal range established from the minimally impacted sites. The OBBN will remove barriers to the application of aquatic biomonitoring techniques across Ontario by specifying standard methods, enabling data sharing between partners, automating analysis using a reference-condition approach, and providing training. EMAN sees the OBBN as a pilot project for a Canada-wide aquatic biomonitoring program.*

Introduction

The Ontario Ministry of the Environment (MOE) and Environment Canada (*Ecological Monitoring and Assessment Network* [EMAN]) are co-founders of the *Ontario Benthos Biomonitoring Network* (OBBN). The OBBN will allow partners to evaluate aquatic ecosystem condition using the reference-condition approach and shallow-water benthos as indicators of environmental quality. We are developing the OBBN on the principles of partnership, free data sharing, and standardization. The network's protocol outlines field, laboratory, and data-interpretation options, which ensure standardization with proposed federal protocols and provide enough flexibility that partners with varying financial and technical resources can participate. This paper outlines the importance of biomonitoring, explains what benthos are and why they are frequently used as indicators of aquatic ecosystem condition, describes OBBN components, discusses how participating in the OBBN would benefit Ontario Parks, and lists several research questions related to the development of the network.

Importance of Aquatic Biomonitoring

Monitoring supports adaptive water management; it provides feedback on the status of aquatic resources and the performance of policies, programs, and legislation (Executive Resource Group, 2001). Biomonitoring — the process of sampling, evaluating, and reporting on ecosystem condition using biological indicators (Rosenberg and Resh, 1996a) — is an important part of aquatic ecosystem management. This is because management end-points are often biological (e.g., protection of aquatic biota and their habitats), and because Ontario laws and policies stress the protection of aquatic biota.

Ontario's legislative basis for biomonitoring includes the Ontario *Water Resources Act*, which states that:

> "*the quality of water shall be deemed ... impaired if ... the material discharged ... causes or may cause injury to any person, animal, bird or other living thing ...*" (Government of Ontario, 1990a).

It also includes the *Environmental Protection Act*, which has several biological components in its definition of adverse impact:

> "*(a) impairment of the quality of the natural environment for any use that can be made of it; (b) injury or damage to property or to plant or animal life; ... (d) an adverse effect on the health of any person; and ... (f) rendering any property or plant or animal life unfit for human use.*" (Government of Ontario, 1990b).

The federal *Fisheries Act* provides further impetus for biomonitoring by stating that no person shall carry on any work or undertaking that results in the harmful alteration, disruption, or destruction of fish habitat (e.g., spawning grounds; nursery, rearing, and migration areas; and food supply) (Government of Canada, 1985).

Reflecting on our legislation, Ontario's policies also suggest a need for biomonitoring. The document, *Water Management: Policies Guidelines Provincial Water Quality Objectives of the Ministry of Environment and Energy* [sic] states:

> "*With respect to surface water quality, the goal is to ensure that ... water quality is satisfactory for aquatic life...*". (MOEE, 1994).

Similarly, the *Provincial Policy Statement* (PPS), which is based on the *Planning Act*, states:

> "*the quality and quantity of ground water and surface water and the function of sensitive ground water recharge/discharge areas, aquifers, and headwaters will be protected or enhanced*". (Government of Ontario, 1997)

The PPS further states that development and site alteration is only permitted in significant habitats if no negative impacts on the natural features or the ecological functions will result.

Biomonitoring is further justified in parks and protected areas by Ontario Parks' mission statement (e.g., Government of Ontario, 2005): ensuring that "Ontario's provincial parks protect significant natural, cultural, and recreational environments, while providing ample opportunities for visitors to participate in recreational activities" requires us to have knowledge about the condition of the aquatic biota within our parks and protected areas.

Benthos as Indicators

Benthos are large, bottom dwelling insects, crustaceans, worms, molluscs and related aquatic animals. They are good indicators of aquatic ecosystem health because they are sedentary; their life cycles range in length from months to years; they are easy to collect and identify; they are responsive to changes in water and sediment quality; they are ubiquitous; and they are not typically seen as an economic or recreational resource themselves (Mackie, 2001). Benthos have been used extensively to assess water quality in streams and lakes (Rosenberg and Resh, 1993; 1996b).

Complementarity of Biological and Physical-Chemical Monitoring

Physical-chemical (stressor-based) and biological (effect-based) monitoring approaches are complementary (Table 1). An example of a stressor-based index is the number of skiers visiting Quetico Provincial Park in winter – a surrogate for impact on woodland caribou (*Rangifer tarandus caribou*) foraging success). An example of an effect-based index is the average mass of adult male woodland caribou at age two – a surrogate measure for foraging success and effect of foraging interference by skiers. To illustrate the complementarity of these two types of indicators, consider water quality and benthos data collect-

Table 1. *Complementarity of stressor- and effect-based aquatic monitoring (Source: adapted from Roux* et al.*, 1999).*

	Stressor-based Approach	Effect-based Approach
Monitoring focus	Stressors causing environmental change, i.e., chemical and physical inputs	Effects (responses) of natural and/or anthropogenic disturbances, e.g., changes in the structure and function of biological communities
Management focus	Water quality regulation: controlling stressors through regulations	Aquatic ecosystem protection: managing ecological integrity
Primary indicators	Chemical and physical habitat variables, e.g., pH, dissolved oxygen, copper concentration	Structural and functional biological attributes (e.g., relative taxa abundances, frequency of deformities)
Assessment end points	Degree of compliance with a set criterion or discharge standard	Degree of deviation from a benchmark or desired biological condition

ed in the Pretty River between 1996 and 2001 (Figure 1). The majority of the distribution of data for phosphorus and zinc (stressor-based indicators) were well below provincial water quality objectives (e.g., MOEE, 1994), suggesting good water quality conditions. In comparison to local, minimally impacted Niagara Escarpment stream communities, however, the very low densities of benthos (effect-based indicator) collected in the Pretty River suggested habitat degradation (which was consistent with the site's history as a man-made bedrock floodway channel). In this case, seemingly contradictory water chemistry and biological monitoring results can be combined to make a more complete assessment of aquatic ecosystem condition than either approach could on its own, i.e., to conclude that water quality is good but that biota are suppressed by habitat degradation.

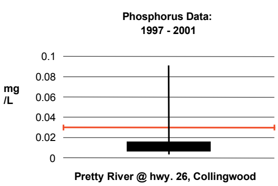
Biological

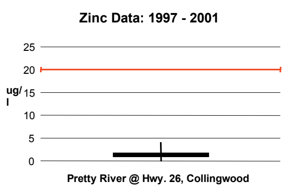
Benthos Data, Pretty River @ Hwy. 26 Collingwood, October 1996

Stream Physiography:				
Moderate gradient stream with gravel and rock rubble substrate. Drains largely forested Niagara Escarpment catchment.				
Qualitative Sample	**Kick 1 (~5 min)**		**Kick 2 (~5 min)**	
Molophilus	Hydropsyche	37	Hydropsyche	4
Caenis	Stenelmis	3	Optioservus	1
Stenonema femoratum	Optioservus	2	Stenonema (imm.)	1
Stenonema (imm.)	Antocha	12	Fossaria	1
Caecidotea	Hemerodromia	1	Paracapnia	4
Hydropsyche	Stenonema (imm.)	13		
Stenelmis (l)	Orthocladiinae	1		
Hesperocorixa	Tanypodinae	1		
Agnetina	Chironomini	1		
Taenioteryx	Tanytarsini	6		
Paracapnia	Ephemerella	1		

Stressor- and Effect-based Approaches are Complementary

Chemical





= Ontario Water Quality Objective

Pretty River, Highway 26, Collingwood, Ontario

Figure 1. *Water chemistry and benthos sampling data for the Pretty River, Collingwood, Ontario. Under the Biological Monitoring heading, table entries are abundances for each listed taxon collected during a five-minute kick and sweep sample. Chemical monitoring charts show box plots for phosphorus and zinc. The central 50% of the data is shown as the box (more variable data has a larger box), with vertical bars extending to the the maximum and minimum observed values. Unpublished data (Photo source: Nottawasaga Valley Conservation Authority).*

OBBN Vision

Even though the need for benthos biomonitoring is well known, its application has not been widespread in Ontario for a number of reasons: although regulatory guidelines for water chemistry are available, no such 'biocriteria' exist for biomonitoring; bioassessment is complex due to a number of confounding factors (i.e., biota respond to factors other than water quality); no standard sampling protocol exists; benthos identification requires special expertise; experts disagree on interpretation; and traditional methods are costly.

A patchwork approach to biomonitoring in Ontario has created a number of barriers to wider application, including no standard protocol, no mechanism for sharing data, and no consistent training. The OBBN will remove these barriers by specifying standard methods, enabling data sharing between partners, automating analysis using a reference-condition approach, and providing training. With the direction of a multi-partner Technical Advisory Committee, we are developing the network according to the principles of partnership, free data sharing, and standardization. EMAN sees the OBBN as a pilot project for a Canada-wide aquatic biomonitoring program.

The Ontario Benthos Biomonitoring Network has five objectives:

1) to enable the assessment of lakes, streams, and wetlands using benthic macro-invertebrates as indicators of environmental quality;
2) to provide a biological performance measure related to management of aquatic ecosystems;
3) to provide a biological complement to the *Provincial Water Quality Monitoring Network*, a water chemistry monitoring program, administered by the Ontario Ministry of Environment, that has been operating since the 1960s;
4) to facilitate a reference condition approach to bioassessment in which minimally impacted sites are used to derive a community expectation for a test site; and,
5) to support development of aquatic biocriteria and a biological water quality index for Ontario that can be integrated with federal biomonitoring initiatives.

We expect to implement the OBBN fully by 2005. Coordinating partners, MOE and EMAN, are providing scientific guidance and limited sampling equipment. Partners (federal and provincial ministries, conservation authorities, municipalities, universities, non-governmental groups, and volunteers) are sampling lakes, streams, and wetlands, and they are helping to evaluate OBBN protocols.

Reference Condition Approach

We recommend a reference condition approach (RCA) to bioassessment (Figure 2), in which minimally impacted reference sites are used to define 'normal' and set an expectation for community composition at test sites where water and habitat quality are in question (e.g., Wright *et al.*, 2000; Bailey *et al.*, 2004). Using RCA, we consider test sites unusual if their communities fall outside of the normal range. Unusual sites warrant further study to determine if human activities are responsible for the deviant community composition.

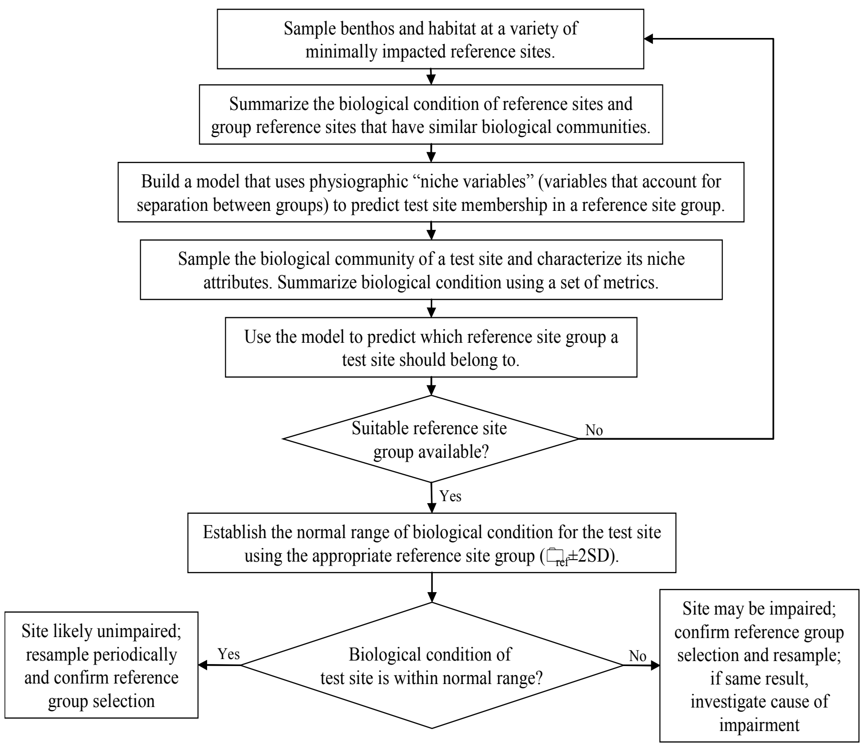


Figure 2. *The reference condition approach.*

The first step in the RCA is to sample reference sites. Because no objective quantitative criteria for 'minimally impacted' exist, we ask partners to sample sites that are not obviously exposed to any human impacts (such as point-source contamination, regulation of water level, water impoundment, deforestation, habitat alteration, development, agriculture, or acidification), and that represent best local conditions. Test site sampling will commence once a reasonable amount of reference site data is available.

OBBN Protocol

The OBBN protocol manual (Jones *et al*., 2004) balances standardization and flexibility. We need standard methods to ensure comparability of data but also need flexibility to accommodate partners with different financial resources and expertise. Table 2 summarizes OBBN protocol recommendations.

Table 2. *Summary of OBBN protocol recommendations.*

Biomonitoring Component	Recommendation
Benthos collection method	Traveling kick and sweep (other optional methods are available for special studies or atypical habitats)
Mesh size	500 µm
Time of year	Any season; assessment comparisons made using data from the same season
Picking	In lab (preferred) or in field (optional); preserved (preferred) or live (optional); microscope (preferred) or visually unaided (optional); random sub-sampling to provide a fixed count per sample
Taxonomic level	Mix of 27 Phyla, Classes, Orders and Families (minimum); more detailed identifications are optional and are recommended for reference sites
Analysis	Reference condition approach

OBBN Database

The OBBN database will be internet accessible. In addition to storing reference and test site data, it will contain several applications that automate the assessment process: a test site and reference site selection utility, a mapping utility, a summary metrics calculator, and a statistical module for hypothesis testing. These additional modules will allow partners to generate custom assessment reports so practitioners will have instantaneous results in a readable format.

Research Needs

We have identified a number of research questions related to development and evaluation of OBBN protocols. We list these questions below to stimulate discussion and highlight opportunities for collaborative studies:

- Is the reference site mean ± 2 SDs a reasonable definition of the normal range? What is an ecologically significant effect, i.e., the minimum effect size we wish to detect?
- Do taxonomic resolution and sampling method affect sensitivity and diagnostic ability?
- Can we use 'response signatures' to identify causes of impairment?
- How many groups of reference sites are there? How many sites are required to define a group?
- How accurately can we predict a test site's reference group membership? What are the best attributes to build our predictive model on?
- What qualifies as a reference site? How minimally impacted is minimally impacted enough?
- How many samples are enough for whole lake, whole river, or whole wetland assessments?
- Do optional sub-sampling methods yield the same estimates of relative densities?
- What is the ideal ratio of reference sites to number of metrics used in the analysis? Which indices contribute the most information to bioassessments in different parts of Ontario?

Partnership Benefits Specific to Ontario Parks

Ontario Parks' participation in the OBBN will benefit both park managers and other OBBN partners. Ontario's parks and protected areas are very important to OBBN partners because they contain minimally impacted reference sites. Reference sites in parks and protected areas are likely to become increasingly important as land-use changes occur in surrounding areas. Park managers will benefit by having access to a method of evaluating aquatic ecosystem condition that provides both surveillance and performance information related to aquatic ecosystems. The OBBN has established standard procedures, uses a world-renowned indicator, is relatively inexpensive, and provides some flexibility to account for differences in available time and expertise. Furthermore, the network will give instant gratification: bioassessment results, which indicate whether or not a site is within the normal range of biological condition observed at reference sites, will be generated by automated analytical tools, at the click of a button.

Summary

Our key messages presented in this paper are listed below:

- Aquatic biomonitoring is important for adaptive management.
- Benthos are excellent indicators of aquatic ecosystem health.
- The OBBN will remove barriers to benthos monitoring by providing a standard protocol, training, data sharing, and automation.
- We will implement the network by 2005 on the principles of standardization, partnership, and free data sharing.
- The OBBN database will provide custom reports so results are instantaneous and in a readable format. Citizen scientists' assessments will use the same rigorous approach that research scientists use.
- Refining the OBBN protocol requires answering several research questions.

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Challenges within the *Ontario's Living Legacy* (OLL) Inventory Program for the Ontario Ministry of Natural Resources-Northeast Region

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Abstract

The Northeast Region of the Ontario Ministry of Natural Resources took the initiative to complete assessments and inventory on all of the conservation reserves internally. These conservation reserves were originally created during the Lands for Life *land-use exercise (including gap analysis) and allocated under the current* Ontario's Living Legacy Land Use Strategy *(OLLLUS) (OMNR, 1999). Each of these sites was surveyed for life science, earth science and recreational values. During the process of creating more protected areas and identifying and assessing natural heritage values, many challenges were encountered. Challenges included a large geographic area, simultaneous deployment of the inventory, regulation and planning components of the OLL program, assessments including pre-flight preparations and standardization of checksheets (post-flight). Managing staff expectations at the district, regional and provincial levels continues to be a challenge. This paper illustrates how challenges were overcome by establishing a partnership with OMNR-Timmins Geomatics Service Centre (TGSC) and Aviation Services, using in-house staff and by creating regional standards for inventory methods and checksheet products. The importance of establishing relationships and processes to complete the work that evolved from year one to the present was essential. Current and future challenges are discussed.*

Introduction

The Ontario Ministry of Natural Resources (OMNR) carried out an extensive public planning process between 1997 and 1999 to protect areas for natural and cultural heritage values. The Parks and Protected Areas (PAPA) component focused on specific sites that contribute to the best representation of biological or geological features or landscapes that require protection based on uniqueness, rarity, sensitivity or other special natural heritage values placed on them by society, while minimizing impacts on other land uses. The total PAPA allocation is the *Ontario's Living Legacy Land Use Strategy* (OLLLUS) (OMNR, 1999).

Inventories for life science, earth science and recreational values were conducted by regional and district OMNR staff for 143 conservation reserves and selected provincial parks. The surveys were conducted to confirm landscape and vegetation types identified through GIS-based gap analysis, and to collect and compile information for future management planning (OMNR, 2003a; 2003b).

From the time that OLLLUS was created, the Northeast Region has met many challenges and issues concerning the inventory component of OLL implementation. Challenges include:

- a large geographic area;
- simultaneous deployment of the inventory, regulation and planning components of the OLL program;
- assessment including pre-flight preparations; and,
- standardization of checksheets (post-flight).

Managing staff expectations at the district, region and provincial levels continues to be a challenge.

The objective of this paper is to discuss the evolution of the inventory program from the first year (2000/2001) to the present by discussing each of the challenges and how they were resolved. Future challenges regarding conservation reserves and other protected areas are also discussed.

Large Geographic Area

The OMNR Northeast Region is 440 774 km^2 in size and comprises approximately half of the total provincial area (Figure 1). The Northeast Region is responsible for 143 conservation reserves (48% of the provincial total) or 43% of the total provincial area allocated. Conservation reserves (CRs) range from 82 to 153 844 ha and are widely distributed (Figure 1). Each site is complex in values, topography, degree of isolation, and boundary configurations.

Our approach to managing the inventory workload and enhancing integration among government levels resulted in building internal staff capacity versus through independent contractors. OMNR contract staff were used for both CR

Figure 1. *Parks and protected areas of northeastern Ontario.*

assessments and checksheet production with the help of district staff, Timmins Geographic Service Centre (TGSC) and OMNR Aviation Services. The commitment to hire OMNR staff resulted in:

- the building of capacity at the district level to help districts become familiar with the inventory program and to have staff involvement in field exercises;
- the involvement of district staff in the planning and management of the PAPA program including natural heritage protection which is not well understood by district staff;
- the promotion and facilitation of staff interest and knowledge concerning natural heritage values that require protection since the OLLLUS was a provincial strategy with little input from district staff; and,
- the enabling of district staff to champion the protection of CRs since districts are responsible for CR management according to the *Public Lands Act*.

Simultaneous Deployment of Inventory, Regulation and Planning

Inventory, regulation and planning were implemented simultaneously since the first year (2000/2001) under the OLLLUS. Inventory and regulation of CRs were expected to be at their highest level in the second year of the program with planning expected to peak in the fourth year (Table 1).

Table 1. *Summary of implementation strategy (OMNR, 2001).*

Year	Regulation	Inventory	Planning
1 (2000/2001)	31	30	15
2 (2001/2002)	65	75	20
3 (2002/2003)	46	37	43
4 (2003/2004)	0	0	64
Total	142	142	142

As with any new program, issues began to arise. Many CRs containing forest reserves (e.g., mining tenure) still have boundary issues and are not regulated to this date, inevitably delaying inventory and planning. In the first year, 15 checksheets of earth, life and recreation inventory had to be completed before 'Statement of Conservation Interests' (SCI) or 'Resource Management Plans' (RMP) could be written. Delays occurred when the site inventory (aerial or field) was not completed until the end of September. To address these challenges, inventory targets were reduced for the second year but shortfalls in targets still occurred. Checksheet completions were falling behind planning needs. In order for planning to meet their targets, SCIs were being written without completed checksheets and in some cases unregulated boundaries. In December 2002, a modified implementation strategy was written to meet new inventory targets while meeting local planning needs and provincial standards (OMNR, 2002). This modified strategy resulted in increased communication between the Northeast Region and Ontario Parks main office, established a new template that displayed pre-inventory data and new checksheet formats, integrated earth and life science products, and provided draft summaries for planning if no checksheets were completed.

Assessment Challenges Including Pre-flight Preparations

Pre-flight preparation issues included rough flight maps, difficulties with co-ordinating schedules and staff, and data layers (linked to checksheets). The original flight maps consisted of photocopied National Topographic Series (NTS) maps with hand-coloured *Forest Resources Inventory* (FRI) (Figure 2), as GIS capabilities within the Northeast Region-Planning Unit were almost non-existent. These maps were messy for both the staff doing the assessments and for the pilot to use for navigation. Partnership with TGSC resulted in maps that were more user friendly. The new life inventory flight maps were originally designed by the TGSC staff and then the procedure was passed on to the district level. Clipped, geo-referenced digital images of NTS maps were used as the background cover and overlaid with FRI and other values obtained from the provincial *Natural Resources Value Information System* (NRVIS) layer (Figure 3). Obtaining updated FRI from the districts was often difficult and so the TGSC was required to compile FRI from the provincial archives which were incomplete, archaic, and not standardized or map-joined. The procedure took days to complete and correct the FRI for each district.

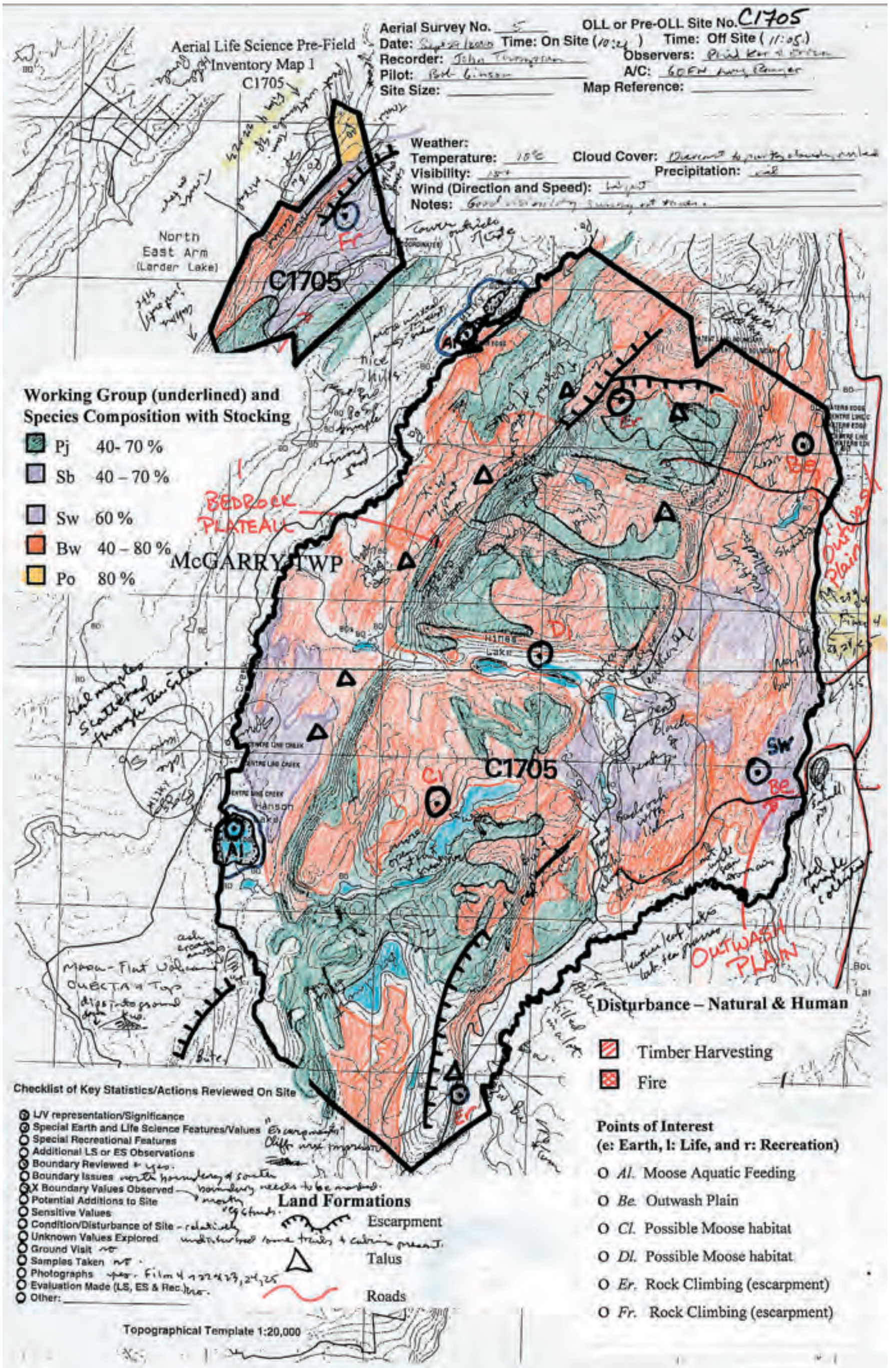

Figure 2. *Inventory map from the first year.*

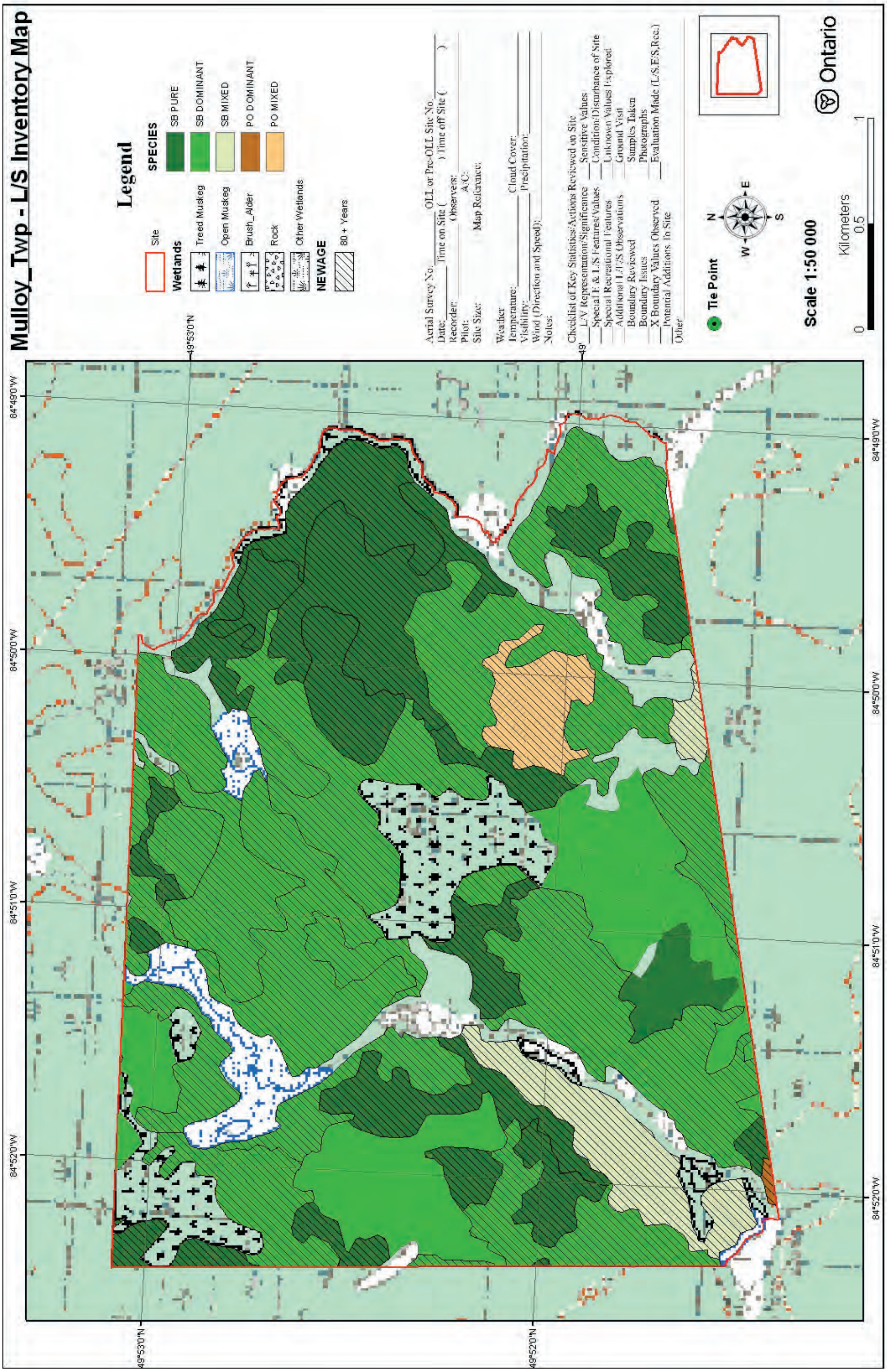

Figure 3. *Inventory map from the fourth year.*

Earth inventory maps also had NTS maps as the background and were digitally overlaid with the *Northern Ontario Engineering Geology Terrain Study* (NOEGTS) maps. NOEGTS proved to be a worthy reference during the flight assessments and post-flight interpretation. It also provided opportunity to do some ground-truthing of the NOEGTS data.

Co-ordinating flight schedules and staff, dealing with significant staff turnover, and prioritizing communication and safety were also a major issue. Schedules had to be co-ordinated with availability of district staff, radio operators and helicopters. With that, inventories were usually conducted in the end of August to mid-October when the fire season and field operations by the district usually dwindles. Schedules and maps were provided to the pilots, the information and client services officer, district radio operator and designated regional staff member(s) so that at any one time the inventory field team could be located. The Provincial Co-ordination Centre was also contacted on a daily basis during the field season to verify helicopter availability and schedules. Before any inventory could be done, a training flight was arranged to ensure that the pilots were familiar with our mandate and for life science staff training in value assessment, record keeping and field safety.

In many cases, a whole CR could not be investigated due to budget and time constraints. Only a standard aerial reconnaissance inventory for life, earth and recreational values was conducted without a complete species list. Time permitting, the assessment team landed in CRs to obtain some ground-truth of earth and life science features. Assessments were concentrated on confirming values from the OLLLUS and determining the current state of resources such as condition, sensitivity and special features including wetland communities and old growth. All of this could not happen without establishing a team approach to ensure preparations are made ahead of time – knowing what is expected and important, providing options in the field as required, and following procedures from the time of safety check at the helicopter until landing time at the end of the day.

Checksheet Production (Post-flight)

Earth Science

Few sites inventoried annually were designated for earth science protection. During the early stages of the inventory program, the OLL geologist was to provide geological descriptions for all of the CRs; detailed, large-scale, surficial geological mapping for only the designated earth science sites; and geological interpretation as required by OMNR staff.

It was considered unnecessary to prepare detailed surficial geological mapping for all life science sites. For life science checksheet production it was decided to utilize published, provincial-scale, surficial geological mapping since these maps, despite the small scale, were considered sufficiently detailed for the purpose of conducting landform-vegetation analyses. In addition, provincial-scale map series provided a standardized map legend, which was both immediately available and applicable within all parts of the province.

After the initial year of the inventory program, an unintended but important result was the identification of significant discrepancies between provincial-scale, surficial geological mapping and the actual surficial geology of many of the CRs. Provincial-scale, surficial geological map units are generally defined on the basis of the dominance of a particular geological material (e.g., till deposits), despite the presence of subordinate areas of other geological materials (e.g., exposed bedrock or peatland). Given the coarse scale of the mapping (e.g., 1:1,000,000), it is simply impractical, or impossible, to depict minor areas of other geological materials. In addition, many of the CRs within the Northeast Region are small. The discrepancy between published, provincial-scale mapping and earth science inventory of a small CR could be extremely large. In such cases, an area of exposed bedrock (or peatland), too small to be depicted on a provincial-scale map, could dominate the surficial geology of the entire CR.

During the second year of the inventory program, it was decided to prepare detailed, large-scale surficial geological mapping for all of the CRs. This decision substantially increased the workload, which, in turn, complicated scheduling immensely for meeting both inventory and planning targets as now a large amount of time was expended on conducting aerial photo interpretation and producing surficial geological maps. As a result, the preparation of earth science checksheets, and the meeting of earth science targets, was delayed. As well, the planning process, which required up-to-date earth science and life science information, was also delayed.

The challenge was to provide enough information on a semi-regular basis so that each stakeholder could at least move toward the completion of their particular targets. In order to meet this challenge, it became necessary for the OLL geologist to spend some time conducting ‘quick aerial photo interpretations’ by doing a brief stereoscopic scan of the aerial photography, providing a tally of the surficial geological units within a CR, as well as providing general information on the occurrence and distribution of the units. This quick interpretation was incorporated into an ‘earth science planning summary’, a short paragraph which both identified the surficial geological units and briefly described their significance and sensitivity. In addition to these planning summaries, formal earth science information products were also being produced.

Life Science

In the year a site is flown, many districts require background information on a CR to complete the SCI planning, particularly in the earth and life science components. The Region developed a five-step format for life science checksheets based on information available (Thompson *et al.,* 2003). ‘Step one’ was formally considered a planning summary checksheet and contained basic information on the CR. It contained no landform-vegetation analysis at the local level as earth science interpretation was not available for the life science checksheet. It could be signed off by the regional director as meeting the minimum standard for checksheet accountability. A ‘step four’ checksheet is the most advanced in that it contains landform-vegetation analysis based on digitized landscape interpretation from the OLL geologist. ‘Step one’ to ‘step three’ checksheets could be upgraded to a ‘step four’ with complete representation added into a new appendix. ‘Step five’ would take ‘step four’ checksheet information and determine the site’s significance within a newly run provincial gap analysis which is currently pending.

From the onset of OLL inventory, lack of GIS expertise and technology within the planning unit of the OMNR Northeast Region made it difficult to produce checksheets to the standard required for SCI planning. During the early stages of OLL implementation, life science and earth science checksheets were written with little interaction between the two authors resulting in an incomplete representation of the landform-vegetation information. Representation was determined using photocopies of maps of forest communities overlapping provincial geology coverage (not verified by the OLL geologist) and doing a manual count of landform-vegetation combinations. As well, these forest communities were subjectively grouped without any set guidelines by the checksheet author. With the help of the TGSC and co-operation from the OLL geologist(s) and district staff, new standards were produced to determine representation. The life science inventory was conducted at the forest community level based on the best FRI available. The forests within the Northeast Region were divided into the three major forest divisions: 'true boreal forest', 'true Great Lakes-St. Lawrence (GLSL) forest' and a 'transition forest zone'. Those forest communities within the 'transition forest zone' were declared 'boreal forest' or 'GLSL forest' depending on tree species assemblages. Forest communities were grouped into hardwood and softwood components based on definitions by Taylor *et al.* (2000). For example, a stand dominated by coniferous tree species with less than 30% cover of hardwood in the main canopy was defined as coniferous mixedwood and vice versa for hardwood mixedwood. Each forest community has to be manually defined and this was quite time-consuming for very large sites, but is standardized and not subjective. FRI data was also grouped ecologically into Standard Forest Units (SFU) for the boreal forest and Habitat Units (HU) for the GLSL forest. Boreal forests were further grouped into development stages (immature, mature, old growth) based on Bridge *et al.* (2000) definitions. No definitions could be found for the GLSL except for old growth definitions from Uhlig *et al.* (2001). ArcView Avenue scripts created by the TSGC based on parameters from Northeast Science and Information team of the OMNR were run through the FRI to calculate the SFU/HU. These units are a common language among the forest industry and the different specialty teams in the province.

Gap analysis was originally done using the Ontario Forest Research Institute (OFRI) surficial geology layer and the provincial land cover for vegetation derived from LANDSAT 28 imagery. In 2003, Ontario Parks provided the Region with a new gap analysis using instead the Ontario Geological Survey's (OGS) *Quaternary Geology of Ontario* coverage at a scale of 1:1,000,000. The original gap analysis provided data for candidate areas whereas Ontario Parks used the regulated or the most current boundaries. This new gap analysis would be used to verify the landform-vegetation combinations present within the site, gathered from the writing team based on SFU/HU and aerial photograph interpretation of earth science features. Upon further examination, several discrepancies were noted. First, it became apparent there was a 'shift' in the Quaternary geology layer that made it impossible to use the new gap analysis. Further investigation into the reason for the shift is required. Second, the satellite imagery used in the land cover provides only information on general species classification (e.g., dense conifer forest, mixed deciduous forest, etc.), but lacks sufficient detail in terms of species composition and age class at the local level.

Recreation

The objective of the recreation resource inventory is to identify the unique mix of recreational features, activities, access and recreational factors (feature scarcity, uniqueness, attractiveness, geographic significance and sensitivity). It must identify the most significant landforms and features which are or may be used for recreation, identify existing activities, identify uses in contravention of existing park/CR policy, etc. (OMNR, 2002).

Several issues arose during the recreational component of OLL. In the early years, the region was responsible for preparing the recreational checksheets until it was decided the districts should assume responsibility. Because of lack of accountability with district staff, incomplete checksheets were often sent to the region, or information was lost with the high staff turnover within both levels. Another problem was that standards and guidelines for checksheets changed from year-to-year.

As a result, in the third year, Ontario Parks developed guidelines for mapping templates and checksheets that had to be adhered to by all writing staff (OMNR, 2002). The information collected is essential to properly plan and manage the protected areas and to ensure that gaps in information are minimized.

Future Challenges

As OLL implementation approaches March 2005, we are still faced with challenges and a need for a vision for the CRs within the PAPA framework. The removal of forest reserves from CRs is still on-going, all information from the initiation of this program needs to be archived, and all information needs to be managed and accessible.

Some of the most diverse and pristine CRs and provincial parks should be identified to establish a baseline system of protected areas for a long-term monitoring program. To function as a baseline system, it would be necessary to subject identified CRs to intensive ground surveys of the surficial geology, soil development, and vegetation. The information gathered from the ground surveys would be used to produce detailed and highly accurate maps showing the landform-soil-vegetation units within each CR and to try and capture the present ecodiversity within these protected areas. Only the vegetation component would need to be re-surveyed, perhaps every ten to 20 years, to determine shifts in community assemblages. Next, it would be necessary to instrument the identified CR to undertake long-term monitoring programs of selected parameters (precipitation, temperature, water levels, etc.) both characteristic of regional climate and sensitive to regional climate change. The up-front costs associated with the intensive ground surveys and the instrumentation of each selected CR might be a challenge, but the costs associated with the long-term monitoring programs should be very reasonable. It is anticipated that the use of electronic data loggers will prove to be practical and economical. The baseline information generated by such a program would be invaluable, especially 100 or 150 years in the future. More intensive monitoring could be targeted on a small suite of sites that are most diverse and pristine. Long-term monitoring could include a variety of funding and partnerships, both within the OMNR as well as with other governments and non-governmental organizations. Perhaps the greatest challenge will be to foster the political environment within which long-term monitoring programs are accepted and funded.

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Assessing the Carpathian Ecoregion Initiative (CEI)

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Abstract

In the 1990s the World Wide Fund for Nature (WWF) added a new ecoregional approach to its longstanding efforts to conserve nature. One of the areas that became an early focus of this approach was the Carpathian Mountain system, a lengthy multinational region of rugged peaks, rolling hills, valleys, forests, grasslands and diverse landscapes, in central and eastern Europe. This system is part of Ecoregion 77, the European-Mediterranean mixed forests. This is an assessment of work in that ecoregion up to spring 2002 through what is called the Carpathian Ecoregion Initiative *(CEI). The assessment begins with an introduction to the Carpathian system, relying mainly on information collected by the CEI. This introduction is followed by sections on the origins of the CEI, the terms of reference and methods used in the assessment, the work schedule, the results, and recommendations for the future. Some observations are also made on recent research relating to planning theory and methods, as these apply to the CEI and other extensive ecoregional landscape and land-use planning projects. Overall, this assessment is intended to assist the CEI with its ongoing work and to be useful to others concerned with ecoregional and landscape planning work elsewhere in the world. This paper summarizes a longer report (Nelson, 2004).*

Introduction

The Alps are undoubtedly the most renowned mountain system in Europe. Yet the lesser known Carpathians are worthy of equivalent, if not greater, recognition (CEI, 2001). This comparatively young (Tertiary) mountain system rises up to 2000 m north of Vienna on the Danube River and extends in a great 1500 km arc through the Czech Republic, Slovakia, Poland, Hungary, Ukraine, and Romania (Figure 1). The peak of the system is the high Tatras of Poland and Slovakia, with Mt. Gerlach at 2653 m above sea level. The width of the system is about 250 km in the northwest, 100 to 120 km in the Ukraine, and 340 km in the southeast, in Romania (Vološćuk, 1999: 9). Overall the Carpathians cover an area of about 210 000 km^2, approximately five times greater than the area of Switzerland (Table 1).

Figure 1. *The Carpathian ecoregion (Source: CEI, 2001).*

According to *The Status of the Carpathians* (CEI, 2001), these uplands are central Europe's largest mountain range of global significance as a natural area. The mountains exhibit complex geology, magnificent scenery, vast tracts of forests and meadows, and a wealth of natural diversity (biodiversity) unparalleled in Europe (Figure 2 through Figure 5). The mountains also have a rich human history and cultural heritage reflecting thousands of years of human interaction with the land. One significant manifestation of this is the extensive high grasslands and meadows created by clearing upper level forests for sheep grazing since about the 15th century (Figure 2). These grasslands are now valued for their high biodiversity and are a focus of concern over forest and shrub encroachment following cessation of grazing in the last few decades.

Table 1. *Carpathians facts and figures (Source: modified from CEI, 2001).*

Total area	209 256 km^2
Carpathian countries (% of Carpathians)	Romania (55%), Slovakia (17%), Ukraine (11%), Poland (10%), Hungary (4%), Czech Republic (3%), Austria (<1%)
Source of major rivers	Vistula, Drista, Prut, Aluta and numerous Danube tributaries including Tisza and Vag
Population	ca. 16-18 million
Main economic sectors	Agriculture, forestry, tourism, local industry, mineral exploration

The climate of the Carpathians varies from west to east. Maritime influences are stronger in the west, along with higher frequencies of cyclonic weather and storms. Continentality increases to the east, with distance from the moderating influence of the Atlantic, bringing decreases in precipitation and temperature. Mediterranean influences increase toward the south where a north-south seasonal shift in atmospheric pressure systems and weather patterns results in drier, hotter summers with more anticyclonic activity, and wetter, cooler winters with westerly winds and cyclonic storms. Elevation, topography, aspect, slope and other factors complicate these general climatic patterns. Broadly speaking, the mean July temperature in the western Carpathians is 19ºC and in the southern Carpathians, 22ºC. Precipitation generally falls from an annual average of 2000 mm in the west to 600 mm in the southeast.

Figure 2. *Pieniny, Poland-Slovakia (Source: CEI, 2001).*

A very general zonal framework of vegetation has been developed for the Carpathians, although biological conditions obviously vary considerably with soil, slope, bedrock, and other meso- or micro-conditions, as well as the effects of human activity.

The zonal framework or model is useful in giving a broad, albeit idealistic, frame of reference for forest and vegetation types in the Carpathians.

The zones in the framework are (Vološćuk, 1999: 10):

- oak (*Quercus)* (150-300 m);
- beech-oak (*Fagus-Quercus)* (300-500 m);
- oak-beech (*Quercus-Fagus)* (400-600 m);
- beech (*Fagus)* (550-750 m);
- fir-beech (*Abies-Fagus)* (700-1000 m);
- spruce-fir-beech (*Picea*-*Abies*-*Fagus*) (950-1300 m);
- spruce (*Picea)* (1250-1550 m);
- subalpine (*Pinus mugo* ssp. *pumillo*) (1500-1850 m);
- alpine, without woody plants (1850-2250 m); and,
- subvival, higher plants are rare (2250 m).

The importance of the Carpathians as a catchment or source area for rivers flowing into more populated surrounding lands is generally described in the CEI reports and data. Ultimately 90% of the Carpathian waters are said to flow into the Black Sea and 10% into the Baltic. The Carpathians serve as source areas for the Vistula, the Tisza, the Prut, and other major streams of Poland, Hungary, the Ukraine, and Romania. Over one third of the flow of the Vistula reportedly originates in the Carpathians, which are also the source of 80% of Romania's freshwater resources if the Danube is excluded.

Figure 3. *The White Carpathians (Source: CEI, 2001).*

Some attention is given in the CEI reports to water quality, but less to flow regimes and flood and drought patterns through space and time. Largely as a result of their economic and social value, the Carpathian streams, lakes, and wetlands have been dammed, straightened and manipulated to reduce floods and increase naturally low flows in summer. Many reaches of the streams were dammed to produce water power for industry, particularly during the Communist Era of 1948 to 1989.

Figure 4. *Belianske Tatry (Source: CEI).*

On a continent where close to 60% of the forest cover has been lost and only 2% of the remaining forest cover is protected, the Carpathians support central Europe's most extensive tracts of forest between 950 and 1350 m above sea level. The Carpathians also support the largest remaining natural beech (*Fagus*) and beech-fir (*Fagus-Abies*) forest ecosystems and the largest area of relatively undisturbed forest left in Europe outside of Russia. Together with semi-natural habitats such as meadow pastures and hay meadows, which are the result of centuries of traditional management of the land, the Carpathians harbor a richness of natural diversity that again is unsurpassed in Europe outside of Russia. No less than one third of European vascular plants can be found in this region: 3988 plant species, 481 of which are found only in the Carpathians. The mountains form a 'bridge' between Europe's northern forests and those in the south and west, and as such are a vital corridor for the dispersal of plants and animals throughout Europe.

According to the CEI report entitled *The Carpathians, Kingdom of the Carnivores* (CEI, nd.), the Carpathians are the last region in Europe to support viable populations of Europe's greatest mammals. The European brown bear (*Ursus arctos arctos*), wolf (*Canis lupus lupus*), and lynx (*Felix lynx*) are all still to be found in the Carpathian forest. The European bison (*Bison bonasus*) is gone although efforts are being made to re-establish this animal, for example, in the Bieszczady Mountains.

In addition to their high natural diversity, the Carpathians also are significant because of their high national and ethnic diversity. They are home to diverse groups such as Czechs, Slovaks, Poles, Ukrainians, Moravians, Romanians, Walachs, Bohemians, Boykos, and others. Although this national and ethnic diversity is recognized in general terms in the work of the CEI, relatively little detail is given on the human dimensions of the Carpathians and surrounding ar-

Figure 5. *Piatra Craiului, central Romania (Source: CEI, 2001).*

eas which have a long and rich human history.

The Carpathians and surrounding regions are the site of significant Paleolithic discoveries dating back well into the Pleistocene. Extensive remains of Neolithic agricultural and mining activities as well as former villages and settlements have also been found in the vicinity of the mountains. Archaeological and literary evidence points to widespread settlement and trade prior to and during Roman and later times. The Carpathians hold traces of the advance of Gothic and other peoples into and following the Roman Empire. The marks of invaders from the east, such as the Huns, the Magyars, the Mongols, and the Turks, have been left on this culturally rich landscape.

Penetration of the mountains appears to have deepened and intensified in the Middle Ages with Barons and noble families claiming extensive tracts for hunting, forestry, and other purposes. Grazing, mining, lumbering, and other activities accelerated in the mountains in the 1700s, 1800s, and early 1900s. With the rise of industrialization in the 19th century, railroads were constructed to mining and other centers in the Carpathians.

The Carpathians also became a contended zone between emerging empires and nations, especially in the 19th and 20th centuries. The borders of Prussia, later, Germany, the Austrio-Hungarian Empire and its descendents, Poland, Russia, the Ukraine, the USSR, and Romania, advanced and retreated across the region. Under Soviet dominance after World War II, the eastern Carpathians were, for some years, a battleground among Poland, Ukraine, and the USSR. Large areas were depopulated. In many areas, grasslands and rural landscapes gave way to forests and wildland. Private lands were nationalized and operated as co-operative enterprises or as protected areas and hunting grounds for the elite of the Communist Party. Bears and other game were frequently fed with hunting in mind. In some areas, isolated high alpine settlements remained comparatively undisturbed. Under the Soviet regime the various Carpathians countries lost much of their autonomy and were linked to Moscow. Trade and contact among the Carpathian countries were strictly controlled.

After the fall of the Berlin Wall and the Communist system in 1988-89, numerous hitherto repressed forces were unleashed including interest in recovering private property lost to the public or communal ownership of the Soviets. People began to reenter, reclaim, and reinhabit the mountains. Forests, wildlife, and animals began to change again. All this human history is significant from the standpoint of those who value cultural heritage and the understanding it gives us of the past, where we have come from, and where we might be going. However, this human history is also highly significant to those interested in the current state of the forests and landscapes of the Carpathians. Obviously these have changed in numerous ways many times over the centuries, often as a result of the long continued, yet fluctuating ideas and activities of humans.

The Origins of the Carpathians Ecological Initiative

The Carpathians are one of the Global 200 ecoregions classified as endangered by WWF, this designation indicating that the ecoregion is considered highly significant from a biodiversity standpoint and is subject or potentially subject to high pressure from human development. In the late 1990s, staff of the WWF *Danube-Carpathian Project* in Vienna began discussing extension of Danube River work into the Carpathians, much of which is part of the Danube watershed. After some internal consultation within its office and WWF more generally, the decision was taken to launch an ecoregion program for the Carpathians. The development of the initial concept occurred between December 1988 and June 1999 and the program was implemented in 1999, 2000 and 2001.

The decision to do an assessment of the *Carpathians Ecoregion Initiative* (CEI) was taken by CEI staff in late 2001. The author was subsequently contracted to undertake the task. In December 2001 the author visited the Vienna office of the WWF-International *Danube-Carpathian Program* (DCP), which included the CEI coordinating unit, to discuss the process and terms of reference in some detail. As a result of the December meeting the author, the CEI coordinator, and the director of the Danube program, agreed to an assessment of the CEI although the assessment was not to include linkages with other senior organizations.

In the late stages of the assessment this limitation was associated with major difficulties in completing the work. Difficulties between the CEI and its umbrella office, the Austrian WWF, led to a cessation of CEI operations in spring 2002. This made it necessary to complete this assessment as a personal enterprise, which has been done largely because the CEI was emerging as a highly successful program up to the time of its cessation, one from which lessons can be drawn of value to others concerned with ecoregional planning elsewhere in the world.

The Assessment Methods

The assessment methods included:

- reviewing existing documents from CEI, additional background from the WWF and other conservation organizations and the CEI website;
- attending several meetings of the CEI;
- preparation of a questionnaire for wide distribution among the CEI network in advance of fieldwork;
- field visits to the Czech and Slovak Republics, Poland, and Romania;
- personal interviews with selected people; and,
- assignment of a German speaking former member of the Austrian Foreign Service to assist with field work and other tasks.

After the completion of an outline report and a summary of field visits by February 28, 2002, the author and the CEI coordinator agreed that a draft report would be submitted by April 1, 2002 and a review workshop planned for May 15, 2002. A revised report was planned for June 1, 2002 with further feedback from sponsors of the study and a final report before the end of June.

The Theoretical or Conceptual Framework for the Assessment

General theories that seem potentially applicable to the CEI assessment are rational or synoptic planning, mixed scanning, transactive planning, and interactive and adaptive planning (Hudson, 1979; Nelson *et al*., 2003). Rational planning tends to be exclusive rather than inclusive of other interests. Decisions on goals, objectives, resources, timelines and other essential details are made internally within the lead agency and these are carried forward with appropriate marketing, education and other programs to elicit support from the affected or general public.

The situation in which the CEI began was not really conducive to a rational planning approach. Much of the scientific and general knowledge was diffuse and uncertain. Nor did the originating group yet understand its goals, objectives, and interests well. It did not have the staff and resources to try to proceed in a relatively exclusive and direct manner to design and implement a program. Rather, the CEI involved building on the new and imperfectly defined notions of biodiversity conservation and the ecoregional approach. It involved beginning in a situation marked by considerable social, economic and political uncertainty. There were questions about how the CEI might be initially defined, who would support and work with such an evolving concept, whether the necessary knowledge and resources were available, and so forth.

In accordance with the foregoing thinking, this assessment of the CEI is based upon a set of principles or processes that underlie participatory, interactive, adaptive and civic planning. These seven processes are: understanding; communication; assessment; planning; management; monitoring; and adaptation (Nelson and Serafin, 1996; Dempster and Nelson, 2001; Nelson, 2003). All these processes are considered to be essential to an efficient, effective, and equitable planning approach. The processes are not thought of as proceeding in any logical or step-by-step sequence, but rather as working together in response to planning challenges. When a challenge presents itself, a planner generally tries, more or less simultaneously, to understand, communicate, assess, plan, manage, monitor and adapt to the situation in deciding how to deal with it. These essential processes were used as general criteria for analyzing and assessing the CEI (Figure 6). It is not possible to discuss the application of these processes in any detail in this paper. Those interested should consult the full assessment report (Nelson, 2004).

Brief Overview of CEI Planning Procedures

The first stages of the CEI planning process involved lead staff in the Danube office collecting background information on relevant government and non-

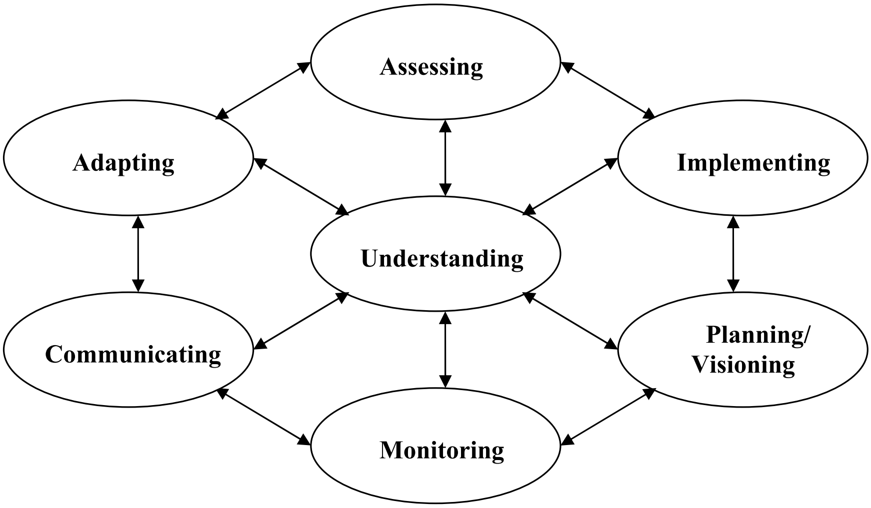

Figure 6. *A civics view of planning and decision-making (Source: Nelson and Serafin, 1994).*

government activities in the Carpathians area and preparing a proposal for WWF-International. This led to an initial workshop May 9-10, 1999, in Hungary, involving participants from governments and NGOs of six Carpathian countries plus some WWF staff and consultants. Here a number of challenges were recognized but a range of participants from the Carpathians' area generally agreed to go ahead with a basic methodology, principles, and a proposal for funding which was prepared and submitted to WWF-Netherlands in June. At that time, WWF-US had embraced the ecoregional approach which was initially called *Ecoregion Based Conservation* (ERBC). WWF was developing EBRC in several exercises in different parts of the world. This approach was accepted by the participants in the initial workshop of the CEI. The idealized WWF methodology consisted of a series of basic steps: reconnaissance; biodiversity assessments; socio-economic assessments; a vision and/or conservation strategy; and action plans for application on the ground. Between July 1999 and approximately December 2001, the CEI undertook the first three of these steps generally guided by a timetable agreed upon by participants.

The CEI made numerous adaptations during the unfolding of the foregoing planning procedure. The biodiversity and socio-economic assessments were not done in sequence but rather by separate but interrelated groups working at the same time. This seems to have provided for more effective interaction and exchange between the two groups. This interaction and the linking of the information was also enhanced by setting up a Geographical Information System (GIS) group to map the data so far as possible electronically. This, in turn, made it possible for the GIS group to analyze the biodiversity and socio-economic data in collaboration with the other groups and to identify 30 'Priority Areas for Biodiversity Conservation' which had high natural diversity values and were under pressure from transport, forestry, and other land use changes. The development of the GIS data and the maps was very challenging and laborious because of differences in data among the countries, varying levels of response to data requests, and other factors. The computer and analytical expertise and efforts of the Slovakia NGO Daphne were crucial in the completion of this work.

As the planning process proceeded, the CEI added two other working groups on Communications and Sustainable Development respectively. The CEI also established a framework for the necessary data collection and analysis on a cross-Carpathian or ecoregional basis. Country coordinators were selected for their general knowledge of each of the countries involved as well as expertise in a field such as biodiversity, socio-economic or GIS. Country coordinators with a broad background and visionary outlook served as members of the CEI Coordination or Steering Group (Samec, pers. com.). The country coordinators were also to recommend knowledgeable people in their countries who would be members of multinational working groups on biodiversity, socio-economics and communications.

Some Major Findings and Recommendations

Only some of the more important findings and recommendations for the CEI program can be given here. In reviewing these, please note that they are based on the situation as it stood in spring 2002, when CEI operations ceased. A new version of the CEI started in 2003. This report represents the first public assessment of the initial version of the CEI.

The major accomplishments of CEI, up to spring 2002, can be summarized as follows:

1) Highlighting an alternative positive vision of the future for the peoples and wildlife of the Carpathians.

2) Completing, primarily through workshops and syntheses of existing knowledge, a series of interrelated wildlife, vegetation, and other studies which made it possible to delineate Priority Areas for Biodiversity Conservation in the Carpathians. In the process, the CEI and its collaborators began to build an ecoregional image of the Carpathians among scientists, scholars, professionals, politicians, other decision-makers and citizens in the countries involved and beyond.

3) Completing socio-economic studies that provided the basis for identifying land use pressures on the Priority Areas as well as contributing to ecotourism and other socio-economic activities with high potential for a role in sustainable development.

4) Planning and implementing a wide-ranging information strategy including a website, as well as information and training sessions, workshops, a CD-ROM, and other means of creating interest in and capacity for biodiversity conservation and sustainable development in the Carpathians region.

5) Introducing a small grants program to offer support and build capacity for biodiversity conservation and sustainable development at the local level.

6) Facilitating a growing network of government and non-governmental conservation organizations involved in biodiversity protection and restoration, and to varying degrees in cultural conservation and sustainable development.

7) Participating in the high level summit at Bucharest, Romania, in April 2002, where the countries of the Carpathians region reached a general agreement on an *Environmental and Sustainable Development Accord* for the Carpathians which could provide the basis for continuing the work begun in the *Carpathians Ecoregion Initiative*. This agreement in turn led to a May 2003 *Framework Convention on the Protection and Sustainable Development of the Carpathians*.

Some Significant Practical Recommendations as of Spring 2002

Recommendations fall into two broad categories, the more immediate and practical and the major adaptations needed in the longer term. The more practical recommendations include:

1) Historical analysis and mapping of all the major ethnic groups in the Carpathians in order to help clarify the range and diversity of impacts that they have had on cultural landscapes, vegetation, wildlife, and natural systems in different parts of the Carpathians historically, and so contribute to better understanding and improved planning for ways of life and both biodiversity and human heritage conservation today and in future.

2) Associated studies of the land-use history and landscape changes in the Carpathians to determine how past human use of the forests, for example, logging and mining, have affected ecosystems and biodiversity in various parts of the Carpathians today and what the implications and needs are for the future.

3) Comparative study of national parks and other protected areas in the various countries to determine their legal, policy and other capacities and lay the groundwork for working toward shared standards and approaches in the Carpathians. Similar studies are needed on land-use, natural resources, water, or other institutional arrangements bearing on biodiversity conservation and sustainable development in the Carpathians.

4) Establishing a cooperative approach to the small grants program among the various organizations involved in the CEI. Differences in ideologies, interests, and values need to be addressed in developing a widely useful and accessible program.

5) Listening to and speaking with local people and local governments, and anticipating their historic, current, and possible future roles in biodiversity conservation, is an urgent challenge for scientists and professionals which will require work and time to address efficiently, effectively and equitably. A workshop on the CEI for municipal planners and local administrators in the region is needed to increase comprehensive understanding of the CEI at this level.

6) Significant additional resources are needed for the CEI to continue into the next stage. A new office, distinct from the previous site, should be created, and additional staff should be taken on board.

Major Adaptation in Future

Beyond such practical recommendations, major adaptations are desirable if the CEI is to proceed as well in the future as in the past. These adaptations in role, tasks, and relationships among cooperating organizations entail the following basic steps:

1) Recognizing WWF as the umbrella organization and a major funder of the CEI and other comparable ecoregional projects in various parts of the world, but with more careful planning and delegation of responsibilities in accordance with the natural, cultural, socio-economic, and other conditions peculiar to the Carpathians. In the project to date, the basic role of the CEI office was to serve as the cog in the wheel. The Vienna office was the hub of fundraising, communication, outreach, interaction, and planning. In the next phase more decentralization and delegation is required and the CEI office is better conceived of as the major unit or gear in an interrelated set of cogs and wheels. This arrangement has, in fact, already begun with the sharing of responsibility for GIS and related work with the NGO Daphne in Slovakia and responsibility for the Sustainable Development Working Group with the Environmental Partnership, Poland. Discussions are also underway to coordinate the small grants program with comparable initiatives of other organizations, one of which might be the prime mover.

2) Recognizing that the CEI project has the prime role in promoting the image of the Carpathians as an ecoregion among scientists, scholars, professionals and citizens. The CEI office would promote more specialized and comprehensive understanding of the Carpathians ecoregion through conferences, workshops, and other educational and media activities which would frequently be led by other allied organizations. In this context, the CEI office would also take a key coordinating role in organizing exchanges of scientists, scholars, professionals, youth, and citizens generally among communities in different parts of the Carpathians.

3) Recognizing that through WWF as an umbrella, the CEI project has a lead role in promoting, organizing, and monitoring research in biodiversity conservation and related fields in the Carpathians. This research would largely be cross-disciplinary and go beyond the specialized research already underway in various organizations and research bodies in the region. The universities in and around the Carpathians could play a much stronger role than they have in the past, perhaps through an *Association of Universities for Research on the Carpathians*. The CEI could undertake to promote such an association as well as applications and funding for related research and planning projects. The CEI could also serve as a depository for project proposals and research results in the Carpathians. Comparable organizations have been created in countries such as Canada, for example, the Association of Canadian Universities for Northern Studies and the Parks Research Forum of Ontario (e.g., Lemieux *et al*., 2003).

4) Recognizing that the CEI needs to remain flexible, responding directly to or organizing collaborative responses to challenges and opportunities for biodiversity conservation throughout the Carpathians. In this respect CEI needs to be able to respond at different scales, ranging from the regional to the local as well as to the different needs and circumstances in various parts of the Carpathians. In the more eastern areas such as Romania, for example, CEI and WWF are said by residents to be needed as a political voice at both the national and local levels because relatively few NGOs are active in that country. This contrasts with the situation in the western part of the Carpathians where numerous NGOs are present and there is more need and opportunity for CEI and WWF to consult, coordinate and delegate. Also, throughout the Carpathians, there is a role for CEI in conflict resolution and in facilitating work with governments and especially businesses, which have had less attention to date.

5) Ultimately, the people and natural systems of the Carpathians are too complex, dynamic and challenging to encompass in an overall management plan in the form of a multi-year blueprint implemented through a number of specific action plans. This complexity, dynamism, and challenge is underlain by a set of historic, economic, social, and political relationships in the Carpathians that must be recognized as likely to have uncertain and long-lasting effects on the Carpathian countries as they all work independently and interactively toward a better future. Here CEI can play a key role in diffusing information and identifying common

interests and concerns among the diverse countries, organizations, and natural and human communities of the Carpathians region. This role, and the associated work of WWF and other national and international organizations, will however, have to involve greater recognition of the evolving indigenous efforts of Carpathian governments and people to steward and sustain environment and quality of life in the region, as for example through the new *Framework Convention on Conservation and Sustainable Development*.

On Emerging Theory and Method in Assessing Landscape and Ecoregional Planning

More assessments are needed in landscape and ecoregional planning, and indeed, the broad field of land-use planning generally. Few ecoregional planning assessments have been undertaken so the results of this CEI assessment cannot be readily compared with others to build a broader base of theory, method and practice in the interests of greater efficiency, effectiveness and equity. The interactive and adaptive approach that has been used in this study has produced useful results that will be of interest to a wide range of parties concerned specifically about the CEI or, more broadly, about ecoregional or related landscape or land-use planning. The approach is worthy of serious consideration in future assessments of such planning. However, during this assessment some research was published on planning and associated theory and method that adds to the tools now at our disposal.

This new research is published in four recent special issues of *Environments: A Journal of Interdisciplinary Studies*. The first two issues were published in late 2002 and early 2003 under the titles of *Managerial Ecology: Contestation and Critique* (Bavington and Slocombe, 2002) and *Managerial Ecology: Counter-proposals* (Bavington and Slocombe, 2003). Numerous other relevant papers are included in *Collaborative Planning and Sustainable Resource Management: The North American Experience* (Gunton *et al.*, 2003a) and *Evaluating Collaborative Planning: The British Comumbia Experience* (Gunton *et al.*, 2003b).

Many factors are identified in these papers that relate to, go beyond, or differ in detail from the process-oriented criteria used as a framework for assessment in this study of the CEI. These new criteria deserve careful consideration by those intending to evaluate or assess landscape or ecological planning programs and projects. Some challenges facing the effectiveness and future of collaboration in the United States include:

- roles and attitudes of agencies;
- leadership and support;
- skills, resources, and time;
- roles and attitudes of nongovernmental groups; and,
- incentives to participate (Yaffee and Wondolleck, 2003).

In this respect, Gunton *et al.* (2003a; 2003b) advance what they call "*ten keys to successful management of collaborative processes"*. These need to be considered in deciding on whether or not to use a collaborative approach, implementing it, and undertaking an evaluation of its program and projects.

The ten keys include:

- determining the suitability of a planning issue for collaborative planning;
- ensuring inclusive representation of stakeholders;
- providing clear ground rules;
- reducing inequities among stakeholders;
- ensuring accountability of the process;
- maintaining flexibility;
- providing effective process management;
- providing sufficient time – about four years – for a process to work;
- developing implementation and monitoring plans; and,
- using multiple-objective evaluation of the planning process.

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Many of the photos are published with permission of the CEI and are credited according to guidance from CEI. Whatever values this assessment has are due overwhelmingly to all who helped me. I am of course responsible for missteps in fact or important omissions. A number of these were avoided through a final review of the manuscript by Phil Weller and Sissi Samec in November 2003. I am especially mindful of all the help that the redoubtable Stephanie Janetos gave me in preparing my assessment report. Stephanie did so while completing work on her MA thesis on protected area research in Macedonia-Greece borderlands with the University of Waterloo. In spite of this pressure she was always gracious in her careful work on this report. Christina Rehbein also helped complete this paper and the published version of my full report (Nelson, 2004).

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Restoring Nature in German National Parks: Policy and Case Studies

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Abstract

*German national parks are faced with significant challenges to restore natural landscapes and show park visitors nature in its natural state. This paper summarizes several of the management issues and policy directions in German national parks. An overview of this relatively new park system is presented along with an introduction to the 'German' view of nature. Case studies using the Harz National Parks (*Nationalpark Harz *and* Nationalpark HochHarz*) located in north-central Germany and* Nationalpark Berchtesgaden*, located in southeast Germany are presented. These parks in very diverse landscapes offer a number of nature restoration challenges to managers. High visitation numbers, centuries of land-use, and highly modified landscapes all contribute to the difficulties in restoring natural structures and processes. We conclude that while German dedication to the national park ideal is admirable, national parks by themselves are not likely to restore nature in Germany.*

German National Parks

There are presently 13 national parks in Germany, with two more in the planning stage (Figure 1). Established in 1970, the Bavarian Forest National Park is the oldest of the German parks. While national parks are recent, the concept of protection has existed in one form or another for over a century, with various designations, such as bird or game sanctuaries, being placed on valued parcels of land.

German national parks are administered at a local level by the state in which each park lies. While all aspire to the World Conservation Union (IUCN) definition of a national park (Category II), each is an independent entity with no central governing body.

Figure 1. *National parks in Germany (Source: Nationalpark Harz, nd.).*

As most of German land has been under private ownership for centuries, the establishment of new national parks is a challenge. National parks are often composed of a mix of public land, past and present working forests, and private land.

Historically, German people have had the right to walk on any public path, without hindrance and without paying. The national parks charge no entrance or gate fees, offer limited services and facilities, and employ small staffs, but afford unfettered access to visitors.

Case Study 1: National Parks *Harz* and *HochHarz*

The Harz Mountains are a unique region in north-central Germany (Figure 2). A large dome of very old mountains juts up abruptly from a large flat plain. This area of Europe has been settled for centuries.

The first documented attempts to offer some form of protection to the area occurred in 1718. As the conquest of nature continued through the industry revolution, the last brown bear was hunted in 1725, and the last wolf in 1798. As industry and population continued to grow in the region, the last known lynx in the area was eradicated in 1818. Thus, the last natural predator in the area disappeared nearly 200 years ago. In 1800, the first tourist services were built on the summit of the Brocken (1142 m.). This began what would become one of the prime tourist draws to the region – hiking in the Harz Mountains.

Twenty years after the establishment of Yellowstone National Park in 1872, the first discussions of establishing a national park in the Harz Mountains were held in the local parliament. No action came from those discussions, but the seed for future plans was set.

Another attempt was made to create a protected area in the Harz in 1955. The military strongly resisted any talk of creating a conservation area in such a strategic location. It would be almost 40 years before a successful bid to create a protected area would come to be.

Figure 2. *Harz National Park. (Source: http://www.germany-tourism.de/e/6293.html).*

In 1990, in one of the last acts of the East German government, *Nationalpark HochHarz* (High Harz) was established. Located in the state of Sachsen-Anhalt, it covers an area of approximately 8900 ha. The park is centred around the Brocken and consists of elevations from 250 m to 1142 m above sea level. The national park is accessible from many locations along the highways in the area and from adjacent towns. An extensive trail network extends for hundreds of km through the park, with a road and railway servicing the top of the Brocken.

The landscape consists of mainly of Norway spruce (*Picea abies*) (a non-native variety planted for its quick growth and tall straight timber), aged 80 to 100 years. The lower levels of the park, below about 600 m, are mixed hardwood forest, dominated by beech (*Fagus*). Located between the rolling mountains are numerous raised bogs dating as old as 8,000 B.C. At about 1000 m, a natural tree-line exists and the environment becomes essentially alpine, with many small hardy plants, and stunted, windswept spruce.

Adjacent to *Nationalpark HochHarz* is *Nationalpark Harz*. Established in 1994 in Neidersachsen, it covers 15 800 ha of the Harz Mountains. Its environment is essentially the same as HochHarz but it contains more land at lower elevations (the highest peak is 937 m).

Combined, the two parks have an area of approximately 25 000 ha and comprise about 10% of the Harz Mountains. While their ecosystems and protection mandates are essentially the same, each park is located in a different state, and, until recently, were managed by two separate agencies. However, on August 28, 2004, the two Harz national parks were united, resulting in a larger national park and a single administration.

Visitation to the area (the parks and adjacent towns) is currently estimated to be about ten million persons per year, with the majority coming to the parks for day visits. As there are no gate houses, entry fees and the like, an exact count of annual visitation to the park is not possible. The majority of the visitors are German, and come from the northern regions.

Management Issues in Harz

The relatively small size of the new Harz National Park and the cultural history of the region provide numerous challenges to managers. One of the prime objectives is the restoration of the original and ‘natural’ forests. The original forest types have been replaced by a commercial timber species, and many of the natural inhabitants of the forests have long been hunted to extinction. These two issues, forests and wildlife, have been the main management focus in the parks. Managers anticipate that restoring a more natural system will require 500 years.

Wildlife

Two of the largest predators in the region have long been extinct, the European brown bear (*Ursus arctos arctos*) (1725) and the wolf (*Canis lupus lupus*) (1798). While managers recognize that there could be great ecological value in re-establishing a viable population of each, they also concede that the national park, and the Harz Mountains as a whole, are too small to support such populations.

There have been two moderately successful attempts at species re-introduction in the national park. The first was the capercaillie (*Tetrao urogallus*). This turkey-like bird once flourished in the Harz. Efforts were made to introduce mating pairs of the birds in various locations; however, due to the intensive use of many areas of the parks in all seasons, the habitat needs of the capercaillie could not be maintained. In 2003, the program was cancelled. While there may be a small natural population scattered in some more remote locations, managers concede that the effort has proven unsuccessful.

One major success, however, has been the reintroduction of the lynx (*Felix lynx*). This project began in 2000 with the introduction of three breeding pairs from Poland. The population is beginning to sustain itself, and there are now no less than 12 lynx active in the park, including three known to be born in the wild. Much work had to be done to gain the acquiescence of local people who live in and near the national park. During the first years, residents often mistook the lynx for large domestic cats and, in some cases, attempted to kill them. With a great deal of public relations and work within the local communities, lynx are now an accepted part of the park. People who once feared the new wildlife, now call the park offices to report sightings and pass along information on the animals. To aid in the success of this project, the lynx has become the symbol for *Nationalpark Harz*.

Forests

In the Harz National Park, the predominant forest is about 80 years old and composed mainly of Norway spruce. This mature monoculture is quickly approaching the end of its natural life and is beginning to die off. To compound this issue, the Harz Mountains lie in the direct path of the major air flow over central Europe, bringing with it the airborne industrial pollution of western Europe.

All of this has produced a great deal of acid rain in this wet environment. With the forests being old and mature, the rain has weakened them and made an ideal host for an invasion of bark beetles (*Ips typognaphus*). In some areas of the parks, this combination of factors has left a landscape that is comparable to what one might see after an intense forest fire. This natural cycle of the beetle has proven to be a large management issue. While park staff acknowledge that the beetle is a natural part of the forest, its impact goes far beyond the park border. Local politicians have complained that the neat, tall forests are no longer so. Dead trees and trees that are falling over are not as attractive to tourists.

The results of the bark beetle infestation are most noticeable in the Quitschenberg area. Here all trees have succumbed to the acid rain/bark beetle combination. To further aggravate things, the prevailing winds have blown over all the trees. The management approach here has been to leave it alone and to interpret the scene for the thousands of visitors who pass through the area on the *Goetheweg* (Goethe's Trail). Here, guides and signage point out that this, as ugly as it may seem, is nature at work. They point out that when the trees fall, they make room for new ones and a variety of other species. Clearly visible amongst the dead Norway spruce are healthy new trees, many of which are the native species for the area – the Harz spruce.

One of the goals of the restoration process is to allow the natural species to re-establish themselves where they once lived. In lower altitudes, patches are cut out to allow the natural hardwoods, beech and rowan (*Sorbus*), to take hold. Along pathways and streams hardwoods are planted and allowed an opportunity to take a foothold. While these species are natural in the area, they need special attention. The absence of natural predators in the Harz has created a large red deer (*Cervus elaphus*) population. Fresh hardwood bark is a tasty meal for these deer and almost all planted hardwoods have some sort of fence around them for protection from browsing.

Case Study 2: Nationalpark Berchtesgaden

Located in the southeast corner of Germany, *Nationalpark Berchtesgaden* is surrounded on three sides by Austria (Figure 3). There is a long history of human use of the region, dating to the second millennium BC.

By 1908, the Association for the Protection and Care of Alpine Plants had initiated the establishment of a protected area. Two years later, 8600 ha were

Figure 3. *Berchtesgaden National Park (Source: http://www.germany-tourism.de/e/6308.html).*

officially designated as the 'Plant Protection Area' of the Berchtesgaden Alps. This designation stopped the local trade in alpine plants, very popular at the time. It did not, however, stop the continuing trophy hunting, as the area was still used as royal hunting grounds. In 1921 the reserve was expanded to 20 400 ha and included protection for wildlife as well. With a few exceptions (notably the establishment of personal hunting areas by members of the Reich, during the Second World War), the new Königsee Nature Reserve remained in place until 1978.

In 1978, the Free State of Bavaria officially designated the area a National Park. Unlike many German national parks, Berchtesgaden consists completely of state-owned land. As such, the government has broad control over the area and how it is used. At approximately 21 000 ha, the national park contains many lakes, moors, alpine meadows, mountains, and rock fields. Elevation ranges from 603 m (*der Königsee*) to 2713 m (*der Watzmann* – Germany's second highest peak), providing for a range of habits including mixed hardwood forests, dense conifers, barren alpine regions and snow capped mountains. Protected area designations for the Austrian lands adjoining on three sides effectively double the total protected area. In 1991, the United Nations designated the area a UNESCO Biosphere Reserve.

This area has, for 2,000 years, been an important region for timber harvesting, cattle grazing and tourism. The town of Berchtesgaden in 2002 celebrated 900 years as a tourist destination. The proximity of the park to the national border and the long American presence in the region provide ample explanation for the 115,000 annual visitors, many of whom are international tourists.

Management Issues in Berchtesgaden National Park

Expanding Wild Land Areas

Managers in Berchtesgaden, while concerned about restoring a natural and self-sustaining ecosystem, have the luxury of being able to take a more protective approach. Being located in the front ranges of the Alps, the national park has been spared much of the extractive use found in the Harz Mountains. Management recognizes the park's unique situation and has developed a series of zones in an effort to protect existing wild lands and decrease the effects of conflicting land-uses.

Three zones have been identified in the national park. By far the largest is the *Kernzone* or 'core' zone. This is essentially the wild land zone in which nature is left to itself. Access is difficult, competing land-use is minimal, and management interference is slight. At present this zone compromises approximately 66% of the park.

Another zone in the parks is the *Pflegezone* – the 'care' zone. This is a zone with a high degree of human interaction and impact. Tourist facilities, such as visitor centres, tour boats, and restaurants are located within this zone. Also located here is much of the traditional cattle grazing and some limited timber operations. This zone allows easy access to the park for visitors and is the focus of almost all visits to the park. It presently occupies about 24% of the park.

The third zone is the *Temporäre Pflegezone* or 'temporary care' zone. Comprising only 10% of the park, this is a unique area that management recognizes as in need of tending in order to restore it. Management here is aimed at restoring it to a more natural state and then adding it to the *Kernzone* or core zone.

Managing Traditional Cattle Grazing

In Berchtesgaden, one of the most noticeable continued land-uses is the cattle grazing. For centuries, farmers grazed their cattle in the protected valleys of the Alps during the winter and then herded them into the alpine meadows for summer grazing. This historical right of the people to use the landscape for grazing purposes creates an obvious dilemma for managers: how to allow nature to re-establish itself, while allowing the people the access that is their right. In Berchtesgaden, pastures in the core and temporary care zones are being closed and allowed to regenerate. To compensate for this, new areas are being created in the care zone. Activities such as grazing will be concentrated in the lower, more developed reaches of the park, while allowing the protected core area to expand. In time, it is expected that this use will move out of the park altogether.

Wildlife

In addition to the management of the land-base and its users, there is active management of wildlife within the park. The absence of large predators has allowed for a blossoming population of deer in Berchtesgaden. The management of this herd is very obviously a contradiction to the effort to increase the extent of natural ecosystems within the national park. The maintenance of an artificially high game population in the 19th century has left a legacy that managers must deal with today. Recreational hunting is permitted in an effort to keep some control on the population. This right to hunt is also a result of the right to free access to public land and has been a traditional land-use within the park for centuries. While controlled hunting is not an unusual management response, what is surprising is a large feeding station in the care zone of the Klausbach Valley. The feeding station seems to contradict the natural population controls, but is meant to supplement the natural vegetation which is insufficient to support this high population. In order to keep the deer in the park, they must be fed. Such action may also serve as a means in assisting the re-establishment of the mixed forests as it may help ease the strain the deer put on it. It appears that a cull of the deer is out of the question.

Conclusions

The Director of Berchtesgaden National Park, Dr. Michael Vogel, points out that, while the goals of German national parks are essentially the same as for any in the world, Germany has a long way to go to meet those goals. He states that:

> "*In most of the 13 German National Parks there is presently a transition period due to the former land use in these areas. During this time the use of land and interventions in the natural processes will be either completely eliminated or greatly reduced."* (Vogel, pers. com., May 2003).

With centuries of land-use over most of the country, finding a natural area suitable for designation as a national park is difficult. Park managers recognize that their task is a monumental one – restoring nature to what it once was. Through research and historical documents, there is a reasonable indication of what was once present. The question remains, however, to what degree should nature be restored? Choosing a goal for restoring nature is not a scientific endeavour, but a social and, perhaps, a political one.

Within the parks studied, there seems to be a realistic approach: eliminate the known intruders (Norway spruce, cattle grazers, etc.) and 'let nature be nature'. This approach is similar to North American approaches, in that both systems attempt to let natural processes happen as they will. In the case of German national parks, the attempt is to restore landscapes to states that are beyond the memories of people now living.

While the percentage of German land protected within national parks is similar to that of Canada, the size of the parks is significantly smaller. In addition to the small size, most parks are isolated from each other and in most cases from any other protected areas. This is particularly true in the Harz parks. They literally serve as a nature island. For the successful restoration of a natural environment, it will be necessary to establish more protected areas and develop some sort of corridor system through which wildlife can travel from one area to another. In the Harz parks, for example, there is not enough space for many species to find suitable habitat. By developing links among the national parks, other protected areas, and existing natural areas, perhaps some species would make a limited comeback.

The lack of a centralized national parks administration appears also to hinder the development and efforts of the national parks. As each park is managed, planned and developed by the state governments, there appears to be a lack of an overall common approach.

Management has surprisingly little control over the use of the parks. While managers attempt to influence use, they cannot control it. There are no gate houses to welcome visitors, or to collect user fees. As there are no fees, that potential income source cannot be used to attain the goals of the parks. Access to the parks is uncontrolled, and visitors can enter and exit from many locations. Rules for park use are posted at trail heads and on park brochures, but managers have little power to enforce them. The right of the people to free access to public land takes precedence.

The effort to establish and to operate German national parks has been challenging. For centuries, the Germans have been accustomed to a manicured form of nature. The idea of returning an area to a wild state has met with some resistance. However, over the past 30 years, this new system of parks has gained acceptance. German people seem to be accepting that there are things in nature that do not need to be tended.

Dr. Michael Vogel aptly sums up the reality facing German national park managers:

> "*For centuries our forefathers toiled and strained to transform 'wilderness' into cultivated land. To return even parts of nature back is undoubtedly considered somewhat hazardous and daring*." (Vogel, pers. com.)

Acknowledgements

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The Challenges of Collaborative Land-Use Planning: A Case Study of the Kawartha Highlands Signature Site

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Abstract

By examining the design and public reception of the Kawartha Highlands Local Stakeholders Committee, this paper highlights some of the fundamental challenges of implementing a more participatory approach to land-use and protected area planning. What needs to be addressed is how to appropriately acknowledge the legacy of historical land-use conflicts through process design. It is a question that can be at least partially answered by an analysis of the lengthy and polarized debate that was waged over the future of the Kawartha Highlands Signature Site.

Introduction

Tucked away in the Kawarthas, some 50 km north of the City of Peterborough, lies a 35 000-ha tract of land that has become a haven for cottagers and weekend recreationists. During the *Lands for Life* land use planning exercise, the Ministry of Natural Resources (OMNR) selected the Kawartha Highlands for inclusion within the province's rapidly expanding parks and protected areas system. The OMNR also committed itself to the establishment of a Local Stakeholders Committee (LSC) to guide the initial planning of the Kawartha Highlands Signature Site (Figure 1). The mandate for this committee, which was formally established in July 2000, was ambitious: it was going to work with the OMNR to make significant land-use and policy decisions, while also developing a co-stewardship organization for the long-term management of the area. Despite the wide scope of its mandate, the committee process was designed so that it stayed within the required timeframes, submitting its final recommendations to the Minister of Natural Resources in October 2001.

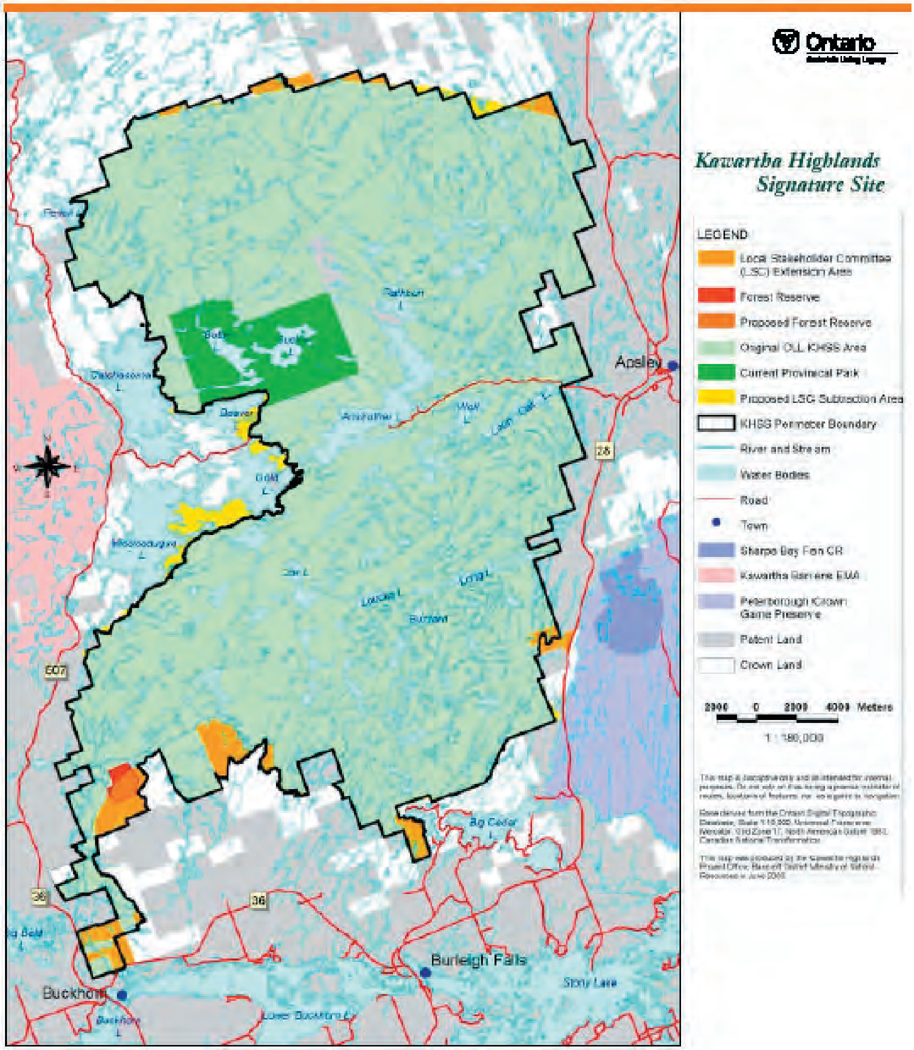

Figure 1. *The Kawartha Highlands Signature Site (Source: Kawartha Highlands Plan).*

Among a series of more specific recommendations, the committee concluded that the area should become a fully operational provincial park, a recommendation that, as we shall see, contributed to the growing dissention amongst a vocal portion of the local community and various provincial interest groups. This paper will summarize some of the findings of a larger research project (Barry, 2004) by highlighting important aspects of the design of the LSC, while also examining some of the key features of the debate that occurred over the future of the Kawartha Highlands. The study was based on the analysis of project documents, local media, and interviews with several LSC members and the OMNR's project coordinator.

Designing a Collaborative Process for the Kawartha Highlands

Collaborative processes are often faced with the task of balancing numerous goals and objectives and the Kawartha Highlands LSC was no exception. A balance had to be struck between the committee's efficiency, workability, cohesiveness, accountability, transparency and broad representation. Choices were made and, at times, one objective was traded-off for the sake of another. These strategic choices began at the very outset, as the selection of committee members tried to ensure that the process would be perceived as broadly representative, while also generating a sense of cohesiveness and a common vision among the committee members. Certain stakeholders were excluded from the committee process, since a personal commitment to natural heritage protection was seen as absolute prerequisite. Persons who intended to act as formal representatives of identifiable interest groups were also excluded, as it was felt that the time that they would need to liaise with their organization would slow down the process, making it virtually unworkable. These choices suggest the committee's laudable ability to achieve its mandate efficiently was, at least partially, achieved at the expense of broader representation.

Such 'trading-off' of procedural objectives can be seen in other aspects of the committee process. Meetings were conducted behind closed doors and were kept strictly confidential and, while this decision has obvious implications for the overall accountability and transparency of the LSC, it was justified by gains in other areas. Closed meetings meant that the committee had the flexibility to re-open decisions as new information surfaced and the security to voice initial thoughts and opinions freely, without fear of premature public criticism. Yet the design of the planning process was also careful to ensure that the public was not completely alienated from the committee process, as the LSC organized numerous public open houses and mass mail-outs. The time and energy that was spent on extra public consultation suggests that efficiency was not the committee's 'bottom-line'. Instead, the designers of the LSC were engaged in a complex juggling act, in which it was exceedingly difficult, if not completely impossible, to simultaneously give the various procedural goals the same level of attention. Certain objectives were 'tossed' higher at certain stages of the collaborative process, but the LSC tried to ensure that none of its objectives were dropped entirely. While the timed ascent (or descent) of certain procedural objectives could be seen as justifiable, or perhaps even necessary or prudent, it is still important to examine the soundness of these choices by contextualizing them within the broader political landscape.

Public Reaction to the Local Stakeholders Committee

The public reacted to the Kawartha Highlands planning process in two distinct ways: correspondence sent directly to the MNR and letters to the editor published in the region's newspapers. Although the comments received by the OMNR indicate a high level of support for the Local Stakeholders Committee (OMNR, 2002), the author's critical analysis of the media's coverage of the Kawartha Highlands planning process presents an entirely different story. Two general trends in the media's coverage need to be specifically highlighted, the first of which relates to how the Kawartha Highlands was used as a vehicle to rekindle unresolved debates and past grievances.

By examining the history of provincial land-use planning, it becomes apparent that the controversy surrounding the Kawartha Highlands was deeply rooted in two of the most significant expansions of the provincial protected areas system: *Lands for Life* (L4L) and *Strategic Land Use Planning* (SLUP). Beginning in the 1970s, SLUP – an initiative that was meant to coordinate and integrate various land-uses – might be considered to be the first major battle in what has come to be known as 'the war of the woods'. For it was during this planning process that the various users of Ontario's Crown land began to organize themselves into what some have termed the "*pro- and anti-park coalitions*" (Killan, 1993: 350), each trying to undermine the power and legitimacy of the other. So, while SLUP had been originally seen as a mechanism for resolving resource conflicts, the complete opposite was the case: positions became even more entrenched as environmental interests were clearly and consistently pitted against the hunting community.

Lands for Life, on the other hand, was seen "*as an attempt to resolve Ontario's 'war of the woods'*" (Rodgers, 2001: 1), as the various interests were to be given more opportunities to participate in land-use and natural resource planning. Yet L4L, arguably, did little to promote any sort of agreement on the nature and necessity of parks and protected areas. As one observer noted, conservationists argued that the "*proposals don't go far enough*" and that park policies should not be weakened to accommodate for hunting, mineral exploration and forestry. Anglers and hunters, on the other hand, suggested that their recreational pursuits should not be restricted through the creation of new provincial parks, while the forest and mining industries highlighted the perceived economic losses that would result from an expanded protected areas system (Rodgers, 2001: 32-33). Since the Kawartha Highlands was a product of L4L, it was only logical that such fundamentally different visions for Ontario's Crown land would spill over into this localized planning process.

Several articles and letters to the editor published in the *Peterborough Examiner* (the region's daily newspaper) gave voice to and fuelled the polarized debate that was developing between some of the province's most prominent conservation groups and the angling and hunting lobby. The environmental community was publicly accused of being unwilling to "*fairly share the gift of public land and fish and wildlife habitat*" (Reader, 2003: A4), while Crown land recreationists were shamed for resisting the appropriate regulation and conservation of "*an area of national [ecological] significance*" (Ladurantaye, 2002: B2). Quotations and sentiments such as these suggest that the controversy surrounding the Kawartha Highlands could accurately be described as a refracturing of Crown land interest groups down old fault lines, with both sides easily slipping back into their historical roles. However, it would be simplistic to suggest that the Kawartha Highlands debate was merely a reenactment of past land-use conflicts, as a significant portion of the local community was also very critical of the design of the LSC process.

Such public criticism forms the second major trend in the media's coverage of the Kawartha Highlands planning process. While many of the published critiques of the Kawartha Highlands committee could be described as emotional and unsubstantiated allegations, some spoke to specific elements of the planning process, flagging many of the strategic choices that were discussed in the previous section. For example, one cottager wrote:

> "*The committee mandate was far too narrow, the process did not allow for the ongoing sharing of information or open discussion and the committee make-up was lacking in significant representation of the true local multi-user stakeholders…*" (Chown, 2003: 4).

And while other letters did express complete confidence in the work of the LSC, it appeared as if the damage had been done and the committee's legitimacy had been seriously called into question.

Initially, it seemed as if the 'Eves' government' was trying to appease the concerns of stakeholders who felt excluded by the LSC. They did so by introducing the controversial *Recreation Reserves Act* (Bill 239), which was supposed to strike a more appropriate balance between protection and use. But, it was also a Bill that was condemned by the both the LSC and the environmental community for its lack of meaningful natural heritage protection. In an apparent attempt to avoid further controversy, the Tory government eventually backed away from the Bill, leaving it to die on the order paper, but the Kawartha Highlands debacle was still in need of an agreeable solution.

In March 2003, almost three years after the planning process began, Premier Eves responded to this need by appointing an MPP, Chris Hodgson, to lead yet another consultation process. The Hodgson process translated into closed-door meetings with four prominent provincial and local interests groups, including the original LSC. In the end, the final products these meetings bore a great deal of similarity to the LSC's initial recommendations, forcing one to question whether or not these extra phases in the Kawartha Highlands planning process could have been avoided.

Conclusions and Implications for Future Planning

By examining the procedural choices that were made during the design of the Kawartha Highlands' committee process, as well as the public's reaction to the work of the LSC, this case study has highlighted some of the challenges of collaborative land-use planning. It has suggested that such decision-making processes are often guided by several potentially competing objectives (e.g., efficiency, transparency, etc.) and that these objectives might need to be (temporarily) traded-off for the sake of another. In the case of the Kawartha Highlands, broader stakeholder representation and the transparency of the committee meetings appear to have been partially sacrificed to achieve a more efficient collaborative process. While these choices may have seemed prudent at the outset, the committee's ability to fairly represent and account for the needs of all stakeholders was later called into question in letters to the region's daily newspaper. The committee's illegitimacy in the eyes of a very vocal portion of the local community ultimately extended the entire planning process, as the Tory government sought to appease the opponents of the LSC through the creation of Bill 239 and the Hodgson consultation process.

The extension and alteration of the Kawartha Highlands planning process suggests that the strategic design of collaborative processes needs to employ a broad historical lens. For the ways is which the controversies surrounding *Lands for Life* and *Strategic Land Use Planning* were brought forward and incorporated into the Kawartha Highlands debate were not unforeseeable and they serve as powerful reminders that collaborative land-use planning does not, and should not, occur in a vacuum. Instead, it carries the legacy of past land-use planning and management decisions, a history that is often marred by resentment, suspicion and distrust. The real challenge lies in how the practitioners of collaborative planning choose to mitigate such tensions through process design. The Kawartha Highlands planning process suggests that efficient and streamlined decision-making processes are not always possible. Collaborative processes are anything but tidy and an already messy process can get even messier when its design fails to appropriately acknowledge the presence of historical resource conflict.

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Human Dimensions

Camp scene, Woodland Caribou Park (T. Beechey)

The Story of Parks: Reflections on Interpretation in Canada's National Parks

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Abstract

Sharpe (1976: 16) suggests that "the complete absence of interpretation may be preferable to a low-quality program". *How do we know when interpretative efforts are effective? How can interpretative efforts be evaluated? In many cases parks are experiencing increased visitor numbers without increased provisions for visitor services including interpretation. Within the past few decades increased attention has been given to formulating meaningful ways of evaluating interpretative programs for a variety of reasons including the continual need to justify (economically, socially and politically) the presence of interpretation within parks. This paper suggests that it is a lack of understanding and purpose, and not simply a lack of evaluation, which serves to confound the interpretative process.*

Introduction

It cannot easily be measured, quantified, evaluated, or even described. So why write about it? This paper briefly chronicles the rationale behind my current research project, which has evolved in an effort to better understand the interpretative process within protected areas. The definition or purpose of interpretation is the focus of the research, rather than a prior requirement. Within the initial research phase it became evident that interpretation, despite a historical and continued presence in national (and some provincial) parks, remains significantly uncharted within Canada. The following are thoughts chosen to inspire discussion around the assumptions inherent in what I refer to as the interpretative process. Comments are welcome!

What is Interpretation?

Generally, interpretation is divided into two categories: personal, which refers to efforts that involve a human element of contact including guided tours or campfire talks, and non-personal efforts that are more static, such as park signs or museum exhibits. Tilden's influential text *Interpreting Our Heritage* (1977) continually advocated for personal interaction and experiential learning over non-personal endeavours. Recent interpretative efforts have come to rely on non-personal interpretation primarily citing lower costs and the ability to reach a wider audience as the main reasons for avoiding, reducing and/or eliminating personal interpretation from the park. The emphasis on cheaper non-personal methods is of concern as it is commonly accepted that personal interpretation "*probably offers the highest potential for achieving interpretive objectives*" (Parsons and Aldrich, 2004: 7). Moreover, lower cost non-personal initiatives raise concerns over the long-term impacts of these types of stories on individual parks as well as the park system as a whole.

Below are three common definitions of interpretation within a protected area context that have been selected to demonstrate generally accepted principles:

1) Interpretation: "*an educational activity which aims to reveal meanings and relationships through the use of original objects, by firsthand experience, and by illustrative media, rather than simply to communicate factual information."* (Tilden, 1977: 8).

2) Interpretation: "*to stimulate, facilitate and extend visitor's understanding of place so that empathy towards heritage, conservation, culture and landscape can be developed."* (Stewart, 1998: 257).

3) Interpretation: "*is a specialized communication process designed to help connect people with their heritage through first-hand experience with the object, artifact, or landscape."* (Curthoys and Cuthbertson, 2002: 224).

The emphasis is on interactive, experiential and participatory processes; however, these processes rarely surface in the majority of parks suffering chronic funding and staff shortages. Whether the interpretative programs are 'effective' is unknown, as 'what they are to achieve' is rarely addressed.

The Interpretative Process

The primary difficulty investigating interpretation is that it involves deconstructing the complicated relationship between the theory of interpretation (why or how it is done), the practice of interpretation (what and where it is done) and the profession (who does it). The term interpretation is often used to describe a tangible product such as a visitor centre as well as a process (for example, facilitating visitor understanding) and thus the differentiation between theory, practice, method, and context of interpretation becomes increasingly inexplicable. I refer collectively to this intersection of concepts as the interpretative process.

The idea that interpretation should be afforded increased attention specifically addressing issues of evaluation and accountability, is not new (Marsh, 1986). The majority of recent literature concerning interpretation continues to suggest that evaluation, such as short visitor surveys or questionnaires, is the missing link within the interpretative process. The prospect of having meaningful evaluation occurring remains improbable without a clear understanding of what we should evaluate as interpretation is thought to incorporate a wide array of activities. Interpretation alone cannot accomplish all the goals of the park system and an unfettered reliance on interpretative activities to achieve everything perpetuates overly broad, disorganized and short-sighted programs that accomplish little.

> "*Interpretation lifts recreation beyond mundane fun to intelligent use of leisure time, and from appreciation to understanding of the cultural and natural environment. It also represents good business sense by the public and private agencies and institutions that have an opportunity to use interpreters. Their success and public support may be directly or indirectly related to effective interpretation.*" (Beck and Cable, 1999: 13).

The above quote illustrates the zealous and often romantic attitudes toward interpretation that are present in most protected areas in Canada, which no doubt contribute to why it often goes without critical examination. Interpretation is thought to relate directly to the success of a park system and as such remains a key component to park operations. What is not clear is how this could be the case when there is little research to suggest that interpretation does foster support for a park system or a sense of environmental stewardship.

Purpose of Interpretation

Increased staff and funding will allow for a necessary examination of interpretation, including the creation of plans with clearly stated objectives, but to merely increase the number of interpretative efforts will not fundamentally address the larger problem of what these plans should contain. The shortcomings within interpretation expose a larger incapacity to express ideas about the nature of protected area systems in Canada and our disjointed relationship with our environment.

The above definitions of interpretation are simplistic overviews of a complicated process that, at the core, attempt to reconnect humans with natural processes. Difficulty arises when a park system must decide what messages to convey to the desired audiences which may include: park staff, policy officials, park visitors, local residents, co-management groups, private partners, and international protected area agencies. Interpretation, as a profession, currently serves many complex functions including (but not limited to):

1) a forum for the exploration of issues pertaining to communication (for example, the increasingly inextricable link between marketing, ‘outreach’, ‘education’ and interpretation);

2) an instrument of social change (e.g., concerning how or why certain ideals are perpetuated through interpretative efforts);

3) a forum for understanding and facilitating visitor expectations, behaviour and experience pertaining to or within national parks (e.g., the examination of why people visit parks, what they do while they are there, and their overall understanding of the park context and operation);

4) a communication tool of national legislation/policy (e.g., to articulate or reflect socio-political views toward national parks and the environment);

5) a method of gauging social and economic change (e.g., the introduction of user fees for interpretative services); and,

6) a process of responsibility pertaining to park operations and safety (e.g., conveying basic information such as bear safety and route maps).

The difficulty for the national park system lies in the creation of interpretative programs that in practice accomplish a desired outcome as plans often include vague and/or unrealistic goals. Devising a system in which the monitoring of interpretation is possible (including the planning, implementation and evaluation of programs) will remain difficult without addressing a specific purpose.

Generating Environmental Concern

> "*Is interpretation just nice? Is it essential? Is it astute management and public relations? People have interpretive philosophies that relate to all of these opinions."* (Knudson *et al.*, 1999: 12).

In one of the most highly regarded works on interpretative practice, Ham (1992) states:

> "*...if these [environmental] crises are to be solved, they will be solved in place by empowered and informed citizens who understand their relationship with nature. The craft of environmental interpretation can contribute to this empowerment*".

This is a philosophy echoed by the majority of those involved with national parks and the interpretative field (Tilden, 1977; Sharpe, 1976; Machlis, 1986; Regnier and Zimmerman, 1992; Veverka, 1998). Beck and Cable (1999) suggest:

> "*...interpretation, properly carried out, serves as an indispensable tool to achieve successful, intelligent cultural and natural resource stewardship*". (Beck and Cable, 1999: 12).

What is less clear is how this relationship between knowledge and action functions within national parks, a process referred to as "*ecological literacy*" (Curthoys and Cuthbertson, 2002: 225).

Within the national parks, interpretation is thought to function as a method of empowerment. However, Canada's landscapes, including those within and surrounding national parks, are becoming increasingly degraded. The role of interpretation within parks and current societal attitudes toward natural processes has been insufficiently examined rendering the question of whether or not the problem is poor interpretation or not enough interpretation trivial by comparison. It is hoped, as suggested within the Parks Canada (2001) document, *Engaging Canadians*, that improved communications would achieve the mandate of the park system by stating, "*communication is everyone's business*". Interpretative efforts remain one small part of a vast communication strategy that is increasingly pressured to work within a business model highlighting the needs of target markets, cost recovery and clients. Such needs are often diametrically opposed to the core principles of interpretation, which reflect the integration of people with natural processes.

The underlying assumption within Parks Canada is that information is a primary element in garnering public support as demonstrated through the desired linear process beginning with "*awareness*", moving to "*understanding and enjoyment*", and finalizing with a "*sense of ownership*" (Parks Canada, 2001: 24). Parks Canada has neither the resources nor the collective research to support the claim that current interpretative efforts do indeed follow this continuum, which raises questions regarding the legitimacy of interpretation within parks. This is not to suggest that interpretation should not occur within national parks, merely that interpretation should not continue without critical examination. Historical presence is a strong motivation for continuing interpretative efforts, however; it is time to re-address why interpretation is in parks. Curthoys and Cuthbertson (2002) suggest:

> "*...if experience, knowledge, and action are to become the result of good interpretive products, the planning processes must be an intentional reflection of the goal to reveal meaning and relationships*". (Curthoys and Cuthbertson, 2002: 237).

The inherent emphasis on meaning and relationships has been key to the perpetuation of interpretation however, what the meaning *is* and what the relationships *are* often present the principal obstacles to the interpretative process and ultimately to formulating an understanding of environmental processes for Canadians.

Visitor Behaviour

There has been increased attention afforded to evaluating the visitor response to interpretative efforts. Butler and Hvenegaard (2002: 179) go beyond the assumption that interpretation improves understanding and environmental protection to also include improved visitor experiences. How interpretation improves visitor experiences is also a difficult area to assess, as there have been few comprehensive visitor studies (including experiences prior, during, and/or after the visit to the park) to suggest that visitor experience is improved by interpretative efforts.

It is possible to suggest that an interpretative program is successful based on positive visitor attitudes or behaviour; however, this does not acknowledge what the visitor is learning from the experience or how this will affect future behaviour. What the park (as a collective reflection of the federal government, Parks Canada and ultimately the park staff) desires a visitor to do may be different from what the visitor desires to do while in the park. Before any adequate studies of visitor behaviour and expectations pertaining to interpretation can be conducted it is necessary to explore what the park system is trying to accomplish. Butler and Hvenegaard (2002) may indeed be correct in asserting that interpretation improves visitor experience, and even environmental protection as suggested by Ham (1992); however, these assumptions must be critically examined prior to perpetuating current interpretative efforts which may or may not be responsible for the perceived increase in environmental protection or visitor satisfaction.

Concluding Thoughts

For Parks Canada (2001: 5) to suggest that interpretation is designed to “raise awareness… foster understanding and enjoyment… strengthen emotional connections to and the sense of ownership of heritage places…” without critical examination and action is fraught with difficulty as individual parks struggle to decide what their individual interpretive efforts should entail. Parks Canada is the most overt reflection of societies environmental values. A clear direction supporting ecological integrity is needed for interpretation in addition to a direction for other forms of communication involving the park system. The document Engaging Canadians (Parks Canada, 2001) currently governs all interpretation across the Canadian national park system. Ironically, the term interpretation is never used within this document further demonstrating the complexity in fleshing out how the stories of parks should be told. The multitudes of passionate and dedicated interpreters will certainly attest that the sharing of stories is firmly embedded in Canadian park culture. The weakness in the interpretative process may not lie in the evaluative process but in the stories themselves. Perhaps a park system that embodies a mandate that implies natural landscapes belong to Canadians for enjoyment and ecological integrity will forever struggle with the problem of regarding them as distinct.

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Progress in Integration of Social Science in the Parks Canada Science Strategy

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Abstract

In addition to protecting and presenting the nationally significant examples of the diversity that Canada's natural and cultural heritage has to offer, the Parks Canada mandate also recognizes the need for the public to appreciate and enjoy these treasures. As such, Parks Canada must be committed to performing not just natural science but also social science research to discover how to meet, and whether they are meeting the public understanding, appreciation and enjoyment aspect of the mandate. This paper explores three key strategic reports describing the state of social science research in Parks Canada up until 2002. Six interviews were conducted with social scientists in Parks Canada at the service center and national office levels with the line of questioning based on the findings from the key reports. Themes identified through qualitative analysis of the interviews provided direction, criticism and praise for the state of social science research, management and integration of the sciences in Parks Canada.

Introduction

It has been recognized that government and non-governmental organizations often cooperate with local researchers in the fields of the natural sciences, mainly biodiversity and ecology (Hieu, 2003). However, partnerships with researchers in the social sciences have often been overlooked, or alternatively have used social science expertise only in the case of feasibility and prediction studies (Hieu, 2003). Likewise, social science research conducted by outside organizations often neglects natural science aspects (Christie *et al.*, 2003; Hieu, 2003). But, it is imperative to Parks Canada, in meeting its mandate, that both natural science and social science knowledge are evaluated in decision-making (Parks Canada, 2002). Emphasis on contextualized research is also necessary since Parks Canada has a goal of creating and maintaining a system of National Parks that is reflective of all regions of Canada. Hence, this human-use and place-based perspective suggests an expanded role for social science research in the Parks Canada context. Social science research can give voice to meanings and values attached to specific locations that may not otherwise be included in park managers' decision-making and may also bring to light consequences counter to the mandate (Cheng *et al*., 2003).

Three main documents were explored in assessing the progress of social science research within Parks Canada. These comprised the *Parks Canada Science Strategy* (Parks Canada, 2002), the *Review of Priorities for and Use of Social Science Research in Parks Canada* (Praxis Research, 2000), and *A Strategic Plan for Human Use Management Science in Parks Canada* (Payne, 2000). There are many similarities among the three reports: each highlights the need for temporally and place-based research, for assessment of the effectiveness of current research in informing decision-making needs, and each stresses the value of demand and visitor satisfaction research. However, it is apparent that these reports limit the purpose of science research in parks to the production of immediately useful, needs-driven knowledge.

Literature Review

> "*Natural science will in time incorporate into itself the science of man, just as the science of man will incorporate into itself natural science: there will be one science*." (Marx, 1844).

In the 20th century there was an increase in fragmentation of the sciences leading to a plethora of disconnected, complex and specialized fields (Scheuch, 2000). Science divided into biology and chemistry, then biochemistry, which divided further into biotechnology, molecular biochemistry, and so on. This fragmentation was an understandable response to the increasingly complex and microscopic scale of information on how organisms, communities, and systems worked. However, there was, at the same time, a counter tendency in both the social and natural sciences toward inter- and multi-disciplinary approaches, as researchers realized that the natural and social worlds were not so easily disaggregated into 'researchable' chunks (Neumann, 2000; Eagly and Chaiken, 1993). Specialization is an essential part of understanding the complexity of the real world, but integrative approaches are equally important.This realization has led to the development of approaches such as 'ecosystem management' which seeks to include both natural and social sciences in the elucidation of real world problems facing natural resource managers (Bourgeron and Jensen, 1994). Giddens (1976) said:

> "*Sociology is not concerned with a pre-given universe of objects, but with one which is constituted or produced by the active doing of subjects*." (Giddens, 1976: 160-161).

This suggests a society that is recreated every day "*as a skilled performance on the part of its members*" (Scheuch, 2000: 592). Moreover, this changes the definition of society from being a cloudy but singular reality to a society which is multiple, socially constructed and fluid (Scheuch, 2000). Thus, research which is not attuned to the shifting and holistic nature of modern society will fail to provide the necessary guidance to enable managers to deal with the reality of conflicting goals, multiple interpretations, and changing priorities that bedevil park management today.

There is therefore a need for a park science that combines understanding from both the natural and social sciences but, further, this science must be sufficiently flexible in its methods and approaches to accommodate the shifts in meanings and variety of demands that society places on its natural areas (Patterson and Williams, 1998). Through the fragmentation of research, managers are prevented from making appropriate and timely decisions. It is also a temporal problem for managers to make decisions when the accessible research they use as a basis is out of date and not entirely corresponding to the context or representative population the management decision will be affecting. Thus, modern problem-solving needs timely research, performed from a multi-disciplinary approach, and applied to the right population by scientifically and sociologically aware managers. How will this be achieved? The *Parks Canada Science Strategy* recognized the need for a merging of science disciplines in the first paragraph of the report when they stated:

> "*This document represents the sum of many voices…the group working on the Ecological Integrity science strategy... merged with a second group that were independently developing a social sciences strategy, and more recently with the cultural science strategy working group*." (Parks Canada, 2002: 3).

But, the recognition of the need of science research in the three fields by Parks Canada is not enough to ensure that the needs are met. Rather, it acts almost as a hindrance to progressive science for the purpose of application to management decisions, as the challenge is now how to plan, integrate, and put the research into action, cooperatively rather than competitively, and when confronted with changing patterns of human use, enjoyment and ecological needs.

Methods

Six interviews were conducted over the week of March 8-15, 2004, with seven social scientists working for Parks Canada at the service centre and national office level. The interviews were approximately 40 minutes long, and followed a prepared interview guide. The interviews were transcribed, and in one case translated. Each theme contained responses from each of the interviewees. Table 1 is an example of one of the completed thematic areas.

Results

These results were further interpreted into response categories. ‘Funding, Personnel and Resources’ included the themes ‘Limited Capacity’, and ‘Relationships with Universities’. All respondents agreed that there are not enough funding, personnel, or resources to conduct the required social science research. The respondents saw a potential solution in expanding relationships with universities and in expertise-sharing across the country. The category ‘Research Methods’ also had consensus among the coding. This category included the themes ‘Tunnel-Vision/Research Methods’, ‘Measuring Effectiveness’, and ‘Needs-Driven versus Theoretical Research’. The respondents agreed that there was confusion as to what kind of research should be done, and how to evaluate whether they are doing the right research to meet the needs of their clients and the public. Interestingly, some of the respondents felt that with the national visitor information program there was enough basic information being collected on visitors (such as demographics, expenditures, trip length and satisfaction). Thus, the research they should be doing, had they the time and resources, should include human valuation of the parks including spatially-referenced values and experience preferences, and whether the visitors are having a memorable experience.

Table 1. *Themes identified in the interviews.*

Theme	Exemplar Quote
Limited capacity of social science in parks	"Shortage? Yes. At what levels? Everywhere; there isn't enough social science capacity at any level."
Inter-agency networking	"We need to be more coordinated; everyone is running off doing their own thing, not communicating with other social scientists to see what they have done."
Corporate memory	"In the past, social science was reported ad hoc in the State of the Parks reports, it was essentially just fluff. We have to make sure that now that it is legislated, it gets maintained and applied."
Time frames for changes	"We had so many years of bums in seats, that kind of attitude, pushing as many people through the door as possible. That is not going to change over a couple of years; that's going to take a long time."
Tunnel vision – research methods	"The way it looks to me is that the few people doing the research are so caught up in the details of counting people to show the state of things."
Manager-scientist relationship	"They both have to be adaptable and flexible. Managers, in order to respond to political pressure; scientists, in order to respond to managerial pressure."
Strengthening of leadership and direction since 2000	"Strengthening? We've partially achieved it, I'd say about 30% there. There's still no chief, or even plan for a chief to be in the national office before September. As a community we work well together, perhaps better than ever, but …it's been four years and it hasn't moved a long way."
Needs-driven versus theoretical research	"On the one hand, if you don't know how many people are visiting you, you can't do anything or make any decisions. But, how many times can you count heads without becoming redundant?"
Measuring effectiveness	"It's great to develop new messages, but how do we know if people are getting our messages? How effective are we being at communicating them? How can we do it better?"
Right place/people/numbers/expectations	"There's no right at all – it oversimplifies the challenges we face. There is no right number of people or right expectations and anyone who believes that is delusional. We have to replace right with optimal, and then this will be a workable vision."
Demands of clients	"Social science is the science of people, it is not used enough by management in the national office, and field units don't always have the understanding they need to really use the information we give them."
Relationships with universities	"Through university partnerships each institutions gets all sorts of benefits. We get links to faculty, university resources, and the students get access to us, our data sets, and practical experience."

There were three areas where contention arose in response pattern. In the category of 'Communication', embracing the themes of 'Intra-Agency Networking', 'Corporate Memory', and 'Demands of Service Centre Clients', most agreed that communication among the members of the social science community in Parks Canada was working well. However, the respondents pointed out that it may be simply because the social scientists had been working so long together that they knew each other personally, and stayed in touch for non-agency purposes as well. The respondents noted that the *Social Science Update* and *Quarterly Bulletin* were not adequately accessed by all parks employees. Moreover, each respondent had unique links to outside networks that were not consistent across Canada. Some respondents communicated more with universities and colleges for information needs and peer review, others communicated more with organizations such as the Travel and Tourism Research Association, or with American researchers. This diversity in networks is very impressive, but the information must also be shared amongst Parks Canada workers.

Three respondents were concerned about a concept called ‘Corporate Memory’; the compiling of evidence of actions/publications that is provided by records in seeking comprehensive corporate knowledge. Corporate memory is at risk of being lost through poor communication of findings to the next generation and inadequate record-keeping. Records give evidence of management planning and evaluations of business actions. Without records, organizations cannot prove that actions have been taken, commitments entered into or obligations carried out. Furthermore, the loss of records impairs the ability for organizations to build from past mistakes or miscommunications. But records have a broader purpose: organizations exist within regulatory frameworks which impose various degrees of accountability for their activities. Corporate memory can be maintained through improving networks, solidifying the social science updates and bulletins, continuing communications with outside agencies and relaying information through the agency network.

Communication also is emphasized in the theme of ‘Demands of Clients’. Traditionally, the service centres had two clients: their main one being the field unit, and secondary to this, the national office. Three respondents said that the information that gets distributed to national office is the same as that distributed to field units, while three respondents said that they focus their information dispersal to national office on trends, effectiveness of monitoring programs and management techniques, and evaluations of management plans instead of the localized functional information that gets provided to field units. One respondent said that the type of information given was unimportant compared with the level of understanding of the receiver. Communication of the research sometimes means communicating, clarifying, teaching, and contextualizing the research to the target audiences be it national office or service centres. The discovery that they do not necessarily deliver the same research to national office brings up another question: how can the national office amalgamate the research and devise national-level strategies when they are not collecting the same research across the country? The answer to this, the respondents saw, is in 'specialist-sharing'. Sharing specialists also helps to reduce communication disparities, and helps to keep research timely as time is not spent seeking expertise outside the agency.

The category of 'Management Relationships' included the themes 'Manager-scientist Relationship', 'Time Frames for Changes', and 'Right People/Place /Numbers/Expectations'. Several respondents noted that scientists primarily provide managers with information to make decisions, while others noted that managers provide scientists with problems to solve as a first step. Two respondents said that managers are unreasonable in their time allowance for research findings. This theme became more evident when one participant pointed out that the two jobs seemed to be designed to conflict: managers need to make timely decisions while under intense political, economical and local pressure, while scientists need to do thorough study that requires time and focus while maintaining scientific rigor. Both have to be adaptable and flexible, teach each other, be able to understand the research process for studies they are establishing, and remain up-to-date on advances in science and management.

Another key difference was that managers are task-oriented: they respond to conditions that are brought to their attention. Hence, managers are perpetually in a problem-centered, response-driven environment where time is a regulatory factor. This contributes to the science conducted in parks being based on needs-driven research. Managers ask scientists for specific data and analyses. They do not seek broader knowledge; although, it was pointed out that when they receive interesting spontaneous research such as that done through university co-op projects, they do take an active interest and apply the information. In a corporation, there is pressure to remain accountable to mandated needs. Although it is unwise for managers to seek out unsolicited research as a primary source of information, non-mainstream research should not be set aside. It is often through unsolicited findings that new trends or paradigms are made clear.

Large changes in the corporate structure, planning, and modeling of an agency take time to enact. Four of the respondents agreed that few changes have come about since the publishing of the three strategies; however, they did not expect many changes to occur right away since the static inertia created by years of old strategies is difficult to overcome. The other respondents stated that there were so many changes over the last two to three years that it was difficult to keep up with new policy and procedures, difficult to interpret and apply policy coming out of the national office, and difficult to keep the change in focus of *Parks Canada's Science Strategy* in mind.

The last theme under the category of 'Management Actions' was the response to the action plan's statement of attracting visitors to the right place, and the right time, in the right numbers, with the right expectations. Two participants felt that this goal was impracticable, unattainable and idealistic. They felt that each visitor had unique motivations and expectations when they visit, and trying to satisfy these by priming visitors to have the same expectations as each other essentially makes visitors into manipulatable pieces absent of individual autonomy. However, the four other respondents felt that with proper marketing, demand management, communication within the organization and with the public, and adequate human use study, a strategic plan can be made to ensure that the 'right people, right places' goal is met.

The last area where interviewees responded diversely was in relation to how much the social science workings of Parks Canada had strengthened since the Praxis study called attention to the vital need for social science development (Praxix Research, 2000). Two respondents felt that social sciences have significantly strengthened, especially in comparison to other areas where cuts abounded in the last four years. Once again four respondents disagreed. They felt that since a chief has yet to be established in the national office, no clear leadership or direction was being promoted. Consequently, there is still an under-representation of social science at the management tables. Furthermore, without a chief to give feedback or interpret plans that come out of national office, it is difficult for social scientists at the service centre or field level to understand and apply managerial-style instructions. Without a chief, or an established personnel chain of command, cohesiveness was lacking.

Conclusions

It is evident that many changes are occurring in the direction and use of social science study and recommendations in Parks Canada's policy and management planning. The Science Strategy written in 2002 has several conflicting instructions on how science (in the inclusive sense) should be completed. There is a heavy stress on science that is needs-driven and provides usable knowledge so that managers can make decisions. However, science as a legitimate use of parks and decreased fragmentation of science must also be considered in looking to proactively meet the mandate. Communication is one key to maintaining corporate memory and accountability between managers and scientists. Without a chief, the leadership and representation at the management table is lacking at the moment. However, the teamwork and networking skills of the social science community in Parks Canada is an example of the adaptability of those employees under changing conditions. Changes in policy and procedure take a long time to establish and coordinate, but are beginning to appear and function. The time-frame for science study is also lengthy, but to maintain rigor, it is essential. Forging relationships with universities is one area where Parks Canada social scientists saw a need for concentrating resources and expertise as well as meeting a continuum of science purposes: some science to meet mandated needs and management requirements, and some science for the sake of science and to balance reactive and proactive management planning, by 'unclouding' potential future problems in the social needs of visitors. Expertise-sharing is an additional source of solution to the contentious areas.

Parks Canada is a leader in applying social science to management planning. But, before it can meet the needs of future generations of visitors, it must also meet the needs of employees by reducing the limited capacity of social science.

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Implementing Capacity-Building, Respect, Equity, and Empowerment (CREE) in the Social Sciences

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Abstract

*The goals of '*naturalized knowledge systems*' (NKS) and '*empowering partnerships*' are to improve information networks, expand and refine local knowledge systems, and provide a healthy environment for future generations. With equity as it foundation, empowering partnerships seek to incorporate the concepts of capacity-building, respect, equity, and empowerment (CREE) in research. However, before empowering partnerships can be initiated, the process of '*healing the hurt*' must be addressed.* Healing the hurt *acknowledges the socio-historical context of First Nations, rural communities, and academic researchers. The following article discusses how* naturalized knowledge systems, healing the hurt*, and the concepts of CREE were successfully applied into two research projects. The conclusions examines how this process can be implemented in protected area management.*

Introduction

The involvement of local people in research initiatives has become a major feature of community-based research and participatory action research. However, while these principles have received widespread support (Lickers, 1994; Panel on the Ecological Integrity of Canada's National Parks, 2000; Adams and Hulme, 2001; Mowforth and Munt, 2003), there has been little research on the concepts and ideas upon which it draws. In this paper we discuss these roots and their application in two graduate studies, and examine how this process can be implemented in protected area management.

According to Henry Lickers, the Director of Akwesasne's Environmental Division, partnerships in sustainable development projects can succeed within the parameters of '*naturalized knowledge systems'* (NKS) and the methodological approaches of '*healing the hurt*' and the '*zeal to deal*' (also referred to as '*empowering partnerships*') (Lickers, pers. com., 1996). Extending beyond the traditional realms of '*traditional ecological knowledge*' (TEK) – the basic understanding of the flora and fauna – NKS illustrates a mutual relationship between human societies and their environments. NKS can be best summarised as the sum total of grass-root experiences, technical expertise, ecological proficiency, socio-political competence, spiritual and ecological attunement, and inter-generational knowledge transfer (Lickers, 1994). NKS can be found in most communities that have a historical link or 'bond to the land'. In addition, NKS communities can be distinguished by the following six foundations:

1) the Earth is our mother;

2) the emotional and spiritual spheres are intertwined within our daily reality;

3) consensus, cooperation and mediation are the proper ways to solve challenges;

4) responsibility is the cornerstone of a mutualistic society – each individual must acknowledge his/her responsibilities and learn from them without fear of failure;

5) knowledge must be linked with responsibility and wisdom; and,

6) the process of cause and effect is seen as a web, spiralling back and forth from the physical, social, economical, and spiritual spheres – science and technology are components of this complex equation (Lickers, 1994).

Representing decentralisation, participation, respect, equity generation, and empowerment, NKS is a natural link to community based research or community conservation initiatives (Lickers, pers. com., 1995).

Applying the Concepts of CREE in the Social Sciences

In the following sections we will examine how the processes of *healing the hurt* and *empowering partnerships* were incorporated into two academic graduate studies, the first being an MA thesis entitled *The Great Law of Peace and Social Movements in Akwesasne* (Lemelin, 1997) and the second being a doctoral study examining the human dimensions of Churchill's polar bear (*Ursus maritimus*) viewing industry (Lemelin, 2004).

Lasting three years (1993-1996) and conducted in Akwesasne, the objectives of the master's research were to:

- identify Haudenosaunee (Iroquois) and Mohawk socio-political knowledge;
- highlight environmental transformations, conflicts, and socio-cultural adaptation; and,
- illustrate the role of the 'Great Law of Peace' in past and in contemporary Mohawk politics.

Findings from this study revealed that the *Kaianerenkowa* (the Great Law of Peace) has been transformed from a system of lore expounding communal participatory democracy into a socio-political construction servicing the needs of various (and sometimes opposing) Mohawk political groups in Akwesasne. Further, the emergence of the Great Law of Peace in the last half of the 20th century was seen by some as a sign of the revitalization, and perhaps, return to, traditional Mohawk and Haudenosaunee beliefs (Lemelin, 1997).

The second study, a doctoral thesis, lasted from 2000-2003 and was conducted in Churchill, Manitoba. The purpose of this study was to examine the human dimensions of wildlife tourism with the intent of providing a more comprehensive demographic, behavioural and psychographic profile of wildlife tourists visiting this provincially designated protected area, the Churchill Wildlife Management Area; and to determine the extent to which these aspects of wildlife tourists are related to characteristics of the environmental context of their wildlife viewing experience in a protected area. More specifically, research objectives were set to:

- conduct the first human dimensions study pertaining specifically to polar bear viewers, thereby establishing a baseline inventory;

- incorporate stakeholder involvement from the project's onset; and,

- promote researcher transparency and accountability (e.g., information dissemination) (Lemelin, 2004).

Findings in this study revealed that, similar to other wildlife tourism destinations, polar bear viewers in the Churchill Wildlife Management Area (CWMA) were generally older, well-educated, and relatively affluent. However, an examination of their motivations, wildlife values, pro-environmental behaviour, and specialization levels indicated variations among the individuals comprising the overall sample. Using cluster analysis to derive a typology of wildlife tourists based on selected psychographic indicators, some wildlife tourism archetypes (e.g., specialized wildlife tourists) appeared, thereby supporting earlier typologies of wildlife tourists (Orams, 1999). However, other types of polar bear viewers (e.g., general wildlife tourists) were revealed that appear to not particularly embody the ideals of ecotourism, nor were they exemplary models of wildlife tourism.

The following section describes how the process of *healing the hurt* and the *zeal to deal* were applied in both studies.

Empowering Partnerships and *Healing the Hurt*

Rising concerns over past 'research ethics' by non-Indigenous researchers have led Native researchers (LaFromboise and Plake, 1983), applied anthropologists (Hedican, 1995), and proponents of 'community conservation' (Adams and Hulme, 2001) to voice their concerns over the repercussions of research projects in communities. Within the Haudenosaunee (Iroquois) Confederacy, both leaders (Benedict, pers. com., 1994), and scholars (Mohawk, 1988) have stated that research impacts reverberate beyond the traditional realm of government and/or academia and back into the communities themselves. What is needed in these studies is research accountability and transparency, which, would, if not eliminate, at least minimize and regulate researchers and their findings in native communities (Lickers, pers. com., 1995). The concepts of capacity-building, respect, equity and empowerment (or CREE) can promote such research accountability. These four concepts are embodied in two processes known as *healing the hurt* and the *zeal to deal* (*empowering partnerships*). During both studies, community members and researchers were encouraged to acknowledge the socio-cultural context in North America (past and present) through a process known as *healing the hurt.* Both processes are discussed here.

Healing The Hurt

Before *empowering partnerships* can be initiated, past inadequacies must be addressed by *healing the hurt*. *Healing the hurt* is a process that addresses the different histories and cultural diversity in North America. When properly acknowledged and understood, diversity can result in a 'creative tension' contributing to capacity-building, respect, equity and empowerment in partnerships. However, before the concepts of CREE can be implemented, the four stages – denial, anger, introspection and reconciliation – of *healing the hurt* need to be addressed (Lickers, 1994). These concepts are described briefly.

Denial

Denial ensues when researchers and participants become aware of different socio-historical perspectives. This awareness can result in anger or the projection of problems to other parties (Lickers, pers. com., 1995).

Anger

New responsibilities and demands placed upon limited resources can result in perceptions of deprivation. These perceptions (real or imagined) can contribute to rising tension in group dynamics. Rather than suppressing or denying these emotions, *healing the hurt* encourages the partners to vent their dissent. When 'aggression' is addressed through frank and constructive dialogues, then past differences and stereotypes can be discarded. Once achieved, introspection can begin (Lickers, pers. com., 1995).

Introspection

Introspection is attained when the partners acquire the ability to see beyond their own socio-cultural parameters. This cultural awareness can stimulate desires by the partners to address past hurts by emphasizing the strength of diversity and cooperation. This is known as a call to action (Lickers, pers. com., 1995).

Action

Action is the final step of *healing the hurt*. Past injustices have been sincerely addressed, objectives, aims and ambitions have been voiced, and the partners are now prepared to act in a mutually beneficial manner (Lickers, pers. com. 1995).

Healing the hurt deals with difficult and often controversial issues. For example, one possible application of healing the hurt in protected area management would be addressing past exclusionary practices of Ontario Parks or Parks Canada vis-a-vis indigenous peoples (Panel on the Ecological Integrity of Canada's National Parks, 2000). When these issues have been properly addressed, the *zeal to deal* or *empowering partnerships*, in the form of community conservation (Adams and Hulme, 2001) or genuine partnerships (Panel on the Ecological Integrity of Canada's National Parks, 2000) can be set in motion.

The *Zeal To Deal – Empowering Partnerships*

The *zeal to deal* is a call to action for researchers. Together the CREE concepts encourage participatory partnerships and emphasize the strengths of socio-cultural diversity and cooperation, while promoting transparency, flexibility, accountability and understanding. The following section defines the concepts of CREE, and provides examples to illustrate how CREE was incorporated into the two research projects.

The Concepts of CREE

Capacity-building is defined as a process requiring an understanding of the impacts of different historical perspectives and socio-cultural beliefs. In order to accommodate these distinct perspectives, partners may need to develop new skills (i.e., openness and tolerance). Before conducting any field research, the researcher was required to undergo sensitization processes including reviewing literature pertaining to First Nations and local communities and participating in numerous discussions with the principal project directors. Capacity-building for the doctoral study was facilitated by the researcher's presence in the community from 1997 to 2000. It was during this time that the researcher had the chance to communicate formally and informally with local stakeholders involved in bear-viewing and with the establishment of two protected areas near Churchill (the Churchill Wildlife Management Area and Wapusk National Park). This process provided the opportunity to develop a research proposal that could address local issues of concern. Once the researcher had gained a good understanding of the socio-historical context in Churchill, he was ready to activate respect.

Respect and sensitivity are essential to eliminate past stereotypes. Respect is activated when partners are willing to incorporate indigenous systems of lore and follow local protocols (Lickers, pers. com., 1996). During the masters research, two protocols were implemented: lighting a fire at the woods' edge of the Mohawk territory of Akwesasne, and entering the Haudenosaunee Confederacy through the 'Well' or the 'Eastern Door' (guarded by the Mohawk nation) of the Haudenosaunee Longhouse (Lemelin, 1999). Here two members of the community, Henry Lickers and Lloyd Benedict, invited the researcher into the community. Assisted by Lickers and Benedict, a research topic of interest to the community of Akwesasne was developed. A similar approach was used in the development of a research questions for the doctoral thesis, since the idea was developed in the community of Churchill, Manitoba prior to the actual research phase. This process allowed the stakeholders and researcher to examine various ideas before settling on a few specific research questions (Lemelin, 2004).

Equity is often related to financial resources. However, equity encompasses much more than money. Assets include employment, royalties, knowledge systems, and 'sweat equity'. A 'back and brain approach' was used during the three years master's research in Akwesasne. The 'brain approach' comprised of such academic duties as the translation (French to English) of documents for Akwesasne. The 'back approach' included participation in the Sheek Island reclamation project, the erection of an Osprey Nest, and planting trees in the community. The brain approach in the doctoral research consisted of typical academic duties – conference presentations (e.g., academic, and local meetings) and publications. The back approach including assisting guides and drivers with interpretation and feeding the clientele at lunch hour during the tundra vehicle outings.

According to Lord and Hutchison (1993), empowerment is the awareness to create both capacity and alternatives, and the ability to develop new directions. Since empowerment decreases dependence and increases self-reliance, the goal of any researchers should be then to promote empowerment, and essentially work oneself out a job (Lickers, pers. com., 1996). By highlighting the socio-political knowledge of the Mohawk people, Lemelin (1999) demonstrated that the Mohawk's *naturalized knowledge systems* extended far beyond the traditional realms of the flora and fauna. The thesis demonstrated that the Great Law of Peace incorporated a profound ecological insight within a dynamic system of socio-political understanding, and spiritual/cultural attunement. Empowerment was also assured by providing each interviewee with a chance to make changes or add comments from their interviews. In addition, two members of Akwesasne, Henry Lickers (co-thesis director) and Lloyd Benedict (advisor) actively participated in the authors thesis defense and future publications.

The goal of the doctoral study was to produce the first social inventory on the human dimensions of Churchill's polar bear viewing industry. The study also provided the opportunity for community members, stakeholders and wildlife tourists to present their comments and voice their concerns regarding polar bear viewing in the Churchill Wildlife Management Area. These perspectives were then 'given voice' through various presentations (e.g., conferences, informal presentations in Churchill) and publications (e.g., journal articles, newspaper articles).

Discussion

The goal of this article was to demonstrate how *naturalized knowledge systems*, *healing the hurt* and the *zeal to deal* promoted applied and cooperative research approaches among various stakeholders. Demanding an enormous amount of physical energy and 'time commitment', applied participation to community research often extends beyond the traditional parameters of traditional academic research projects, delimited by standardized timelines. In this last section, we discuss some of the challenges encountered and opportunities created by these two projects.

Challenges

Empowering partnerships can be confronted with a multitude of issues, which, if improperly addressed, can obstruct the process of *healing the hurt* and *empowering partnerships*. Some of the difficulties that were faced are:

- socio-cultural barriers were often difficult to overcome;
- spatial and temporal differences (e.g., communication, distances, and differences in communal, academic, and bureaucratic paces) created some communication problems;
- accountability, responsibility, and transparency required personal perseverance and integrity;
- this type of research implied contract work – a type of financing that made budgeting unpredictable for both graduate students and community representatives;
- project directions were transformed by the appearance of new actors or new local demands; and,
- research is dynamic – topics and themes can be transformed with the appearance of new stakeholders.

Opportunities

Empowering partnerships promote transparency and accountability in research. They are an attempt to give something back to the community, beyond the traditional thesis copy or token consultation (Lickers, pers. com., 1995). During *empowering partnerships,* stakeholders are kept informed of developments and findings throughout the study. At the conclusion of the study, researchers are required to disseminate the findings in various formats, which may include traditional presentations, open houses, poster sessions, and writing research summaries outside of traditional academic journals. To summarize *empowering partnerships*:

- recognizes that local community knowledge extends far beyond the ecological awareness of the flora and fauna – indeed, NKS incorporates all forms of knowledge systems including socio-political knowledge, local expertise and spiritual understanding;

- promotes equitable partnerships, which will in turn stimulate external networks with numerous partners including academia, governments, private sectors and the media;

- ensures that trust and integrity become firmly embedded, and research mandates are fulfilled;

- encourages an applied and multicultural approach to research;

- promotes the concept of researcher responsibility: responsibility extends far beyond a commitment to humanity, it extents to all constituents of Mother Earth;

- validates social sciences as part of ecosystem management;

- highlights the need for multi-method analysis (questionnaires, behavioural observations and interviews) and interdisciplinary approaches (history, anthropological, environmental sociology); and,

- requires that publications and research materials are subject to participant review and made available to all partners.

While *empowering partnerships* require larger investments of time and finances by researchers, the contributions to the community and to the researcher on the long-run far outweigh any negative drawbacks on the short-term (Lickers, per. com., 1996).

Conclusion

This article illustrates how *empowering partnerships* were created in two small graduate research projects. However, the contributions of *healing the hurt* and CREE are not relegated to applied research, for the benefits of this approach were highlighted in the Panel on the Ecological Integrity of Canada's National Parks (2000) report:

> "*Healing, building respect and co-operation will shift Parks Canada and its Aboriginal partners away from attitudes and actions based on asserting rights and toward attitudes and actions based on accepting responsibility. Setting such an example can only inspire Canadians as whole to make similar*

> *shift. As Canadians' respect for Aboriginal peoples grows, so too does our understanding of the traditional ethics and uses of Aboriginal peoples within national parks. Developing true partnerships between Parks Canada and Aboriginal peoples will ensure the protection of these sacred places and sets an example for other Canadians to follow."* (Panel on the Ecological Integrity of Canada's National Parks, 2000: 15).

While specifically referring to Aboriginal peoples and Parks Canada the strength of the process is that it can apply to any partnerships requiring joint-management of protected areas. Thus, the achievement of empowering partnerships is not that it provides 'proof' that this approach 'works', its contribution is that it has created the space for a set of community participation that takes many forms and allows for the possibility to achieve different results (Adams and Hulme, 2001).

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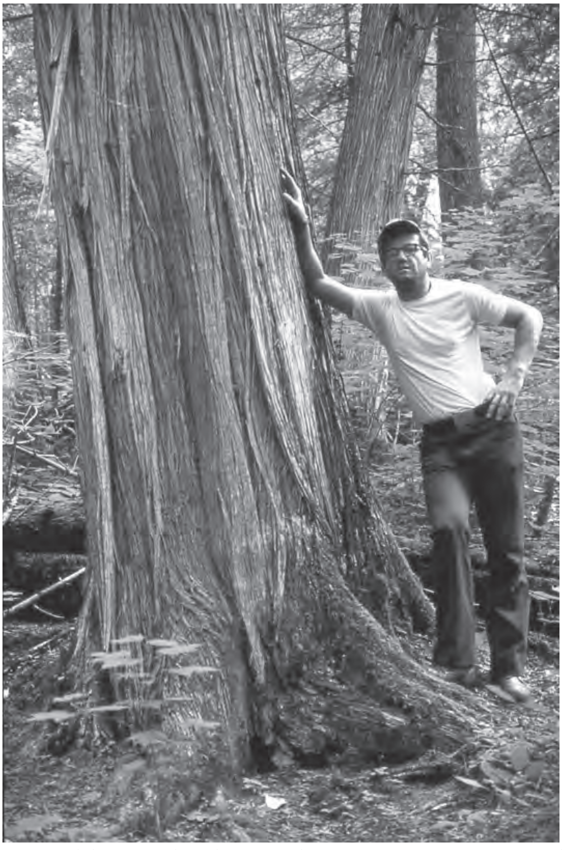
Workshop on Social and Economic Benefits of Provincial Parks



Old growth white cedar, Quetico Provincial Park (T. Beechey)

Rationale

There are broad-based social and economic benefits that are associated with provincial parks. Increasingly, park agencies need to demonstrate these benefits of protected areas. The *Study of the Social and Economic Benefits Associated with the Nine Ontario Living Legacy Signature Sites* was a multi-year effort designed to gather information regarding the benefits from the use of provincial parks. The findings from the study demonstrate the benefits flowing from provincial parks to communities across Ontario.

The PRFO workshop was intended to provide an opportunity for the consultants to present the findings of the study, to receive commentary from other professionals and to foster general discussion among participants. The workshop included presentations by Phil Shantz and Will Wistowsky, commentaries by Dr. Len Hunt and Dr. Peter Boxall and an assessment of the workshop by Mr. Clem Reid.

Finally, the study and the workshop will help to provide more social and economic benefit information needed to support decision making in the Ontario Ministry of Natural Resources.

Dan Mulrooney, Workshop Organizer
Ontario Parks, Ontario Ministry of Natural Resources

The Study of the Economic and Social Benefits of the Nine *Ontario's Living Legacy* Signature Sites

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Readers interested in the results from the entire project should contact Dan Mulrooney at Ontario Parks.

Ontario's Living Legacy (OLL) identified nine protected areas for special planning and management attention based on their size, ecological attributes, location and social and economic significance. These sites, known as 'signature sites' consist of a combination of different protected area classifications including parks, conservation reserves, forest reserves and enhanced management areas. The study sites included: the Kawartha Highlands, Killarney, Spanish River Valley, Nagagamisis Central Plateau Complex, Lake Nipigon Basin, Algoma Headwaters, St. Raphael, Woodland Caribou and the Great Lakes Heritage Coast.

In 2000, the Province commissioned a three-year study entitled, *The Economic and Social Benefits of the Nine Ontario Living Legacy Signature Sites*. This paper presents highlights of the economic and demographic trend analysis, the case studies, the recreational survey and the estimation of recreational value associated with eight of the signature sites.

Economic and Demographic Trends Associated with the Signature Site Regions and Communities

Throughout the OLL planning process, there was concern from Northern Ontario communities that industrial land base withdrawals would result in a loss of resource-based economic opportunities in the area. There was also a strong interest in seeing how these signature sites can create new tourism related economic opportunities. Hence, a baseline trend analysis was conducted to assess whether the regions and communities associated with each signature site region would be positively or negatively impacted over time. A total of 118 communities and 11 different signature site regions (one for each signature site and three for the 2000 km stretch of the Great Lakes Heritage Coast) were profiled for the time period from 1986 to 1996.

The two southerly signature site regions, Kawartha Highlands and Great Lakes Heritage Coast Georgian Bay Region, differ significantly in economic and demographic trends from the other nine more northern regions. These are: Woodland Caribou, St. Raphael, Nipigon Basin, Nagagamisis, Spanish River Valley, Algoma Headwaters, Killarney, Great Lakes Heritage Coast Lake Superior Region and Great Lakes Heritage Coast North Shore and Manitoulin Island and are characterized by stagnant population growth or a small population loss. In contrast, the Kawartha Highlands and Georgian Bay Region of the Great Lakes Heritage Coast are characterized by population growth rates, which typify the provincial population growth rates. The greatest population loss is in the smaller, highly resource-industry dependent communities (e.g., Hearst, Red Lake, Nipigon, Red Rock) while larger regional centers, such as Sudbury, have experienced stagnant or minor population growth.

The northerly signature site regions are characterized by a narrow economic base that is dependent on resource-based industries and the government services sector. The resource industries include the forest products, mining and tourism industries. The tourism industry in and around the signature sites is strongly associated with the natural resource base and includes remote fishing and hunting and highway-based tourism. Most other economic sectors in northern Ontario, such as wholesale and retail trade, transportation, construction and business services industries, are largely dependent on the resource industries and the energy and agricultural industries. Public sector employment and spending across all three tiers of government was found to often provide equal or higher levels of employment and income than the forest products or mining industries in many communities.

Total employment opportunities in the resource extractive industries have, at best, stagnated or declined[1]. Furthermore, since Ontario resource extractive companies operate in continental and global markets, they often substitute technology for labour to increase efficiency and remain competitive. Over the long-term, the overall competitiveness of these operations will be challenged and many of them may not be maintaining their competitive edge (Porter and Monitor Company, 1991; Martin and Porter, 2001). The economic sustainability of the majority of northern Ontario communities remains linked to the competitiveness of these resource-based mills.

Population stagnation and decline in most communities is evidence of the lack of economic opportunities in northern Ontario communities. Community leaders and much of the general public in northern Ontario have expressed concern about these trends and are interested in opportunities that can expand the narrow economic base of communities and provide new employment opportunities.

In contrast to the nine northerly signature site regions, the Kawartha Highlands and the Great Lakes Heritage Coast Georgian Bay regions have very little economic dependency on resource extractive industries. Both regions rely heavily on the tourism industry and government services and the Kawartha Highlands region also has a manufacturing base. In many respects, the differing economic characteristics between the nine northerly signature site regions and the two southerly regions is a function of geography. The nine northerly signature site regions and, in general, all of Ontario north of the French River, remain highly dependent on natural resources. South of the French River, areas such as the Kawartha Highlands and Great Lakes Heritage Coast Georgian Bay Region are linked to, and dependent on, the Southern Ontario economy – whether it is for tourism, recreation and/or proximity to other manufacturing areas and consumer markets.

Economic Value Versus Economic Impact

The study undertook both economic valuation and economic impact analysis. In terms of this study, the economic impact analysis was limited to the total economic impact (direct, indirect and induced) associated only with visitor expenditures. This is because the source for investment spending in Ontario parks and signature sites comes from tax revenues, and thus, is a transfer of wealth from one sector of the economy to another, rather than an increase in economic wealth.

In terms of economic valuation, this study examined the value people put on their trip. The trip value may be considerably different than their actual trip expenditures because no negotiated pricing structure (market) exists for the recreational services provided by public lands. For example, since no actual market exists to pay for the use of Crown land, and the price of park use is set by government policy and not reflective of market factors, there is no actual price for determining the value of visitors experiences. Thus the challenge of using economic valuation is to derive credible estimates in contexts, such as outdoor recreation on public lands, in which there are either no apparent markets or very imperfect markets. As the results from the study will demonstrate, the willingness of users to pay more for a recreational experience beyond the actual costs associated with their trip indicates a 'consumer surplus' (or additional benefits received) that more fully reflects the 'true' value of these recreational experiences to the signature site visitors.

Kawartha Highlands Signature Site Case Study

Three case studies were undertaken for the project. The key findings for the Kawartha Highlands Case Study are presented below.

The Kawartha Highlands Signature Site (KHSS) was already a major natural recreational playground for tens of thousands of individuals prior to the area being designated a provincial park. Results from the 2003 visitor survey indicated that the one-way travel distance to the KHSS for respondents was approximately 186 km. The KHSS lies just over a two-hour drive from most parts of the Greater Toronto Area and the resource base will continue to feel the pressure of the fastest growing region in Ontario together with an increasingly limited supply of semi-wilderness opportunities within reasonable proximity of southern Ontario.

The user statistics generated through this project indicate that by far the greatest economic benefits and likewise the greatest pressure on the resource will come from cottagers. The estimated number of cottager days (defined as those in or adjacent to the site – slightly over 500) is approximately 183,000 user days or ten times the canoer user day number of approximately 18,000. In turn the next largest user groups are hunters and fishermen at approximately 3,000 and 2,500. The local communities have already become 'cottager economies'' As investment continues in these properties this will only continue. The populations of the local communities have already adapted their skills to serving a tourist market and can build on this capacity to further increase the benefits as more economic opportunities are presented.

The existing economic impact of these recreational activities is significant. Based on survey results and using the Ministry's Socio-Economic Impact Model[2] we have projected the following economic impacts.

Cottagers spent an estimated $7.5 million in 2003 resulting in direct, indirect and induced value added impact of $7,372,214, 117 person years of employment and approximately $4 million in wages and salaries. The current economic impact of other users (canoeists, anglers, etc.) are shown below (Table 1).

Table 1. *Economic impact of park users other than cottagers.*

Activity	# Spent in 2003 (Millions)	Value Added (Indirect/Direct and Induced) (Millions)	Total Gross Sales (Millions)	Person Years of Employment
Canoeists	$1.18	$1.1	$2.8	18.5
Anglers	$0.23	$0.23	$0.6	4.5
Hunters	$0.17	$0.17	$0.41	3.3
Others	$0.05	$0.05	$0.13	0.8

As described throughout the case study, the number of canoers in the Kawartha Highlands already rivals similar densities in established wilderness and natural environment parks such as Algonquin and Killarney. At the same time, results from the visitor survey indicated that there is an extremely high tolerance for encountering other users within the signature site. While many canoeists may not see this congestion as an ideal wilderness environment, it does demonstrate that the Kawartha Highlands provides enough of a wilderness experience to meet other canoeists needs.

In this respect, Ontario Parks and OMNR may want to plan and manage the Kawartha Highlands with different objectives than how parks such as Algonquin, Quetico, Killarney or other wilderness parks have been planned. The Kawartha Highlands could meet the demand of increasing numbers of southern Ontario residents who may be seeking a more modest or 'introductory' wilderness experience – fewer portages, reserved campsites, shorter paddles, smaller lakes. New, urbanized and older Ontarions, as well as young families, often lack the experience and physical skills to undertake arduous wilderness trips but may be inclined to seek a quasi-wilderness experience more fitting their skills. This population is also likely to require more rental, guiding and/or purchase other local goods and services – creating more economic opportunities for local businesses. The establishment of the Kawartha Highlands Provincial Park provides a legal, planning and management opportunity to create objectives and strategies that could lead to enhancing the positive economic and social benefits of the area while ensuring the protection of the resource.

Recreational Use Survey and Economic Valuation

The study was limited to non-winter outdoor recreationists including hikers, hunters, front country campers, cottagers, day users, canoeists, sea kayakers, fishermen, lodge guests and other visitors to the select signature sites. To compare willingness-to-pay (WTP) values for recreation trips of different types and lengths, the marginal value (or per day value) for each type of trip was estimated.

In order to develop a survey instrument that was understandable to the user and provided meaningful data for the project a pilot study was conducted in 2002 in both the Killarney and Spanish River Valley Signature Sites. The pilot study provided over 400 returned surveys and represented the basis of a more refined survey tool in 2003. The main survey was conducted from May 17, 2003 through October 13, 2003. This time period corresponds with the signature sites' peak visitation period. In the case of Killarney Park, these are also the only months in which interior access points are open and staffed.

The sampling rate for each park was based on visitor statistics compiled from the previous two years of the study, including the 2002 pilot survey. A census approach was taken and all visitors were sampled. All cottagers, land use permit (LUP) holders and hunt camps whose property or activity was defined as being within or adjacent to the signature site boundary, were surveyed via a direct mail survey instead of at access points. Direct mail surveys to cottagers, LUP holders and hunt camps were done during the fall and early winter to minimize survey sampling redundancy and ensure complete coverage of these user groups.

Trained staff handed out the survey to approximately 3,000 visitors taking to the Kawartha Highlands, Spanish River and Killarney Park Signature Sites. Visitors received the survey at site access or departure points. The sample was stratified by site to identify any systematic differences of visitors in these categories. The survey was a standard mail back survey, and an internet survey return option was also available. In total, almost 1,800 surveys were returned, providing an overall response rate of 62%.

The surveyed sites for which actual valuation data were obtained are referred to as 'primary valuation sites'. The benefits measures from the primary sites were combined with use data and recreational characteristics from the other non-primary valuation signature sites to derive benefits measures for these sites as well. This process is referred to as 'benefits transfer'.

Killarney, Kawartha Highlands and the Spanish River Valley were chosen as the three primary valuation sites because they represented the mix of site characteristics and recreational activities found across the nine signature sites selected for this study. Also, given their proximity to the large urban population of southern Ontario, the well-used Killarney and Kawartha Highlands represented a unique opportunity to survey large numbers of visitors in an economical fashion.

The survey data was used in regression models to estimate parameters for calculating monetary values for benefits that accrue to recreational users and determine how trip benefits differ by site and by type of recreational activity. Differences by recreational activity and site characteristics were used to modify benefits calculations for the other signature sites not included in the primary valuation study.

The non-market 'good' valued in this study was one day of outdoor recreation in one of three signature sites. Since economic theory does not offer guidelines on either the form of the utility function, or the measures of the outdoor recreation experience that is important to visitors, this survey collects other user data to check economic theory and lend credibility to the estimates obtained. The survey also included questions to estimate a random utility model and zonal travel cost model.

Survey Results

The following table identifies the costs per person per day for each of the user groups in the three studied signature sites (Table 2).

Cost per person per day is calculated for each user group in each signature site by taking total group cost and dividing it by persons/group and average length of stay.

As the table demonstrates, most of the user groups incurred costs between $31 and $57 per day.

Table 2. *Costs of park users groups for three signature sites.*

Signature Site and Group	Costs per Person Per Day[3]
Killarney canoers	$51.85
Killarney hikers	$56.51
Killarney kayakers	$84.30
Killarney frontcountry	$31.93
Killarney rest and relaxation	$43.14
Spanish anglers	$42.82
Spanish canoers	$45.78
Spanish rest and relaxation	$19.81
Kawartha canoers	$64.39
Kawartha anglers	$95.43
Kawartha hunters	$52.40
Kawartha other	$31.25
Kawartha cottagers	$40.79

Kawartha Highlands – User Statistics and Estimation of Economic Benefit

The following table identifies the user statistics for the Kawartha Highlands Signature Site (Table 3). Since this was a primary valuation site, the total value is calculated as total user days multiplied by daily willingness-to-pay (WTP) and costs (expenses) incurred per day. The Kawartha Highlands produces an annual value of approximately $12.4 million, of which approximately $10 million is from the cottagers.

Similar tables similar were created for the Killarney and Spanish River Valley Signature Sites as well and the valuation estimates by user groups were used in the benefits transfer exercise for the non-studied sites.

User Group	User Days	WTP Estimates Per Day	Annual Benefits (User Days * Consumer Surplus/Day)	Costs Per Person Per Day (Actual Expenditures)	Annual Costs	Annual Value (Cost + Consumer Surplus)
Canoers	18,380	$30.22	$555,444	$64.39	$1,183,488	$1,738,932
Fishermen	2,433	$28.35	$68,976	$95.43	$232,181	$301,157
Large game hunters	3,171	$17.70	$56,127	$52.40	$166,160	$222,287
Others	2,208	$16.92	$37,359	$31.25	$69,000	$106,359
Cottagers	183,240	$13.79	$2,526,880	$40.79	$7,474,360	$10,001,239
Total	209,432		$3,244,785		$9,125,189	$12,369,974

Table 3. *User statistics for the Kawartha Highlands Signature Site.*

Woodland Caribou Signature Site

One of the non-surveyed sites was the Woodland Caribou Signature Site (WCSS). It is a remote area comprised primarily of the existing provincial park together with some small OLL additions. The results of this benefits transfer are presented below (Table 4). The table summarizes user numbers, presents annual costs and annual recreational benefits measures based on similar daily WTP and cost measures from the primary valuation sites, as indicated in the last column of the table. The table demonstrates the overall significance of the remote angling population in the WCSS. The large number of anglers and the high costs associated with the activity account for almost 90% of the value.

Similar analyses and tables were prepared for the Nipigon Basin, St. Raphael, Algoma Headwaters and Nagagamisiss Central Plateau Complex Signature Sites.

Total Value Estimation for all Eight Signature Sites

Table 5 summarizes the annual costs incurred by users and the consumer surplus for each of the signature sites and provides an overall estimation of annual recreation benefits.

As shown above, the eight signature sites produce annual recreation benefits of close to $36 million. Results indicate that the major driver of high annual recreational benefits is high use. The signature sites with the highest annual economic value – Kawartha Highlands and Killarney – are also the most intensely used and the closest to southern Ontario. The relatively high annual economic value of Woodland Caribou is largely attributable to the park's size, its number of remote fishing operations and the high expenditure pattern associated with this activity.

The estimates above are existing values that reflect the use of these areas prior to the completion of planning exercises for them. Therefore, the values are reflective of pre-OLL use. A study in five, ten or 15 years would be useful to estimate how the designation of these areas has changed the economic values over time.

Table 4. *Woodland Caribou Signature Site user days, consumer surplus, costs and total economic value estimation.*

User Group	Remote Anglers	Moose Hunters	Canoers	Totals
Annual Number of Users	4,715	22	1,045	5,782
Annual User Days	22,442	101	6,796	29,339
Annual Benefits (User Days * Consumer Surplus/Day)	$636,231	$1,788	$235,413	$873,432
Costs Per Person Per Day (actual expenditures)[3]	$202	$52	$43	
Total Costs	$4,536,426	$5,292	$291,005	$4,832,723
Annual Value (Cost + Consumer Surplus)	$5,172,657	$7,080	$526,418	$5,706,155
Transfer Site	Market Price + Kawartha	Kawartha	Spanish	

Table 5. *Summary of total value estimation for all eight signature sites.*

Signature Site	Annual Costs Incurred	Annual Consumer Surplus	Annual Recreation Benefits
Algoma Headwaters	$717,091	$195,974	$913,064
Kawartha Highlands	$9,125,189	$3,244,785	$12,369,974
Killarney Provincial Park	$5,361,289	$3,264,738	$8,626,027
Lake Nipigon Basin (angling only)	$967,103	$184,275	$1,151,378
Nagagamisis	$1,459,526	$964,403	$2,423,929
St. Raphael	$2,122,416	$273,614	$2,122,416
Woodland Caribou	$4,832,723	$235,413	$5,706,155
Spanish River Valley	$1,359,762	$1,074,519	$2,434,281
Totals for the 8 Sites	$25,945,099	$9,437,721	$35,747,224

Conclusions and Summary

Where the Crown owns the land, as is the case of Ontario's signature sites, its management should attempt to provide the public with the highest possible net benefits – not simply to recover costs. The maximum net benefit is the resource allocation that provides the greatest difference between total benefits (consumer surplus) and total costs. For government policy makers and economic development officials in communities near protected areas, the identification of a large consumer surplus indicates an area of 'untapped' economic value or potential. This value represents a potential revenue for capture for protected area authorities by charging higher and/or differential user fees. For the private sector and economic development interests, it represents an area of value that could still be captured by offering goods and services that meet visitors needs. Either way the 'surplus value' does demonstrate that the signature sites (and mostly likely other protected areas created through OLL) do have the potential to create more economic benefit for government and local businesses and communities.

Along with identifying the overall economic benefit of the recreational use associated with the signature sites, and demonstrating that the recreationists 'use value' exceeds their expenditure pattern, there are several other benefits of the study. The identification of the consumer surplus associated with the signature sites, together with research conducted on economic opportunities associated with these areas, can demonstrate to local communities and business the 'uncaptured' economic value of existing consumers and suggest possible ways this value could be captured.

The identification of economic values for the various recreational uses is particularly useful to estimate recreation values associated with other protected areas in the province. However, the biggest data gap in undertaking this would be the lack of recreational use numbers in all areas of the province except for operating provincial parks.

The other major gap in the economic valuation of these areas is that the study did not examine the value non-visitors place on the signature sites and all of the OLL areas in total. This issue of 'non-use' value remains a topic of continual interest for Ontario Parks and represents one of the most logical follow-ups from this study if the total economic value of these sites is to be more completely estimated.

In closing, the results of this study demonstrate that the landscapes within *Ontario's Living Legacy* signature sites provide significant and potentially sustainable economic benefits to a diversity of outdoor recreationists and regional economies. As demonstrated by this study, valuing these areas, based on a more complete estimate of the types, quantities and qualities of the benefits they provide, will facilitate decisions to be made such that the productivity of these landscapes are optimized and secured for present and future Ontario residents.

Endnotes

[1]It is difficult to conclusively state that total employment in the resource-based industries has been in decline. Even with detailed employed labour force data the resource industries have restructured over time and outsourced business functions that would have previously been undertaken by the company (e.g., logging, trucking, suppliers). As well, other resource-based industries have developed (e.g., OSB, value-added manufacturing). Nevertheless, experience from various communities and corporate restructurings have demonstrated that there is a long-term trend of technology replacing labour.

[2]The consultants gathered the economic impact data through the user survey and visitor counting and then assembled the data by user groups for input into the Ministry's SEIM model. All economic impact findings are presented at the provincial level.

[3]The estimated costs per day for remote lodge or outpost angler was based on a survey of price packages of operators in Woodland Caribou, St. Raphael and Algoma Headwaters. This was done as the consultant team made the decision that the angler costs per day captured in the Kawartha Highlands were not reflective of 'remote' fishing operations and instead were more reflective of local/non-outfitted angling opportunities.

A Critique of the *Study on the Social and Economic Benefits Associated with the Nine Ontario Living Legacy Signature Sites*

Len Hunt

Centre for Northern Forest Ecosystem Research, Ontario Ministry of Natural Resources

When I received the materials related to the study, *Social and Economic Benefits Associated with the Nine Ontario Signature Sites*, I was overwhelmed by the amount of information provided by the consultants. After reading through this information, I was impressed with many aspects of the study. In particular, the efforts made by the consultants to collect new information about some users of signature sites were very well done. These efforts to obtain reliable information about the signature sites should make the reader feel less wary about the conclusions reached by the consultants.

As with any research project, however, one may quibble with decisions made because of limited data or with assumptions employed to facilitate the analyses. Limited data on recreational use at the various signature sites led the authors to use a variety of approaches to estimate use at each site. These differing approaches for the various sites makes one believe that the reliability of recreational use information is much higher at some signature sites than at other sites. This reliability concern for recreational use also impacts the summary estimates of economic values for each of the signature sites. Therefore, readers are forewarned that the aggregated economic values presented for each signature site may differ from other sites because of real differences and/or differences attributable to the varying approaches used to estimate recreational use.

The consultants also proceeded to employ a series of assumptions that enabled them to conduct the economic valuation and benefit transfer analyses that were a centre piece of the study. Two major assumptions employed by the consultants included: (i) a constant relationship between per day willingness to pay and the duration of the trip (e.g., the willingness to pay for an additional day of canoeing was assumed to be the same for a one day or 100 day canoe trip); and, (ii) no relationship between increased per day costs of recreation and participation rates within the activities (i.e., it was assumed that if a person was willing to spend $20 per day more for canoeing, their total number of canoeing days would not be affected by this increased cost for canoeing). Hindsight suggests that the consultants could have relaxed these assumptions to employ a more behaviourally realistic modeling approach.

One final concern with the study relates to its mandate. The information from this study was intended to provide baseline data from which future comparisons could evaluate the benefits of the signature site designation for these areas. However, absent from the study are baseline data on areas outside of the signature sites (i.e., control data). Without this control data, it is not possible to evaluate whether future changes to the value of signature sites are due to its unique designation or changes to the demand for public land recreation. Future efforts, therefore, should fill this void by collecting such baseline information on sites that are not designated as signature sites.

In conclusion, I would encourage people to read and make use of the wealth of information provided by the consultants. The consultants have produced good quality data sets that other individuals could employ to research many aspects related to outdoor recreation and tourism. Given all the limitations imposed by the data availability and the original scope for the project, the consultants did a good job with the task at hand.

Review of:
Study of the Economic and Social Benefits of the Nine Ontario Living Legacy Signature Sites

Peter Boxall

Department of Rural Economy, University of Alberta, Edmonton

This study appears to me to be a valuable addition to the information database on the economics of parks in Ontario. The level of detail and rigour of the analysis appears to me to be unprecedented in the study of parks and protected areas in Canada. I think that the other federal and provincial agencies who manage parks and protected areas in Canada should take note of this initiative.

The study involved an interesting approach and components of the research comprised the following components:

- background profiles of communities associated with sites;
- growth and demand for use;
- determination of levels of use;
- expenditure impact analyses;
- literature review and case studie;
- survey and estimation of direct economic benefits; and,
- benefits transfer (value transfer).

The growth in demand component is a key piece of the study and should be a major factor of which Ontario managers should be cognizant. As is typical in most of these exercises, limited data are available to examine in detail growth or potential growth in use. But the following observations are relevant: (i) a growing provincial population (with regional differences) that is likely to place more demands on protected areas; (ii) the high likelihood of significance growth in use from non-resident alien (i.e., U.S.) visitors; and, (iii) the lack of similar wilderness opportunities in the U.S. and Europe. The increase in use of Woodland Caribou by canoeists is a poignant example of this potential (an increase of over 900%).

So the issue is how will park managers respond to this increasing use? What are the downsides of this increase? Of course there will be ecological impacts of increased human use, but there are also other impacts that have the potential to decrease the value of the experience that visitors receive. One of these is congestion which is highlighted in the study.

Economists have put forth a number of tools to manage congestion: things like pricing policies, queuing, quotas, lotteries, etc. The contingent valuation method (CVM) components of the study focused on prices changes as well as congestion level changes. Study team members used CVM to assess total *use* values based on hypothetical price changes, and marginal *use* values based on hypothetical changes in crowding. This information, while useful in examining the current levels of non-market use values provided by parks, can also be used to assess the impacts of fee increases or fee introductions as well as congestion level changes. So, in my opinion, the study offers a good start on understanding the reaction of parks visitors to potential management changes, particularly pricing and congestion strategies.

One criticism of the study may be in the way the CVM questions were asked. The team claims to use a double-bounded approach. This typically involves a series of questions as follows where X represents a randomly drawn number from some distribution of values, and Y is some random number that is either added or subtracted depending on the first answer (Figure 1).

The study team only utilized the approach on the left side of this diagram where a second question always represented a price increase, so the CVM approach is not a true double-bounded one. I am not sure if this will have an impact on the final willingness to pat estimates, but I suspect that it may be minor.

Other elements of the study, however, were exemplary. For example, the distribution of the randomly drawn bids (the $Xs) was updated three times as the study was underway. This serves to adjust the distribution to ensure that a relevant range of values were presented to respondents throughout the study.

One thing missing in the reports I reviewed was a comparison of the value estimates the study team derived with those from other related studies in Ontario and neighbouring provinces for using similar types of parks and protected areas. I constructed a table of the few studies I am aware of and some interesting patterns emerge (Table 1). First, while I haven't adjusted the values estimates to be in constant or real dollars, I suspect that for Killarney the value per trip has increased over time. Understanding why this might have occurred would be instructive as a way of understanding what increases users' value for trips

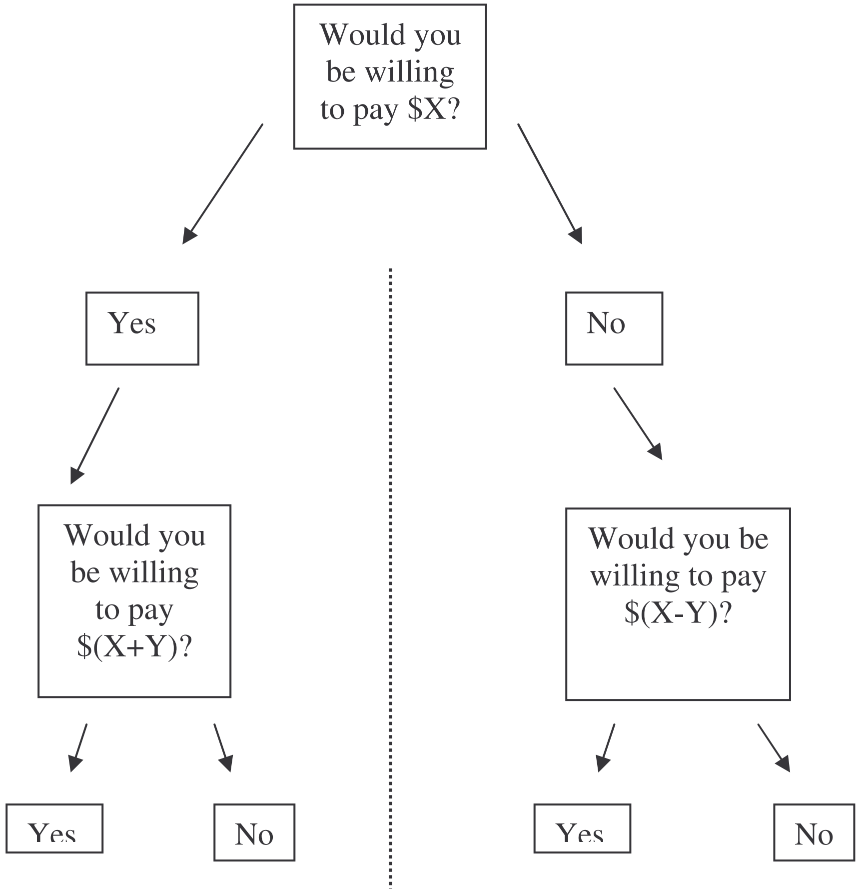

Figure 1. *Typical double-bounded CVM approach.*

Table 1. *A summary of park and protected area values for recreation.*

Location (Study Reference)	Economic Value/Trip
Killarney (Rollins and Wistowski)	$60.65 (overall trip in 1993)
	$54.97 (4 day trip)
Killarney (this study)	$117.38 (4.4 day trip)
Nopiming Manitoba (Boxall *et al.*)	$293 (2.7 day trip in 1993)
Spanish River (this study)	$207.96 (6 day trip)
Woodland Caribou (Englin *et al.*)	$4176 (6 day trip; 4 person group in 1994)

to Killarney. The other values shown suggest that the Spanish River estimates are not much different for what I think may be a similar experience at Nopiming Provincial Park in Manitoba. Finally, the more remote experiences (i.e. at Woodland Caribou) are exceedingly valuable, but keep in mind one must adjust the estimates for trip duration and group size.

Another element of the study that I know was considered but has not been reported is the concept of a recreation demand system. The idea here is that a network of parks/wilderness areas should be considered as a cluster; any changes that occur in the environments or management systems at one place have the potential to influence use in other elements of this system. Table 2, taken from a journal article by Englin *et al*. (1998) provides some idea of a demand system using a travel cost model framework. We built this system as an illustration, knowing that Quetico and Boundary Waters should also be included in this model.

Table 2. *Average use, group size, travel costs, and consumer surplus associated with two alternative specifications of demand for a system of four Canadian wilderness parks.*

	Wilderness Park			
	Nopiming	Atikaki	Whiteshell	Woodland Caribou
Mean days/trip	2.72	6.45	2.50	6.00
Mean group size/trip	4.03	5.93	4.41	3.81
Mean travel cost ($) per person	102.57	389.30	102.14	203.15
Consumer surplus/trip				
Unconstrained	117.89	162.49	132.37	157.61
Constrained	293.23	4941.66	871.65	4176.85
Consumer surplus/day				
Unconstrained	43.34	25.19	52.94	26.26
Constrained	107.80	766.14	327.06	696.14

These types of models are useful for understanding the value of recreation demand systems as well as figuring out how people would sort themselves within the system given management changes, for example, entry fee changes. One can also see which of the parks in this system provide the highest valued experiences. Of course this picture is dependent on the spatial distribution of the market – there are more people closer to Nopiming so that trips there while more frequent in occurrence, may be less 'valuable'. This raises some questions about the values for the remote places presented in the report. Per trips values to these places should be higher values than less remote ones. Indeed, in Table 1, Spanish River values are higher than those for Killarney; but I still wonder if the difference in value should not be even larger. So in summary I think that the Ontario Parks system should be attempting to understand these demand systems. The current study may represent a step towards developing this knowledge.

Economists have recently developed the notion of benefits transfer which is a response to the fact that socioeconomic studies are expensive to conduct and that there never seems to be pots of money around to do these studies unlike for ecological or biological research. This involves the notion of 'transferring' the values or the valuation functions from site to site. The authors attempted to do this by transferring the values among what they viewed as similar parks. Another approach that could be considered in future is to develop travel costs models, and to transfer the functions among places conditional on the availability of local user information. This suggests that the development of registration or permitting systems would have value if the information collected on each permit could be plugged into the valuation functions. This is a simpler approach than conducting further CVM studies, although it relies on managers to be serious about collecting information from visitors at the various parks and protected areas of interest.

In conclusion, this study is likely one of the most comprehensive to date conducted by the federal or provincial government on the economic values of parks and protected areas. I would hope that this study will not be 'terminal' and will be viewed as a good start to collecting, gathering and using socioeconomic information in managing these areas. This information will become critical as demand and competing land uses increase. Since parks and protected areas are 'huge' generators of economic values that are not expressed in economic markets, traditional expenditure impact studies do not fully capture the economic picture of the presence of parks. Furthermore, with protected areas there are what economists call passive use values that may not be associated with actually 'using' the area; the mere existence of protected ecosystems may generate value irrespective of their use. This would be a worthy ground for future additional research.

Appendices

Bon Echo Rock, Bon Echo Provincial Park (C. Rehbein)

Policy Update: Fire Management Policy for Provincial Parks and Conservation Reserves

Dave Heaman[1] and Jonathon Wilkinson[2]

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Background

In 2004, the Ontario Ministry of Natural Resources (OMNR) approved a new *Fire Management Policy for Provincial Parks and Conservation Reserves*. The policy, included after this introduction, was developed jointly between three divisions of OMNR: Ontario Parks, Field Services Division, and the Aviation and Forest Fire Management Program. The goal of the new policy is to advance the management of fire to restore and maintain the ecological health and integrity of Ontario's natural heritage represented in provincial parks and conservation reserves. The policy will also help to ensure that preventing personal injury, value loss and social disruption resulting from forest fires remains the utmost priority. This goal complements OMNR's new *Forest Fire Management Strategy for Ontario* and the objectives of the Aviation and Forest Fire Management Program, which are:

- to prevent personal injury, value loss and social disruption resulting from forest fires; and,
- to promote understanding of the ecological role of fire and utilize its beneficial effects in resource management.

The policy directs protected area stewards and fire managers to:

- consider and document the role of fire;
- develop clear preliminary objectives for fire use and fire response; and,
- develop recommendations for further planning.

These preliminary objectives and recommendations will be recorded in a Statement of Fire Intent (SFI). The three OMNR divisions are also jointly preparing *Draft Fire Management Planning Guidelines for Provincial Parks and Conservation Reserves* to help protected area stewards and fire managers prepare Statements of Fire Intent and develop fire management direction within protected area planning documents, including fire management plans. The guidelines address the range of situations where fire management planning is appropriate and provide assistance in:

- developing objectives for the effective combination of fire response and fire use in individual fire management compartments within the protected area;
- incorporating direction for the effective fire management direction within relevant protected area planning documents; and,
- the planning process, and developing a fire management plan.

Notices regarding this approved policy are posted on the Environmental Bill of Rights website. Once complete, the *Draft Fire Management Planning Guidelines for Provincial Parks and Conservation Reserves* will be posted to the Environmental Bill of Rights website for public review and comment. Information on Ontario Parks or OMNR's Aviation and Forest Fire Management Program, including the new *Forest Fire Management Strategy for Ontario*, is available online at:

- Ontario Parks: www.ontarioparks.com
- Aviation and Forest Fire Management: http://affm.mnr.gov.on.ca/spectrasites/internet/affm/fire.cfm

Fire Management Policy for Provincial Parks and Conservation Reserves

Purpose

This policy provides direction for fire management in provincial parks and conservation reserves.

Introduction

The Ontario Ministry of Natural Resources (OMNR) administers Ontario's provincial parks through Ontario Parks, and conservation reserves through the OMNR district offices.

Many of Ontario's ecosystems are adapted to disturbance by fire for renewal and ecological health. Lack of fire disturbance in the last century has resulted in ecosystem conditions that do not represent the forest, savannah, or grassland conditions before modern intervention. Shifts in species composition, accumulations of biomass, insect infestations, poor regeneration, and degradation of wildlife habitat are examples of changes that have been documented.

Long-term fire suppression can also produce significant accumulations of biomass that function as fuels. Fires in flammable, but often altered, ecosystems may now come with increased risk of intense fire behaviour that can threaten lives, property, neighbouring lands, and some natural and cultural features.

Fire is an important ecosystem process, fundamental to restoring and maintaining the ecological integrity of Ontario's natural spaces. Natural fire regimes contribute to ecological integrity through maintaining a shifting mosaic of healthy vegetation patches.

Ontario has adopted ecological representation as a method to help conserve biological diversity – the variety of life. Its fundamental principle is that protected areas should include representative examples of the known native biodiversity within ecologically defined regions. Ontario aims to include the best representative examples of its natural and cultural diversity within its system of protected areas. Many protected areas will not continue to represent the natural heritage they were designed to protect unless they are exposed to fire in the coming decades.

Returning fire to Ontario's protected areas will be challenging. While the natural role of fire must be accommodated, the need to protect human values remains. Many protected areas have infrastructure, recreational uses, and neighbours that can be negatively affected by fire. The management of fire within protected areas must also consider management activities on adjacent lands.

The safe and effective management of fire in provincial parks and conservation reserves in Ontario requires a firm understanding of fire science and planning, opportunities for public consultation, sound operational delivery, and adaptive management based on continuous learning.

Definitions

Conservation reserves are areas established by O. Reg. 805/94 made under the authority of Section 4 of the *Public Lands Act*. Conservation Reserves protect natural heritage areas and natural features on public land and preserve traditional public land uses

Fire management is the activity concerned with the protection of people, property, and forest areas from wildfire and the use of prescribed fire for the attainment of forest management and land management goals and objectives, all conducted in a manner that considers environmental, social and economic criteria. *Note: For the purposes of this policy, forest areas include other vegetated areas such as prairies, savannahs and tundra.*

Fire management plan is a statement of operational policy that addresses management objectives and prescribed actions with respect to fire use and response to forest fires in a defined area.

Fire regime is the kind of fire activity or patterns of fires that generally characterizes a given area.

Fire response is the observation, assessment, suppression, or other influence of fire behaviour such that costs and/or damage are minimized and benefits from the fire are maximized.

Fire use is the strategy of maintaining fire as an ecological process or meeting resource management objectives through the application or management of prescribed fire.

Forest fire is any fire that is burning in forested areas, brush, grass, tundra, or other vegetation.

Prescribed burning is the knowledgeable application of fire to a specific land area to accomplish predetermined forest management or other land use objectives.

Prescribed fire is a forest fire deliberately utilized in a pre-specified area in accordance with a predetermined burning prescription to achieve preset resource management objectives.

Provincial parks are areas designated by legislation under the *Provincial Parks Act* R.S.O. 1990. Provincial parks protect significant natural, cultural and recreational environments while providing opportunities for visitors to participate in recreational and educational activities.

Statement of fire intent is a document describing the role of fire and preliminary objectives for fire use and fire response.

Wildfire is an unplanned and unwanted forest fire.

Authority

Under the *Forest Fires Prevention Act*, the Minister of Natural Resources is mandated to lead forest fire management efforts on all lands inside the fire region; on crown lands and lands managed by the OMNR outside the fire region, and during forest fire emergencies as defined under the *Emergency Management Act***.**

Under the authority of the *Provincial Parks Act***,** the Minister of Natural Resources can direct use, resource management, and fire management activities within provincial parks.

Under the authority of the *Public Lands Act***,** the Minister of Natural Resources can direct land-use and resource management activities within conservation reserves.

This policy complements existing policies for Forest Fire Management, Ontario Parks, and conservation reserves.

Intent and Direction

Guiding Principle

Fire is an essential natural process, fundamental to restoring and maintaining the ecological integrity of Ontario's natural heritage as represented within its provincial parks and conservation reserves.

Goal

To advance the management of fire in provincial parks and conservation reserves to restore and maintain the ecological integrity of Ontario's natural heritage represented within these areas, while preventing personal injury, value loss, and social disruption associated with forest fires.

Objectives

The objectives of the policy are to:

- promote fire management planning for provincial parks and conservation reserves;
- ensure the role of fire is considered and documented in the management direction for provincial parks and conservation reserves; and,
- ensure clear objectives for fire use and fire response are developed to prevent personal injury, value loss, and social disruption associated with fires, and to meet ecological and resource stewardship objectives.

Application and Responsibility

Application

This policy applies to all provincial parks and conservation reserves in Ontario.

Fire management direction will be developed and approved in accordance with the *Environmental Assessment Act* and the *Fire Management Planning Guidelines for Provincial Parks and Conservation Reserves*.

The *Fire Management Planning Guidelines for Provincial Parks and Conservation Reserves* direct the process of fire management planning which includes:

- considering and documenting the role of fire and preliminary fire management objectives through the preparation of a Statement of Fire Intent;
- incorporating fire management direction within relevant protected area planning documents; and,
- preparing fire management plans where appropriate.

Fire management direction for provincial parks may be provided within the following planning documents:

- interim management statements, which guide the management of newly regulated and recommended parks until a park management plan is in place;
- park management plans, which identify park-level management policies aimed at maintaining or enhancing the achievement of the four parks system objectives: protection, heritage appreciation, recreation, and tourism;
- resource stewardship implementation plans, which guide the operational delivery of certain resource stewardship activities and projects; and,
- fire management plans, which specifically address objectives and prescribed actions with respect to fire response and fire use over a period of time.

Fire management direction for conservation reserves may be provided within the following planning documents:

- statements of conservation interest (SCI), which identify area values and provides direction on management activities and land-uses;
- resource management plans, which contain enhanced information over and above that of a SCI; and,
- fire management plans, which specifically address objectives and prescribed actions with respect to fire response and fire use over a period of time.

In the absence of fire management direction developed and approved consistent with this policy, fire management will be carried out in accordance with the *Forest Fire Management Strategy for Ontario*.

Prescribed burn plans are operational plans prepared for particular prescribed burning operations, and are not to be considered fire management plans. Prescribed burn plans will be completed and approved in accordance with the *Prescribed Burn Policy*. Prescribed burns must be consistent with objectives established for the provincial park or conservation reserve.

Responsibility

Communication among protected area stewards, district staff, fire managers and others is essential for the development and implementation of sound fire management planning.

The role of fire and preliminary fire management objectives and options will be considered and documented for provincial parks and conservation reserves through the preparation of a Statement of Fire Intent in accordance with the *Fire Management Planning Guidelines for Provincial Parks and Conservation Reserves*.

Those responsible for developing the planning documents listed in the Applications section above will ensure that fire management direction is prepared in consultation with local fire management staff and district staff. Once approved, a copy of these planning documents will be provided to the local Fire Management Headquarters.

If a fire management plan is prepared for a provincial park, the Park Superintendent will co-ordinate its development. If a fire management plan is prepared for a conservation reserve, the Area Supervisor will co-ordinate its development. These personnel will ensure that appropriate OMNR staff are assigned to plan development, and initiate contact with the local Fire Management Supervisor.

The local Fire Management Supervisor will contact the Regional Fire Program Manager, who will assign appropriate OMNR fire management staff to participate in the development of the fire management plan.

The Park Zone Manager and the Regional Fire Program Manager are responsible for the review and approval of fire management plans for provincial parks. The District Manager and Regional Fire Program Manager are responsible for the review and approval of fire management plans for conservation reserves.

Toward State of the Protected Areas Monitoring and Reporting: A Pilot Study for Ecoregion 5E

Jennie Aikman, Tim Bellhouse and Dan Mulrooney
Ontario Parks, Planning and Research Section

In 2002, a pilot study was initiated as an exercise to scope the feasibility of implementing monitoring and reporting on the state of protected areas in the province, based on Ontario Parks' ecological monitoring framework. Ecoregion 5E was selected as the study area for the project. The objectives of the pilot study were to collect relevant data sources, to identify data and information needs and gaps, and to develop templates and resource requirements for state of the resource reporting. For this pilot, data was acquired from many different sources and compiled into relational database and GIS formats for analysis and query. In all, 28 indicators and 48 measures of ecological integrity were analyzed for the ecological component of the framework. On the socio-economic side, analysis of 11 indicators and 14 measures was completed. Reports were created in Microsoft Access for each measure. Measures were integrated into template reports for the ecoregion, ecodistrict and individual protected area.

Ontario Parks Comprehensive Monitoring Framework

Tim Bellhouse, Jennie Aikman and Dan Mulrooney
Ontario Parks, Planning and Research Section

Ontario's provincial park system has evolved over the past 100 years into network of protected areas that today includes 636 provincial parks and conservation reserves encompassing an area of 9.5 million ha. Setting areas aside is merely the first step in protection. Public demand for outdoor recreation opportunities has grown tremendously over the past 30 years, coupled with an increasing awareness of nature, wild spaces and the imperative to protect global biological diversity. Ontario Parks has responsibility for planning and management of the system of protected areas within Ontario. Ontario Parks

has developed a comprehensive, ecosystem-based approach to monitoring to support planning and management of provincial parks and conservation reserves across Ontario. The monitoring framework that has been developed is hierarchical and based on a criterion and indicator approach. The framework begins with a vision – healthy ecosystems, healthy people; a mission – ecological sustainability; and three inter-related principles – ecological integrity, economic health and social well-being. Rather than develop an entirely new monitoring network, Ontario Parks intends to make use of monitoring data collected by other partners on the Ontario landscape. Testing of the framework was conducted using a pilot study in ecoregion 5E.

Range Boundary Dynamics of Fishers (*Martes pennanti*) and Flying Squirrels (*Glaucomys volans* and *G. sabrinus*)

Jeff Bowman[1], Paul J. Wilson[2], Denis J. Carr[2], Tara J. McEachen[2], Jay R. Malcolm[3] and Gillian L. Holloway[3]
[1]Wildlife Research and Development Section, Ontario Ministry of Natural Resources
[2]Natural Resources DNA Profiling and Forensic Centre, Trent University
[3]Faculty of Forestry, University of Toronto

Reviewed are two current projects that assess range boundary dynamics of three mammal species in Ontario: fishers (*Martes pennanti*), and northern and southern flying squirrels (*Glaucomys volans* and *G. sabrinus*). Both projects seek to address the cause of recent range boundary shifts. The fisher project is testing the hypothesis that Algonquin Park is an important trapping refuge and has produced emigrants to recolonize southern Ontario. The research involves radio telemetric studies of 77 fishers in both Algonquin Park and southeastern Ontario, a genetic study of > 1000 fishers, and an analysis of > 450,000 trap nights of live captures. The flying squirrel project is testing the hypothesis that climate change has resulted in a range expansion of southern flying squirrels, which has in turn resulted in a range contraction of northern flying squirrels. So far, the study has used 25,139 trap nights to estimate the distribution of the two species, and to sample DNA from > 600 individuals. Interpolated climate maps have been produced and compared to southern flying squirrel distributions from 1985-86 and 2002-03. Results of both studies suggest that recent climate change has dramatically affected the spatial dynamics of these three species.

The Greenhouse Effect: Climate Change and the Flow of Carbon in Forests

Stephen Colombo
Ontario Forest Research Institute, Applied Science and Research Branch, Ontario Ministry of Natural Resources

Forests hold more carbon than any other land class in Ontario. Forests in parks and protected areas are a significant proportion of the total forested area of the province, and their contribution to forest carbon storage is important. Typically, mature forests in Ontario store carbon in proportions of about 2/1.5/1 in soil, living biomass, and dead organic matter respectively. The soil pool is relatively stable, but living biomass and dead organic matter carbon is subject to fairly rapid losses if a disturbance removes the overstory. Removal of overstory trees by fire, harvest or windthrow reduces stored forest carbon for 50 or more years. One of the most likely effects of climate change for Ontario is a significant increase in fire frequency. Increased fire frequency could result in substantial reductions in Ontario's forest carbon storage. Reforestation by planting could offset some losses of forest carbon by replacing forests more promptly.

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

Brian Craig
EMAN Coordinating Office, Environment Canada

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

interpretation and communication tools which can be utilized by interested sites, networks and communities to establish whether and how local ecosystems are changing while at the same time contributing to timely status and trends reporting at all levels. These can serve as a basis for developing partnerships with protected areas managers and stakeholders. This presentation will describe the standardized approaches to ecosystem monitoring that have been most recently developed by the network.

Emerald Lake Prescribed Burn – Quetico Park

Terry Curran[1] and Matt Myers[2]
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Quetico Provincial Park, established in 1913, is one of Ontario's premier wilderness class parks in northwestern Ontario, approximately 160 km west of Thunder Bay and immediately north of the Boundary Waters Canoe Area Wilderness (BWCAW) of Minnesota. Quetico is northwestern Ontario's busiest backcountry park with an annual visitation of approximately 140,000 visitor days. This vast expanse of wilderness covers a total of 4758 km^2. On July 4, 1999 a complex wind and thunderstorm event blew down 250 000 ha of timber along the international boundary between Ontario and Minnesota. In Ontario the blowdown impacted the southern border of Quetico Park and the southern border of the Thunder Bay District. In Minnesota the blowdown impacted an extensive area of the Boundary Waters Canoe Area Wilderness in the Superior National Forest. Quetico's blowdown is approximately 11 000 ha in size, in a section of the park that is highly utilized by wilderness canoe trippers as a major access zone.

The primary objective of the Emerald Lake prescribed burn in Quetico Park was the removal of blowdown fuels to reduce the potential hazard of large-scale wildfires in the area of the park hardest hit by the windstorm. The prescribed burn also involved low intensity, understorey burning where fire burns off forest vegetation on the forest floor but does not kill the standing timber. This reduces competition and creates a favorable seedbed for regeneration of fire evolved plant and tree species of which the Quetico ecosystem is comprised. After an area of mature timber blows down and drys out it becomes very flammable and receptive to fires as the secondary renewal agent. The 2000 ha prescribed burn was successfully conducted on October 12, 2000 when park visitor use drops, and weather patterns favor low intensity fire, minimizing the impact on people, wildlife and values in the area. The burn operation was a joint cooperative project between Ontario Parks, MNR's Aviation and Fire Management Branch and the USFS of the Superior National Forest. It is one of the first of a large-scale burn project to treat approximately 31 000 ha of blown-down timber with prescribed fire over the next seven years.

On the Use of Umbrella Species for Conservation of Biodiversity

Ryan M. Gorman and Heather A. Hager
Department of Zoology, University of Guelph

Managers often face the dilemma of planning reserve networks with limited amounts of data on species' distributions: 'umbrella species', as surrogates for other taxa, were thus proposed. Despite their theoretical potential and frequent use, there has been little effort to evaluate the efficacy of reserve design using umbrellas. The relative efficiencies of species' representation in reserves selected using 'single-species umbrellas' and 'umbrella species groups', relative to each other and to that which would result if protected areas were selected at random, were compared. Distribution data for vertebrates and plants on islands of six Great Lakes basin archipelagos were analyzed. Reserves selected using 'umbrella groups' contained more species than did those selected using 'single-species umbrellas'. Random selection, constrained to the same numbers of islands, and the same total areas, occupied by umbrellas typically performed poorer, and marginally better, respectively, than did umbrellas of any type. Where data is limited, managers may be consoled by the result that random reserve selection appears to perform as well, or better, than any of the traditional applications of 'umbrella species'.

Climate Change, Parks, and an Ecosystem Approach to Management: An Overview

Paul Gray
Applied Research and Development Branch and Ontario Parks, Ministry of Natural Resources

Current trends and modelled predictions indicate that known and potential impacts of global warming during the next century will be significant and widespread. All ecosystems and their constituent organisms, including people, will be affected. And there are implications to all natural resource management programs. While it is logical to assume that the best solutions for a sustained future will result from combinations of cultural-social-economic-ecological decisions, determining optimal mixes of decisions in a rapidly changing world (ecosphere) will be difficult. In large part, effective management of climate change impacts will depend on how well societies embrace sustainable living objectives and implement an ecosystem approach. This presentation explores tools and techniques for the sustained management of parks and protected areas in a changing climate.

Developing a Binational Framework for the Conservation of Great Lakes Islands

Daniel Kraus
Nature Conservancy of Canada

The 30,000+ islands of the Great Lakes form the world's largest collection of freshwater islands and their biological diversity is of global importance. These islands make a unique contribution to the ecology of North America and include endemic species, rare habitats, and critical biological functions. A strategic action plan is being developed through a bi-national project team to design a framework for effective long-term conservation. This framework includes: (i) assembling an ecological baseline; (ii) assessing threats to viability; and, (iii) development and implementation of an action plan. This presentation will provide an update on the project, and a summary of the baseline information and conservation assessment methods. This includes the development of a Geographic Information Systems (GIS) database to better understand and manage Great Lake islands. This database will be used to prioritize islands on basin-wide scale. An island classification system and SOLEC indicators are also being developed using the baseline information.

Valuing Forests in the U.S.A. and Canada: What's the Difference?

N. McIntyre, J.Moore, M. Yuan, and R. J. Payne
Centre for Parks, Recreation and Tourism Research, Lakehead University

Rural/urban differences in valuing forests have been well recognized for many years. However recent research emanating from the USA suggests that there is a 'greening' of rural communities and a general shift from an anthropocentric to a biocentric valuing of forests. This paper examines a recent study undertaken in northwestern Ontario that surveyed forest values among a diverse population of visitors from the U.S.A., parts of Canada and residents of northwestern Ontario. Results suggest that rural/urban differences as to the use of forests may be alive and well in Canada.

Parks or Crown Land? Factors Affecting the Destination Choice of American Recreational Visitors to Northwestern Ontario

J. Moore, M. Yuan, N. McIntyre, and R.J. Payne
Centre for Parks, Recreation and Tourism Research, Lakehead University

Northwestern Ontario provides a wide range of recreational opportunities, both in provincial parks and on Crown land. Quetico Provincial Park is a world-class canoeing destination, attracting nearly 20,000 backcountry visitors per summer season, the vast majority of whom are Americans. Adjacent to Quetico is the Dog River-Matawin (DRM) forest region, an area of Crown land providing many alternative recreation opportunities. To explore what motivates American visitors to choose between the park and the adjacent Crown land as a recreation destination, differences in trip characteristics, visitor mo-

tivations, and activity participation are examined. Visitors to Quetico are seeking adventure, tranquillity, and solitude, and they participate in non-motorized, non-consumptive recreation activities such as canoeing, photography, and wildlife viewing. Visitors to the DRM are seeking more social recreational experiences, and are more likely to fish and motorboat. Visitors to Quetico are more often male, are younger, more highly educated, and make more money than visitors to the DRM.

Priorities and Opportunities for Protected Area Research and Management

D.R. Paleczny[1] and P.A. Gray[2]
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Like PRFO, domestic and international gatherings provide opportunities for collaboration among people from academic institutions, non-governmental organizations, government agencies, industry, and the public. They are effective venues for information dissemination and identification of research and management priorities for a variety of issues in parks and protected areas, including climate change, land-use and protection strategies. Accordingly, research and management initiatives in Ontario benefit when such collaboration occurs. This paper examines products from protected area forums, including the Fifth IUCN World Parks Congress convened in Durban, South Africa in 2003 and various COPs (Conference of the Parties) organized in support of the *United Nations Convention on Biological Diversity*, which emerged from the 1992 Earth Summit in Rio de Janeiro. We make suggestions about how these outputs are expected to inform discussions at the upcoming 2004 *World Conservation Congress* in Bangkok, Thailand and provide a synthesis to assist people working to identify needs, priorities, and opportunities for research and management in Ontario.

Fire Planning in Quetico Park – Weaving Together Operations with Policy

Robin Reilly
Ontario Parks

Quetico Provincial Park is the only park in northern Ontario with an approved fire plan. That fire plan was used to provide guidance to prescribed burns in prior years at Emerald Lake in 2001 and North Bay in 2002. In 2004, Quetico Park is anticipating another prescribed burn on Pickerel Lake. This project presents interesting operating and policy challenges. Fundamental questions include whether it is even appropriate to intervene in natural processes on a wilderness park. This issue is complicated as the fire would be ignited in an area that currently is designated for fire suppression and therefore already has a history of intervention. The fire is in response to a large forest blowdown near the main campground, adjacent private cottages and commercial timber. There are safety reasons for wanting to reduce the blowdown trees, but also safety issues associated with burning. Salvage logging is planned for an area across the park boundary and there will be some arguments in favour of logging within the park. Finally, there are important ecological succession research opportunities presented by the juxtaposition of areas alternately treated by salvage logging, prescribed burning and leaving trees to rot in place.

A Discussion of the Use of Multi-cohort Forest Management in Parks and Protected Areas Planning

Kim Taylor and Gordon Kayahara
Northeast Science and Information, Ontario Ministry of Natural Resources

Current research into forest management has been embracing the use of natural disturbance regimes and natural succession in the planning and management of areas under forest operations. Many of these same principles which are being indicated for use in areas used for forestry operations in order to insure ecological sustainability have validity for use in the management of parks and protected areas as natural fire regimes and successional trajectories do not recognize planning boundaries. In this presentation, the concept of multi-co-

hort forest management, and its uses at the stand- and landscape-scales in the management of parks and protected areas will be discussed.

Beyond Parks: Understanding Resource-Based Tourism Supply in Northern Ontario

Mike Yuan
Lakehead University

Appropriate resource-based tourism (RBT) development in Ontario is predicated on understanding the public's need for such opportunities. While the knowledge base of RBT demand is growing, it is becoming more apparent that future demand will be constrained by supply. While the industry has examined RBT supply by focusing on RBT operators, little attention has been made on the resource on which RBT occurs. In Canada, RBT supply has focused on parks and protected areas but the great majority of all potential RBT supply is on Crown lands. It is suggested that we need to look beyond parks and protected areas when examining RBT. Because Crown lands are managed primarily for commodity production, they are often overlooked when examining RBT supply. As pressures increase for both commodity production and non-commodity uses of the same resource, there is a concomitant need to better understand the interrelationships among these competing values. A major reason that RBT has been largely ignored is that there is no systematic recreation or tourism management framework used at either the provincial or national level. A new paradigm shift is needed in the management of Crown lands as it affects a range of resource values – recreation and tourism must be an integral component to Crown land management. To better provide for RBT supply, a suggestion is made to develop information management systems, strategic plans, a recreation and tourism use strategy, and integration of policy, planning and management.

Appendix C: PRFO 2004 Annual General Meeting Conference Program

Program

Day 1 – Tuesday, May 4, 2004: Theme Day (Room: ATAC 1001)

8:00 a.m. - 9:00 a.m. **Registration and posters**

9:00 a.m. - 9:15 a.m. **Welcome and introductions**

9:15 a.m. - 12:15 p.m. **Keynote Papers**

9:15 a.m. - 10:00 a.m. 1) **Quetico-Boundary Waters Wilderness Canoe Area: Research, Planning and Management – Past, Present and Future**
Roger Suffling[1] and Robin Reilly[2]
[1]Professor, School of Planning, University of Waterloo
[2]Superintendent, Quetico Provincial Park, Ontario Parks

2) **The Lake Superior National Marine Conservation Area: Research, Planning and Management – Past, Present and Future**
Gail Jackson
Project Manager, Lake Superior NMCA candidate, Parks Canada

10:00 a.m. - 10:30 a.m. **Commentary and questions**

10:30 a.m. - 11:00 a.m. **Break**

11:00 a.m. - 11:45 a.m. 3) **Protected Areas and the Conservation of the Boreal Forest: the Contributions of Research Past, Present and Future**
Bob Payne
Professor, School of Outdoor Recreation, Lakehead University

4) **Protected Areas, Research, Recreation and Tourism in Northern Ontario**
Mike Yuan
Associate Professor, School of Outdoor Recreation, Lakehead University

11:45 a.m. - 12:15 p.m. **Commentary and questions**

12:15 p.m. - 1:30 p.m. **Lunch**

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1:30 p.m. - 3:30 p.m. **Panel Discussion**

Tourism and Protected Areas: Planning Challenges and Research Needs in Northern Ontario, **including a commentary and question time period**

- David Carruthers, *The Nature Conservancy of Canada*
- Norman McIntyre, *School of Outdoor Recreation & Tourism, Lakehead University*
- Robin Reilly, *Quetico Provincial Park, Ontario Parks*
- Keith Wade, *Pukaskwa National Park, Parks Canada*
- Margaret Wanlin, *Community Economic Development Consultant*

3:30 p.m. - 4:00 p.m. **Break**

4:00 p.m. - 4:30 p.m. **Rappoteurs' Review and Commentary**

1) Steve Murphy, *University of Waterloo*
2) Harvey Lemelin, *Lakehead University*

4:30 p.m. – 5:00 p.m. **PRFO 2003-2005: A Report & Questions**

5:00 p.m. - 6:30 p.m. **Break**

6:30 p.m. - 7:00 p.m. **Cash Bar**

7:00 p.m. - 9:00 p.m. **Dinner at Old Fort William**

Speaker: Ernie Epp, Department of History, Lakehead University

Live Music provided by *Kam Valley Fiddlers*

Free time

Day 2 – Wednesday, May 5, 2004

8:00a.m. – 9:00a.m. **Registration and Posters**

9:00a.m. – 10:30a.m. **Concurrent Sessions of Volunteered Papers**

Session 1: **Climate Change** (ATAC 1010)

Session 2: **International Perspectives** (ATAC 1007)

Session 3: **Monitoring** (ATAC 2019)

Session 4: **Implications & Approaches to Disturbances** (ATAC 2021)

10:30a.m. – 11:00a.m. **Break**

11:00a.m. – 12:30p.m. **Concurrent Sessions of Volunteered Papers**

Session 5: **Species, Distributions & Change** (ATAC 1010)

Session 6: **Integrative Approaches** (ATAC 1007)

Session 7: **Fire & Management** (ATAC 2019)

Session 8: **Tourism & Recreation** (ATAC 2021)

12:30p.m. – 1:30p.m. **Lunch**

1:30p.m. – 1:45p.m. **Welcome and Introduction**
Dan Mulrooney, *Ontario Parks*

1:45p.m. – 2:45p.m. **Presentation of the report:**
A Study of the Social and Economic Benefits Associated with the Nine OLL Signature Sites
Phil Shantz, *SENES Consultants Limited*
Will Wistowsky, *University of Guelph*

2:45p.m. – 3:00p.m. **Break**

3:00p.m. – 3:30p.m. **Commentary**
Len Hunt, *Ontario Ministry of Natural Resources*

3:30p.m. – 4:00p.m. **Commentary**
Peter Boxall, *University of Alberta*

4:00p.m. – 4:30p.m. **Plenary Discussion with audience and presenters**

4:30p.m. – 5:00p.m. **Wrap-up**

Concluding rapporteur's assessment
Clem Reid, *Ontario Ministry of Natural Resources*

Wrap-up comments
Dan Mulrooney, *Ontario Ministry of Natural Resources*

Free evening

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Day 3 – Thursday, May 6, 2004

PRFO Field Trip Itinerary - Lake Superior North Shore (Thunder Bay to Rossport)

8:30 a.m. Depart: Lakehead University

Stop 1: Terry Fox Monument: view of Thunder Bay

Stop 2: Wild Goose Park, Shuniah Township: Cottages and public land along the Thunder Bay Shore

Stop 3: Sleeping Giant Provincial Park: Visitor Centre and Silver Islet and lunch

Stop 4: Red Rock Inn: Tourism and the Lake Superior NMCA

Stop 5: Kama Hill Overlook: Lake Superior NMCA

Stop 6: Gravel River Conservation Reserve: new protected area

Stop 7: Pays Plat First Nation: First Nations and protected areas

Stop 8: Rossport: Lake Superior NMCA, Great Lakes Heritage Coast, Ecotourism

4:30p.m. Return: Lakehead University

Appendix D: Participant Contact Information

Conference delegates as of April 27, 2004.

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Appendix E: Participation Benefits to PRFO Members

A Brief History of the Parks Research Forum of Ontario

In March, 1996, an inaugural meeting to discuss research on parks and protected areas in Ontario was convened by the Heritage Resources Centre, University of Waterloo; the Frost Centre for Canadian Heritage and Development Studies; Ontario Parks; and Parks Canada (Ontario Region). This meeting was held at Buckhorn Lake near Peterborough. About 50 invited people from government, business, universities and non-government organizations attended the meeting and a set of Proceedings was published (Lawrence and Nelson, 1996). This meeting led to the creation of the Parks Research Forum of Ontario (PRFO).

Goal and Objectives of PRFO

The goal of PRFO is to encourage research relating to parks and protected areas and its application to understanding, planning, management and decision-making. This goal is to be achieved through the following objectives:

1. Promoting research to improve understanding, planning, management, and decision-making for parks and protected areas;

2. Encouraging educational and training activities relating to parks and protected areas;

3. Facilitating more co-operation in parks and protected areas research;

4. Establishing a meeting place for people involved in parks and protected areas research;

5. Exchanging information on a regular basis among people involved in parks and protected areas research; and,

6. Monitoring and reporting on research on parks and protected areas.

In its work to date, PRFO has operated in a manner that seeks to respond to the needs of concerned government and non-governmental organizations and other participants in the following ways:

- ***Collaboratively*** by providing an interactive research forum that combines a fine-tuned cooperative spirit with operational independence.
- ***Inclusively*** by coordinating core partners, and operating in an inclusive manner to engage the broad fraternity of protected area interests.
- ***Objectively*** by committing to an open and neutral approach to research relating to parks and protected areas.
- ***Topically*** by being responsive to highest priority needs, such as park system design, ecological integrity, heritage stewardship and monitoring.
- ***Productively*** by timely publication of conference proceedings to broadcast relevant results to the widest audience.
- ***Efficiently*** by combining core financial support together with other income and in-kind contributions.
- ***Excellently*** by striving to maintain the highest level of quality in all endeavours and promoting a high standard of research.
- ***Significantly*** by taking up an important and unique intermediary position among government, universities and the private sector through provision of a research forum and through networking, reporting, knowledge transfer and professional development.

PRFO has just completed a very successful seventh-year of operation. From its beginnings in 1996, PRFO has grown to be an important and recognized forum for research exchange and networking about parks and protected areas among academics, professionals and concerned citizens.

Annual General Meeting

Six major annual general meetings (AGMs) have been hosted by PRFO, including: *Parks and Protected Areas in the Canadian Shield: Information and Research Needs* (Nelson *et al.,* 1998); *Challenges to Parks and Protected Areas in Southern Ontario* (Pollack-Ellwand *et al.,* 1999); *Managing Protected Areas in a Changing World* (Bondrup-Neilsen *et al.,* 2000); *Ecological Integrity and Protected Areas* (Porter *et al.,* 2002); and, *Protected Areas and Heritage Coastal Ecosystems* (Lemieux *et al.,* 2003). In 2003, approximately 170 people participated in the PRFO AGM on *Protected Areas and Watershed Management* (Lemieux *et al.,* 2004), hosted by the University of Western Ontario. On average, about 130 individuals have attended these AGMs with 430 attending the 2000 Science and the Management of Protected Areas Association SAMPAA/PRFO joint conference. The table of contents for each proceedings can be downloaded from the PRFO website (www.prfo.ca). Copies of each proceedings can be ordered through the PRFO secretariat the University of Waterloo. The theme of the PRFO 2004 AGM, at Lakehead University, Thunder Bay, May 6 – 8, is *Planning Parks and Protected Areas in Northern Ontario: Challenges, Opportunities and Research Needs*.

The Proceedings demonstrate the value of research on parks and protected areas and the role of PRFO and its AGM. The Proceedings reflect the desire to receive and disseminate research that is in various phases of completeness. The intent of the Proceedings is to encourage communication and co-operation among researchers in universities, government and private situations and to stimulate research and its use for the benefit of parks and protected areas and society in Ontario as a whole.

Algonquin Provincial Park Research Symposia

In addition to hosting its own AGMs, PRFO has participated in three Algonquin Provincial Park Research Symposia These are the 2000 Algonquin Forest Wildlife Symposium (170 participants), 2002 Algonquin Fisheries Symposium (70 participants) the 2003 symposium on Social Science and Research in Parks and Protected Areas (80 participants). Out of these Symposia have come two Occasional Papers (Quinn and Mason, 2000 and Parker *et al.,* 2001) which provide abstracts pertaining to the respective Symposium theme. These publications were completed collaboratively by PRFO and Ontario Parks and provide interested individuals with the opportunity to follow up with park staff and authors on the research topics presented in the publications. The third Occasional Paper on *Social Science in Parks and Protected Areas* is currently in preparation. The main benefit of these publications is that they make Algonquin research more widely known to the parks and protected areas community. Such research is of value for its own sake and also in contributing to better planning, management and decision making. The nature of PRFO's participation in these Symposia has included assistance with coordination and sponsorship, and with publication of Symposia Proceedings.

State of the Art Workshops

In 2004, a State of the Art Workshop on *Climate Change and Ontario's Parks* was hosted by Ontario Parks and PRFO at the Leslie Frost Research Centre in Dorset, Ontario. The aim of the workshop was to explore the evidence for climate changes, the uncertainties involved, and the measures that have been taken and might be taken to adapt to them. Over 40 persons participated in the workshop which was primarily intended for Ontario Parks' park managers and other senior staff. The workshop provided participants with the opportunity to gain state of the art knowledge about climate change as it bears on their current and future responsibilities. Given the success of this workshop, future State of the Art Workshops are currently being considered by the PRFO Steering Committee.

Steering Committee Management Structure

Currently, PRFO is led by a Steering Committee consisting of a representative of each of the member institutions, which as of 2004 included: Ontario Parks; Parks Canada; Environment Canada's Ecological Monitoring and Assessment Network (EMAN); and, the Universities of Waterloo, Trent, York, Western Ontario, Guelph.

The Canadian Council on Ecological Areas (CCEA) and Lakehead University are currently observers to PRFO. Traditionally, the Steering Committee has met at least twice a year since inauguration to plan the annual meetings, review finances and budget, and also arrange for the publication of the proceedings.

The chair and the Secretariat of PRFO have operated in association with the Heritage Resource Centre at the University of Waterloo. They have had annually responsibility for:

1. Organization and preparation of Steering Committee meetings and other consultations;
2. Planning and preparation of documents including the proceedings of the annual meeting;
3. The editing, typing, publication, marketing and distribution of the proceedings;
4. Advertising, registration and marketing of the annual meeting;
5. Budget control, financial accountability and reporting; and,
6. Maintaining the mailing list and other records of PRFO.

Ontario Parks and Parks Canada representatives on the Steering Committee have been especially supportive in regard to planning, marketing and publication. Generally, the local arrangements for the annual meetings have been the responsibility of the host university (1998: Trent, 1999: Guelph, 2000: Waterloo, 2001: York, 2002: Ridgetown/Guelph, 2003: Western Ontario, 2004: Lakehead). The Heritage Resources Centre has, however, generally provided organizational, student and other assistance for the local arrangements.

The Role and Responsibility of PRFO Members

Financial support is provided through the contribution of a PRFO membership fee. This is a critical aspect of participation that provides the PRFO Steering Committee with the means to pursue various initiatives. It is recognized that not all participants are equal in their ability to contribute financially. Consequently, four participation categories have been created for university members, which include:

- Full University Members $3000 (3 year membership);
- Interim Members $1000 per year;
- Observers (no fee: limited range of participation); and,
- Government and Institutional members: subject to negotiation.

In-kind support has been provided through participation of the Steering Committee members or other interested persons in planning or implementation of PRFO activities. Although difficult to quantify, such contributions are invaluable to success by providing the proverbial "grease" to the wheel. Hosting annual meetings or workshops is, for example, often accompanied by additional administrative and coordination tasks, as well as arrangements for potential speakers for events.

Benefits of Membership

The benefits include:

- Participating in planning for parks and protected area research in Ontario;
- Involvement in planning and implementation of PRFO annual meetings, which include a theme day, an open session for volunteered papers and a workshop;
- Involvement in the publication of research results from the annual meeting and other activities;

- Involvement in convening and attending meetings as well as publishing proceedings from other activities such as State of the Art Workshops;

- Involvement in the exchange of information relating to research via the PRFO website, electronic communication and networking generally;

- An opportunity to meet academics, government employees, NGO members and others concerned about research and its role in parks and protected areas;

- Opportunities to provide learning and research opportunities for graduate and undergraduate students; and,

- Opportunities to host PRFO meetings and contribute directly to research relating to parks and protected areas in Ontario and elsewhere.