PRFO

Parks Research Forum of Ontario

Parks and Protected Areas Research in Ontario 2002

Proceedings of the
Parks Research Forum of Ontario (PRFO) Annual Meeting 2002

Ridgetown College
April 25, 26 & 27, Ridgetown, Ontario

Includes Special Theme Session on:
Protected Areas and Heritage Coastal Ecosystems

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Edited by:

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Published by:

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Cover designed by: Christopher J. Lemieux, PRFO
Cover photo: OMNR Archive Photo

National Library of Canada Cataloguing in Publication

Parks Research Forum of Ontario. Meeting (2002 : Ridgetown, Ont.)
Parks and protected areas research in Ontario, 2002 : proceedings of the Parks Research Forum of Ontario (PRFO) annual general meeting, April 25-27, 2002, Ridgetown, Ontario / edited by Christopher J. Lemieux, J. Gordon Nelson and Tom J. Beechey.

Includes bibliographical references.
ISBN 0-9684655-8-7

1. Parks—Research—Ontario—Congresses. 2. Natural areas—Research—Ontario—Congresses. I. Lemieux, Christopher J., 1977- II. Nelson, J. G. (James Gordon), 1932- III. Beechey, Tom J., 1946- IV. Title.

QH77.C3P374 2002 333.78'3'0720713 C2003-902459-8

Acknowledgments

PRFO 2002 was held at the University of Guelph, Ridgetown Agricultural College from May 25th to 27th, 2002. The theme was Protected Areas and Heritage Coastal Ecosystems and a number of interesting papers were presented on that topic for which we owe the authors many thanks. We are also in debt to the Panelists and other commentators who participated in the theme day on Heritage Coastal Ecosystems. We also owe thanks to the many government staff, faculty, student and other researchers who participated in the volunteered paper sessions which are normally presented on Day 2 of the PRFO Annual Meeting.

Many other people attended the conference and participated in the discussions on both days of the conference. It is always a pleasure to see so many people expressing their interest and support for research on protected areas and other related topics. Protected Area policies, programs and practices require and will benefit from the multidisciplinary research that PRFO hosts each year. The role of PRFO as a forum for research relating to protected areas is a unique one in Ontario linking government, university, college, non-government and other concerned groups which can all benefit from the results of collaborative efforts.

Ontario Parks and Parks Canada are the major supporters of PRFO and these agencies are due very special thanks. In this regard, it should be noted that two long-time practicioners and supporters of research on Protected Areas received Outstanding Conribution Awards at PRFO 2002. Both are founding members of PRFO and we look to them for continued involvement even in retirement in the years ahead. So particular thanks are due to Tom Beechey and Bill Stephenson of Ontario Parks and Parks Canada respectively.

We would also like to recognize the attendance at PRFO 2002 of about thirty senior high school students from Ridgetown and the Waterloo Region. These students participated in the discussions and also joined in a field trip to Rondeau Provincial Park, Clear Creek Nature Reserve and other nearby areas following the regular conference. We thank Mathis Natvik very much for sharing his deep knowledge of the ecology of these areas with the students and others on the field trip.

The Appendix to these proceedings contains a report and plan for PRFO for 2003-2005. This plan was worked out by members of the Steering Committee during 2001-2002. All the member universities, Ontario Parks, and Parks Canada, have agreed to the plan and are committed to its success. Outside of the Steering Committee, Barton Feilders, Manager Ontario Parks, was a key supporter of the plan and associated funding. We are very greatful to him as we are to the other principal supporter, Parks Canada.

Numerous people assisted in the planning and implementation of the 2002 Conference. Profound thanks are offered to Jim Porter, then co-ordinator of PRFO, for his outstanding work in preparing the 2001 Proceedings and for his stellar efforts in organizing the meeting and promoting attendance, with over 100 people participating, even in the face of a work stoppage by provincial employees. Jim has since left PRFO and we wish him great success in the future. Other volunteers who helped with conference arrangements were Chris Lemieux, Cynthia Franklin, Stephanie Janetos, Beth Dempster and Eric Tucs.

Chris Lemieux is the new co-ordinator of PRFO. He has played a principal role in preparing the Proceedings of PRFO 2002 as well as serving in numerous other ways. Tom Beechey is also due thanks for providing important editorial assistance in preparing these 2002 Proceedings. His insights and suggestions certainly improved the volume. Finally, as Chair, I would like to offer thanks to the members of the Steering Committee without whose help PRFO would be impossible. Two new members joined PRFO in 2002-2003. We welcome Brian Craig of Environment Canada's Ecological Monitoring and Assessment Network (EMAN) and Michael Troughton of the University of Western Ontario. Michael has taken on the task of leading local arrangements for PRFO 2003 at London and we appreciate this very much. In 2002-2003, our accounting arrangements have improved considerably and we offer many thanks to Dolly Coelho who assisted PRFO and its host, the Heritage Resources Centre (HRC).

In closing, we recognize that not everyone who helped PRFO in the past year or so likely has been or could be recognized. We are all in debt to many people. I hope we continue to receive strong support in our effort to facilitate research on Protected Areas and so contribute to nature conservation, recreation and sustainable development in Ontario and elsewhere.

J.Gordon Nelson, Chair of the Parks Research Forum of Ontario (PRFO) and the Heritage Resources Centre, University of Waterloo

PRFO Steering Committee and Members include:

Barton Feilders, Ontario Parks
Bob Davidson, Ontario Parks
Bill Stephenson, Parks Canada
Tom Beechey, Canadian Council on Ecological Areas
Brian Craig, Ecological Monitoring and Assessment Network (EMAN), Environment Canada
Michael Troughton, University of Western Ontario
John Marsh, Trent University
Dawn Bazely, York University
Tom Nudds, University of Guelph
Bob Payne, Observer - Lakehead University

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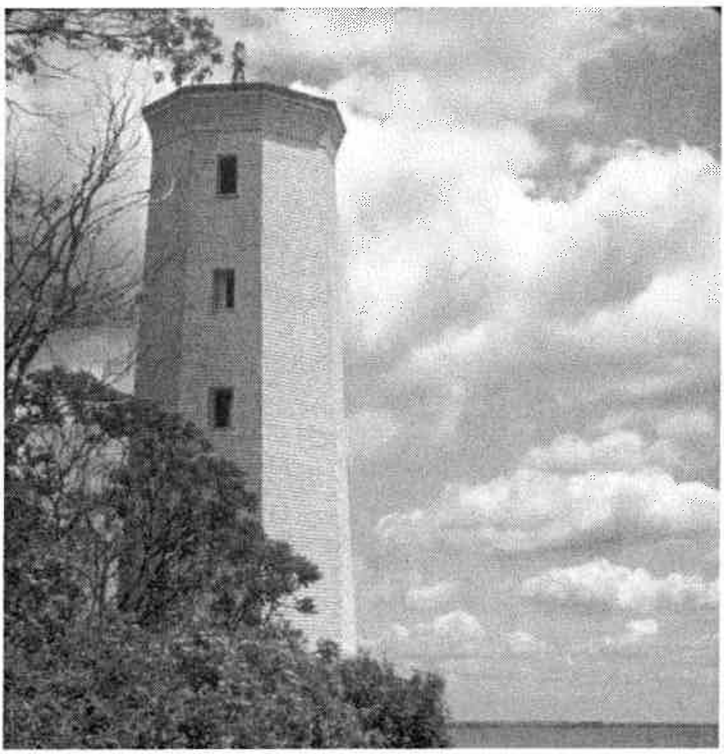

Early lighthouse at Presqu'ile Provincial Park (T. Beechey)

Protected Areas and Heritage Coastal Ecosystems

Theme Session of the
2002 Parks Research Forum of Ontario
PRFO

Heritage Coastal Ecosystems and Protected Areas are critical defining and influencing features of environmental protection around the Great Lakes Region and in Ontario. Many examples of provincial protected area designations can be found on Ontario's coasts. They are areas rich in history, culture and ecology, and are valuable places for the pursuit of research, protection and stewardship. Their multi-jurisdictional management characteristics create a context that not only encourages, but necessitates sharing and collaboration among academics, governments, non-government institutions and citizens. The exploration of Heritage Coastal Ecosystems and Protected Areas is a vital component in achieving a better understanding of environmental protection and sustainability in Ontario and the role of Protected Areas research in that context.

With these thoughts in mind, the Parks Research Forum of Ontario took Heritage Coasts as the topic for the theme day of its 2002 Annual Conference in Ridgetown. The conference was attended by more that 100 people, and engendered lively discussion and participation not only on the Heritage Coasts theme but on the more than 30 papers on protected area topics presented on the second day of the conference. For the first time, a group of about 30 students from the Kitchener-Waterloo and Ridgetown areas participated in the conference as part of a Civic Youth Exchange Program led by Kitchener and Ridgetown Rotary Clubs in association with PRFO.

All in all, the conference was a big success as a reading of this rich set of papers and commmentary will show.

J. Gordon Nelson, *Chair, PRFO Steering Committee*

Special Session on Protected Areas and Heritage Coastal Ecosystems

Sleeping Giant Provincial Park (D. Cuddy, OMNR Archive Photo)

Great Lakes Protected Areas in Ontario: A Celebration with A Challenge*

Tom J. Beechey
Nature Matters, The Conservatory

Abstract

North America's Great Lakes showcase extraordinary natural diversity with a remarkable array of environments and ecological conditions, many of which are unique to this region. The vast coastal region is a virtual kaleidoscope that merges billions of years of earth history with an impressive record of evolutionary development. The coastal area houses an impressive heritage estate featuring many significant foundation parks and other protected areas that represent well the terrestrial environments and ecological diversity of the region. The less robust representation of marine environments and conditions requires more research and concerted conservation attention. This paper combines a synopsis of the region's natural heritage with a pictorial essay of some of its more outstanding parks and other protected areas to celebrate this Great Lakes legacy and to encourage efforts to preserve it.

Introduction

Like a stunning giant oasis, the Great Lakes sit at the heart of North America, within daily motor access of more than 100 million people. The Great Lakes basin is the single largest reservoir of freshwater in the world, with Lakes Superior, Michigan, Huron, Erie, Ontario and their connecting water bodies housing 20 per cent of the world's freshwater. If fully unravelled, the Great Lakes coastline would more than extend across Canada. This vast coastal region provides a unique window into the Precambrian Shield of central Ontario, the St. Lawrence Lowlands underlying southern Ontario, and the ecosystems, flora and fauna of the associated ecological regions. Altogether, the Great Lakes feature an extraordinary array of natural heritage attributes (Table 1).

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* This paper was not presented at PRFO 2002. This introductory photo essay was added to illuminate the PRFO 2002 Proceedings.

Table 1. Selected extraordinary heritage attributes of the Great Lakes.

- the single largest reservoir of freshwater in the world
- the longest continuous freshwater coastline on Earth
- Lake Superior, the largest freshwater lake on the globe
- the world's largest freshwater island, Manitoulin Island
- Caribou Island, the world's most remote freshwater island
- St.Clair marshes, one of North America's largest freshwater deltas
- spectacular geological and geomorphological environments
- an exceptional concentration of freshwater islands and habitats
- a continental crossroads of ecological regions, flora and fauna
- many biogeographical ties with endemics and disjunct species
- highly diverse aboriginal cultural heritage and human history
- exceptional amenity, recreational and socio-economic values
- an outstanding network of parks and other protected areas

A Remarkable Heritage

The Superior basin encompasses rocks from most of the major subdivisions of the Precambrian Shield. Granitic and volcanic rocks of the Superior Province, which form the basement core of the Shield, occur along the shore of Lake Superior. Basaltic and volcanic rocks related to mid-continental rifting (a splitting apart of the continent) provide dramatic topography around Thunder Bay and Nipigon, where giant mesas and cuestas known as the 'Port Arthur Hills', dominate the topography. Along the east shore of Lake Superior, relatively unmodified, very fresh looking volcanic rocks are strongly banded and have created a serrated shoreline character.

The coastal area of Lake Superior is marked by cold deepwater habitats punctuated by shallows only in protected bays and inlets. Along the shore, dramatic cliffs and rugged bedrock shores are interspersed with shorelines of cobble, gravel and sand deposits, adding to the diversity of habitats for plants and animals. Along the north shore, the harsh attenuating effect of the lake is evident in the Boreal flavour of the coastal and inland forests between Thunder Bay and Wawa. In sharp contrast, the eastern side of Superior features transitional deciduous forests of sugar maple *(Acer saccharum)* and yellow birch *(Betula lutea)* dominating the till-mantled uplands, with Boreal forest largely confined to the valleys and topographic lows.

Owing to its location, diverse geology and harsh climate, the Superior basin exhibits many special features. Around the lake, on suitable substrates, 'colder-than-normal' sites sustain true arctic 'relict' communities with many disjunct plants that have persisted since deglaciation. Stranded glacial beaches sustain extensive, lichen gardens, believed to have survived since the decline of earlier post-glacial lakes. Woodland caribou (*Rangifer tarandus caribou*)—native to the region—persist in some areas with re-introductions in others. Other large herbivores and carnivores signify the true wilderness character of the region. The many islands around the lake enhance the habitat diversity of the coast, offering refugia for plants and animals including colonial nesting birds.

The North Channel of Lake Huron is dominated by sedimentary rocks of the Southern Province. These represent the deposition of sand, gravel and mud into a deep basin adjacent to the Shield. The most dramatic topographic expression of these rocks are the stunning quartzite hills and ridges of the La Cloche mountains. There is evidence in the rocks of the Southern Province that glacial periods were common during this time. In contrast, the Georgian Bay coast shows highly deformed gneissic and migmatitic rocks of the Grenville Province. This represents the core of a mountain chain that was built here a billion years ago during the collision of two continental masses. This area is very smooth and flat due to the relatively equal resistance to erosion of all of the rocks in the Grenville, and the great time of its erosion.

The North Channel and Georgian Bay is arguably the most diverse ecological region in the Great Lakes basin. The transition between the Boreal and Great Lakes regions associated with variations in physiography and ecological conditions, gives rise to diverse forests punctuated with wetlands, alvars and coastal habitats. Many of Ontario's finest alvars occur in the region, along with a predominance of Atlantic coastal plain plants and Great Lakes endemics. The numerous islands create a complex terrestrial and aquatic matrix, featuring numerous shallow aquatic habitats in the countless bays and inlets, and remote settings that provide refuge for colonial nesting birds.

South of the Canadian Shield, the geology consists of Palaeozoic rocks which are expressed most dramatically in the Bruce Peninsula, the mainland terminus of the Niagara Escarpment which extends in Ontario from Niagara Falls through Manitoulin Island. The carbonate-rich rocks of this complex, which links Michigan with New York state, represent the shallow-water deposition of reef-building animals into a warm marine environment some 450 million years ago. Its expression throughout the Bruce Peninsula and associated islands offers many opportunities to appreciate the Niagara Escarpment and its influence in determining distinctive patterns of vegetation communities and habitats.

Beyond the Bruce Peninsula, the flat lying sedimentary beds are exposed only sporadically along the coast of the lower Great Lakes, most notably in the Erie Archipelago where they house significant fossil exposures, and Prince Edward County where they contrast with the Frontenac Axis, a tongue of Precambrian bedrock which extends into New York state. Around the lower lakes—Lakes Huron, Erie and Ontario—the coast line cross-cuts extensive glacial and meltwater features and pervasive shoreline and lacustrine deposits associated with earlier post-glacial lakes.

The Lower Lakes bridge two major forest regions—the Carolinian region extending north of Lake Erie for approximately 100 kilometres inland between Sarnia and Toronto, and the Great Lakes-St.Lawrence Forest Region extending beyond the Carolinian region onto the Canadian Shield. The ameliorating climatic influence of the lower lakes—especially Lake Erie—is a key factor in the extent of the Carolinian region, which once featured extensive rich deciduous forests interspersed with open woodlands, savannahs and prairies. Since pre-settlement times, these ecosystems have been drastically reduced to pockets of remnants so that the coastal area—like the interior—is now almost totally dominated by agricultural, rural and urban lands. This has placed added pressure on the survival of many southern species found nowhere else in Canada, giving this region the dubious distinction of housing more species at risk than any other in the nation.

The Great Lakes have been an important place of habitation since deglaciation. Numerous archaeological sites and pre-contact artifacts attest to extensive aboriginal occupation. The region's significant natural resources fueled European settlement, beginning with the fur trade, the early logging industry and agricultural development. Today, the Great Lakes remains a vital ecological and cultural asset, providing industry, recreation and amenity to many millions of people who reside in or vacation in the region. The unique ecological, social and economic perspectives associated with the Great Lakes have given rise to contrasting views and practices of stewardship and heritage preservation ranging from exploitation at one extreme to the highest order of amenity preservation at the other. This dichotomy is expressed most vividly in the juxtaposition of polluted and degraded environments alongside the elaborate network of coastal parks and other protected areas.

Protected Areas

Parks and protected areas around the Great Lakes comprise a world class heritage estate, with a lineage and maturity as impressive as the natural diversity of the region. The allure of 'big water' is reflected in many of the early foundation parks which were created along the coast: Ontario's first park—Queen Victoria Niagara Falls in 1887; Rondeau Provincial Park in 1894; Point Pelee National Park in 1918; Long Point Provincial Park in 1921; Presqu'ile Provincial Park in 1922; Lake Superior Provincial Park and Sibley (now Sleeping Giant) Provincial Parks in 1944; and Pukaskwa Wilderness Area in 1960 (later incorporated into Pukaskwa National Park) (Killan, 1993) (Figures 1 and 2). Most recently, the designation of the Great Lakes Heritage Coast, a signature site encompassing all of Ontario's Lake Superior coast and the north/east coast of Georgian Bay, caps more than a century of progress in preserving this Great Lakes heritage (O'Donoghue, this volume).

Today, examples of virtually every protective designation in Ontario are found within the extensive network of Great Lakes sites: First Nations lands, MAB reserves; CHRS designated rivers, national parks; provincial parks; national and provincial wildlife areas, conservation reserves; various natural heritage designations including areas of natural and scientific interest, wetlands, and sites for species at risk; park commission lands; conservation areas; municipal designations; and significant private holdings.

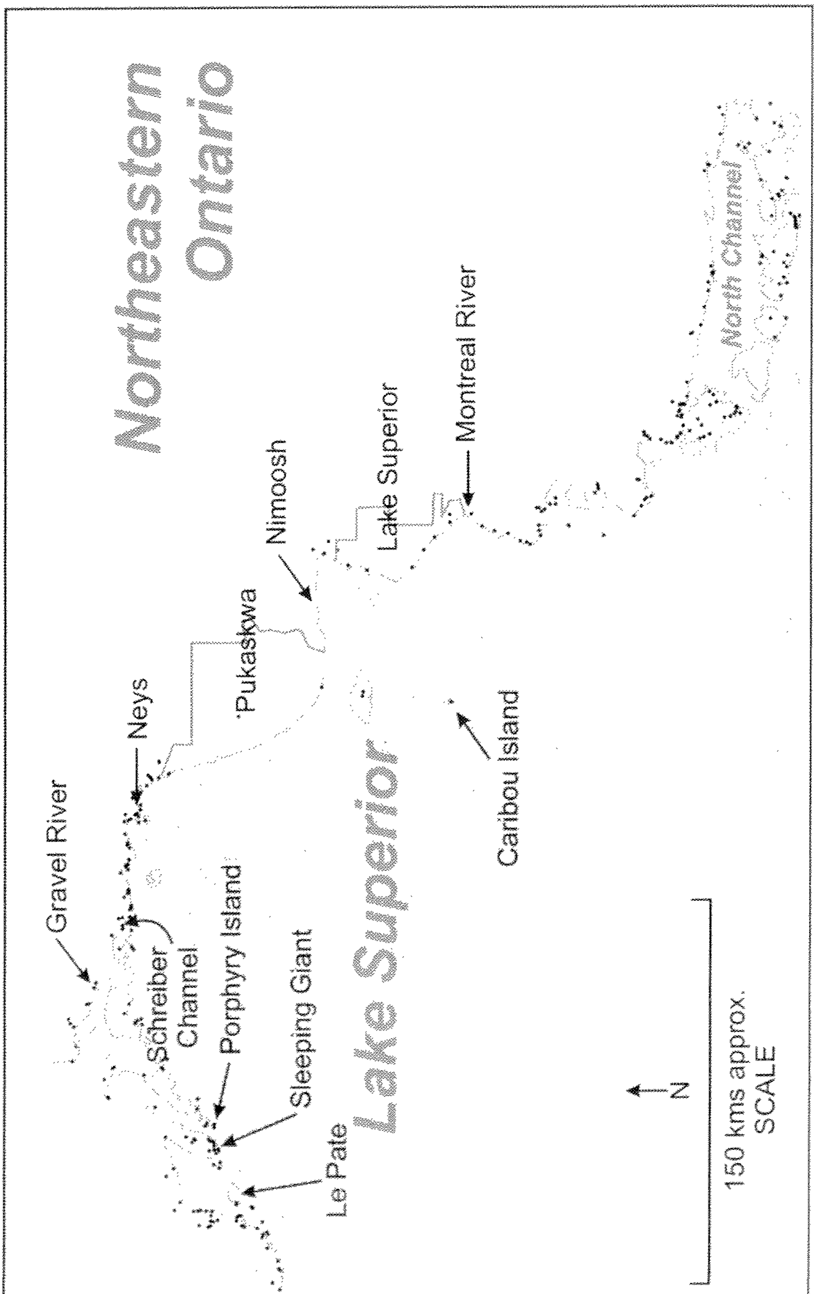
A Conservation Challenge

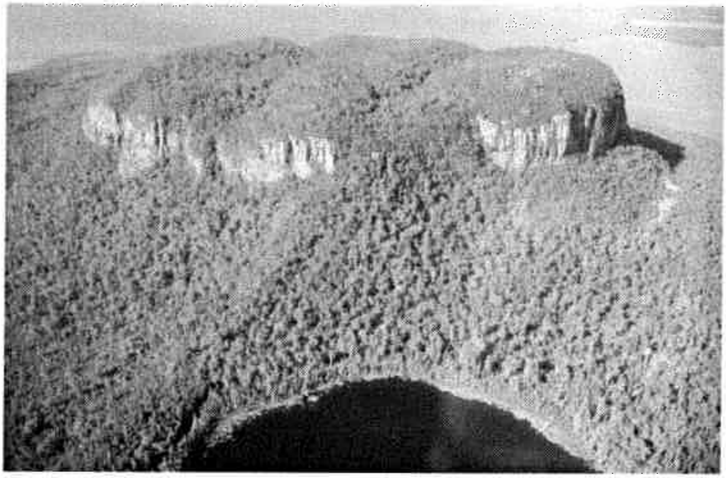
Notwithstanding the progress in establishing and managing coastal protected areas, much more remains to be done, especially on the aquatic side of the line. To date, only one formally protected 'marine conservation area'—Fathom Five National Marine Park—has been established on the Great Lakes. Many other existing coastal parks and protected areas include waterlots—some quite significant—within their regulated boundary. In many cases, more articulate policies and practices are required to protect and manage these aquatic zones. In addition, more aquatic areas still need to be designated in order to represent adequately the diversity of marine environments and ecosystems in the Great Lakes.

To meet the challenges of aquatic heritage conservation will require dedicated planning and research. More work is required in defining what constitutes an adequate system of aquatic protected areas in the Great Lakes from various perspectives including 'representation', 'special features' and 'ecological integrity'. In addition, further work is required to address the many special stewardship needs associated with protection, management and environmental monitoring. Foremost among these challenges is the need to better sort out jurisdictional responsibilities among the many stakeholders involved in the aquatic domain.

In celebration of achievements to date, and with encouragement to build upon this work, what follows is a pictorial essay of some of the most stunning, coastal protected areas around the Great Lakes (Figures 1 and 2).

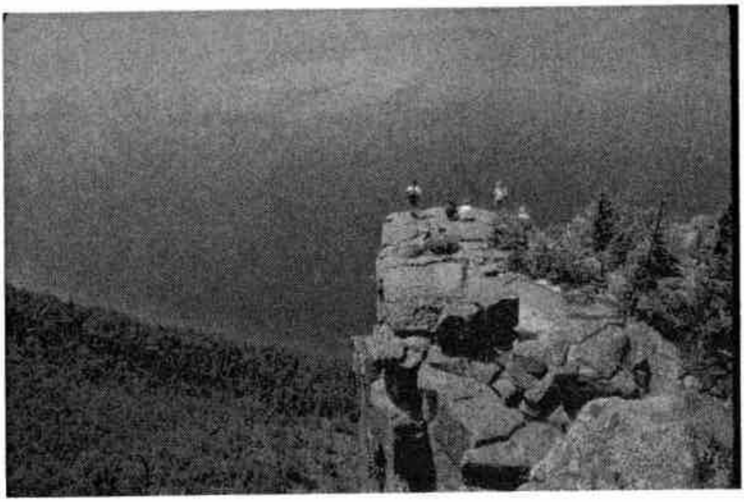
Figure 1. Featured Parks and Protected Areas with other Protected Sites in Ontario's coastal region of Lake Superior. Points depict centroids of sites on or within 5 kms of the coast. (Source: Natural Heritage Information Centre).





Le Pate, a tall isolated mesa on Pie Island, typifies the dramatic physiography of the 'Port Arthur Hills' around Thunder Bay. Le Pate Provincial Nature Reserve. (PSK)

The multiple mesa and cuesta landform complex at the tip of the Sibley Peninsula is personified as the 'Sleeping Giant' in local mythology. Sleeping Giant Provincial Park. (PSK)

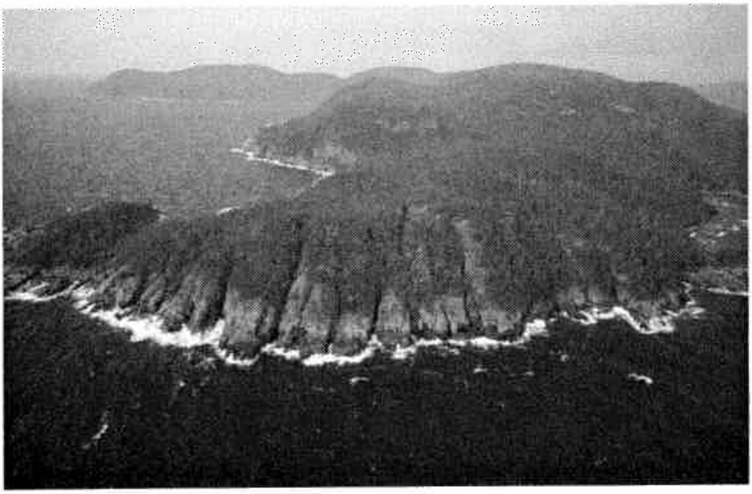


Lookouts on the Sibley Peninsula, 500 metres above Lake Superior, afford panoramic vistas of Lake Superior and the 'Port Arthur Hills'. Sleeping Giant Provincial Park. (M. Jones, OMNR Archive Photo)

Barren bedrock shores of ancient volcanic lava flows are typical of the island chain extending southwest from the Black Bay Peninsula. Porphyry Island Provincial Nature Reserve. (G. Merchant, OMNR Archive Photo)

The active bird's foot delta at the mouth of the Gravel River supports a dynamic complex of biotic communities. Gravel River Provincial Nature Reserve. (PSK)

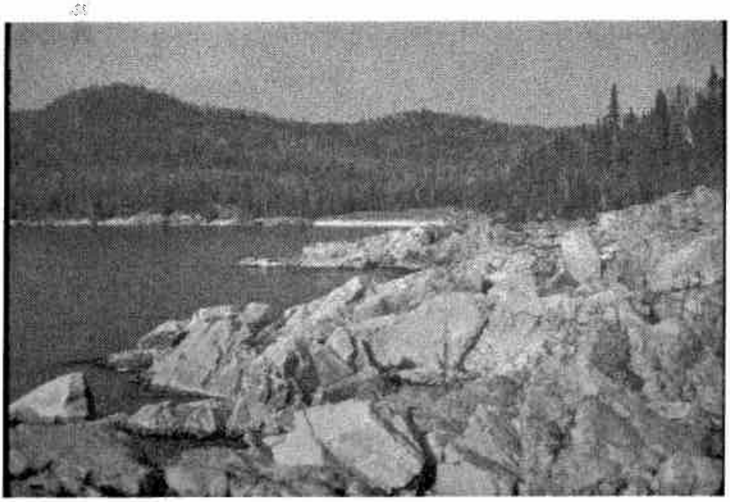
A small outcrop of Precambrian chert houses a community of world-renowned stromatolitic macrofossils (concentric imprints). Schreiber Channel Provincial Nature Reserve. (PSK)



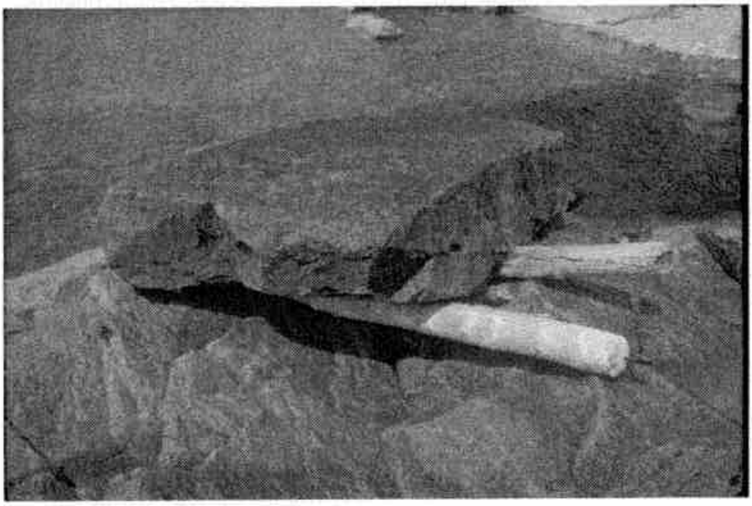
Detention Island is recognized for its spectacular topography and its concentration of post-Minong cobble beaches which ring the island's volcanic bedrock spine. Neys Provincial Park. (PSK)

Tundra-like ecosystems with arctic plants persist in colder-than-normal exposures on the north shore of Lake Superior. Neys Provincial Park. (Anon. OMNR Archive Photo)

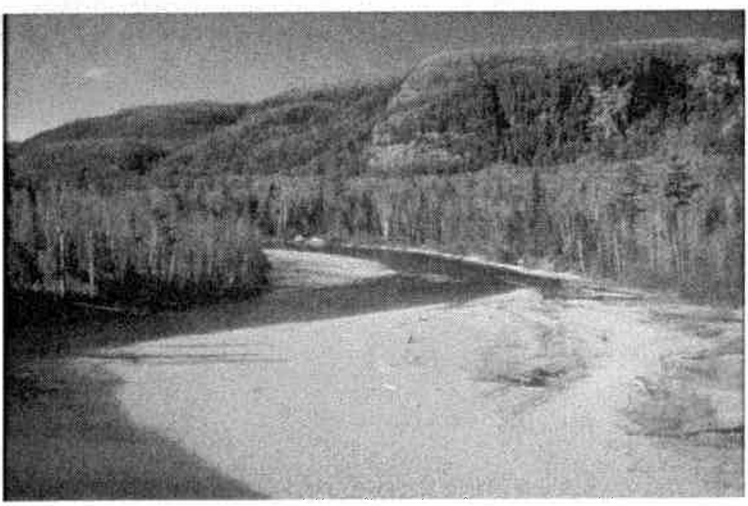
The sand spit and rock cliff at the mouth of the Dog River, which emerges from rolling, forested Precambrian Hills. Nimoosh Provincial Park. (PSK)



Rugged, ice-plucked bedrock shores with forested Precambrian hills are typical of the eastern Lake Superior coastline. Lake Superior Provincial Park. (TJB)



A massive boulder slab perched on driftwood timbers marks a high wave surge on Lake Superior. Lake Superior Provincial Park. (TJB)

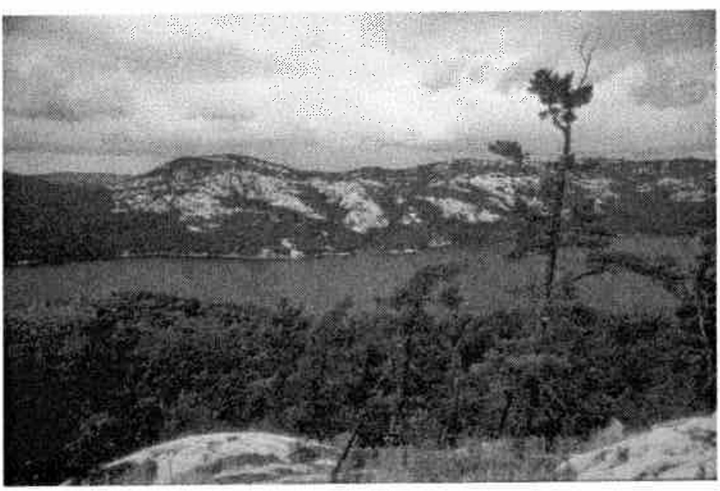


Rugged, forested Precambrian headlands, such as the Agawa River escarpment, mark many river mouths exiting into Lake Superior. Lake Superior Provincial Park. (TJB)

'Misshepezhieu' the swimming horned lynx in Ojibway lore, is one of numerous pictographs in many protected areas and other locales around Lake Superior. Lake Superior Provincial Park. (M. Sundland, OMNR Archive Photo)

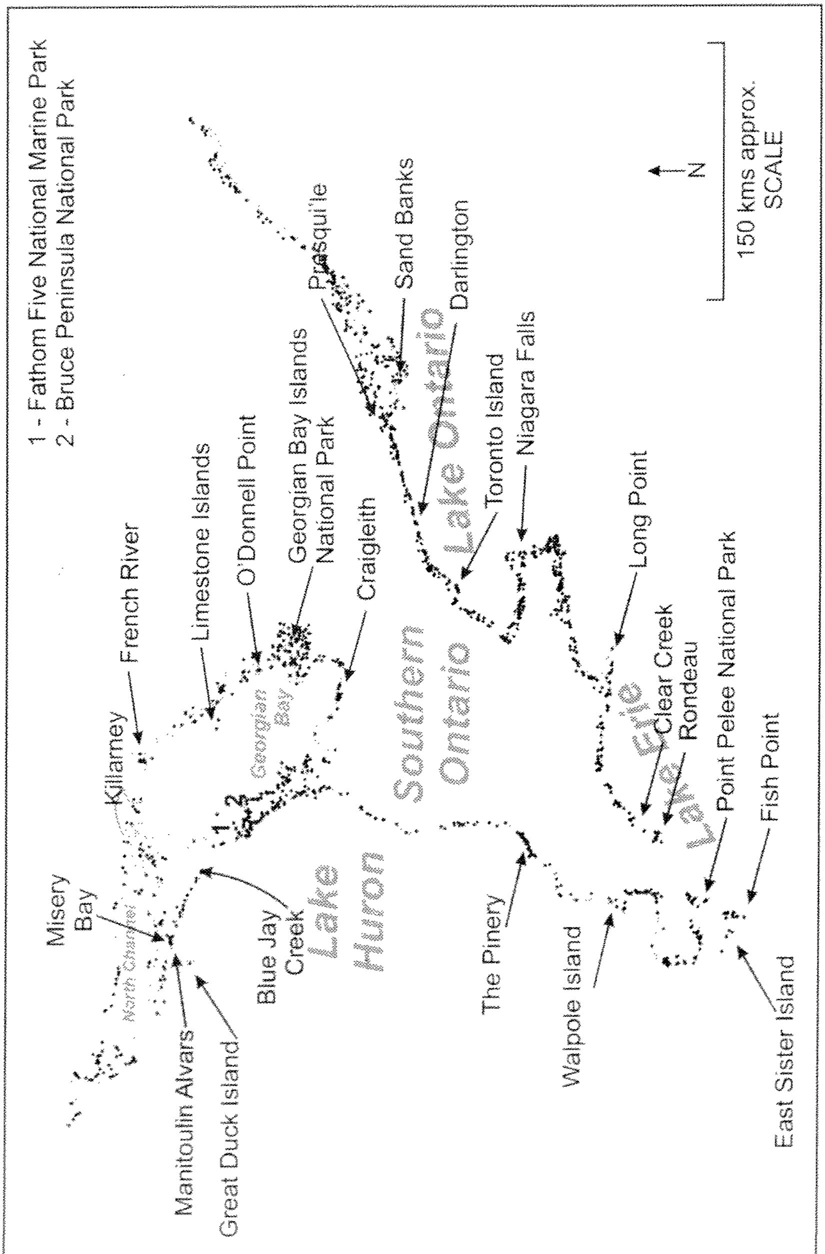
Raised cobble beaches with diverse lichen gardens mark the shorelines of post-glacial lakes in the Superior basin. Montreal River Provincial Nature Reserve. (G.Merchant, OMNR Archive Photo)

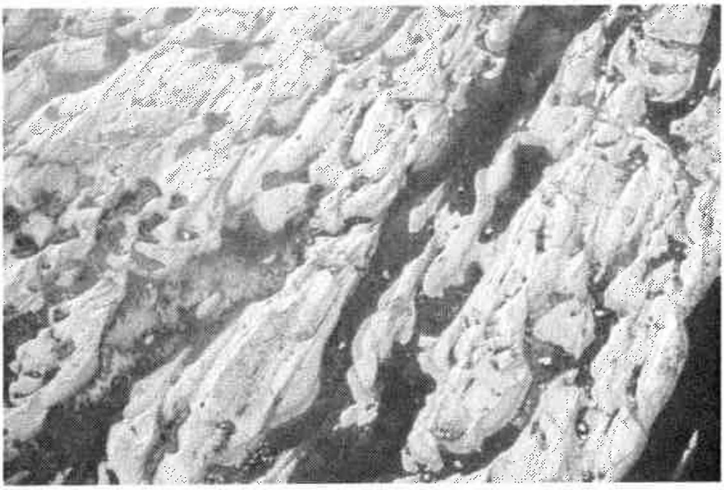
Caribou Island, an extensive, flat-lying sedimentary formation with boreal forest and wetlands, is the most isolated freshwater island in the world. Caribou Island Area of Natural and Scientific Interest. (PSK)



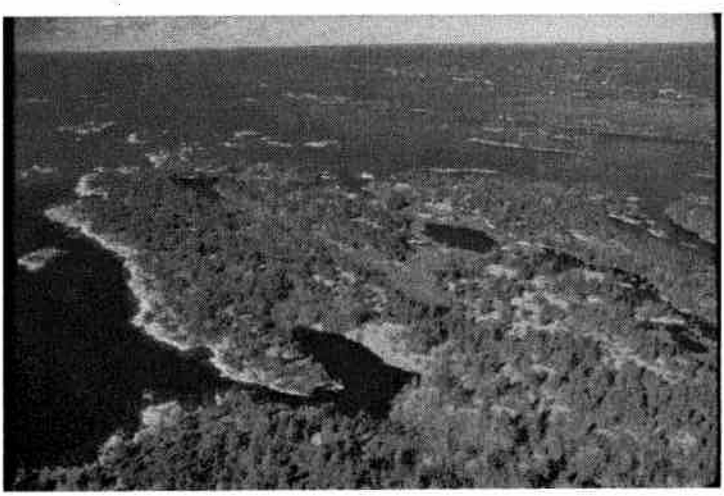
Magnificent 'Sphinx' ridges of ghostly Lorrain quartzite offer a magical aura to the La Cloche Hills on the North Channel of Georgian Bay. Killarney Provincial Park. (I.Macdonald, OMNR Archive Photo)

Figure 2. Featured Parks and Protected Areas with other Protected Sites in Ontario's coastal region of Georgian Bay, Lake Huron, Lake Erie and Lake Ontario. Points depict centroids of sites on or within 5 kms of the coast. (Source: Natural Heritage Information Centre).

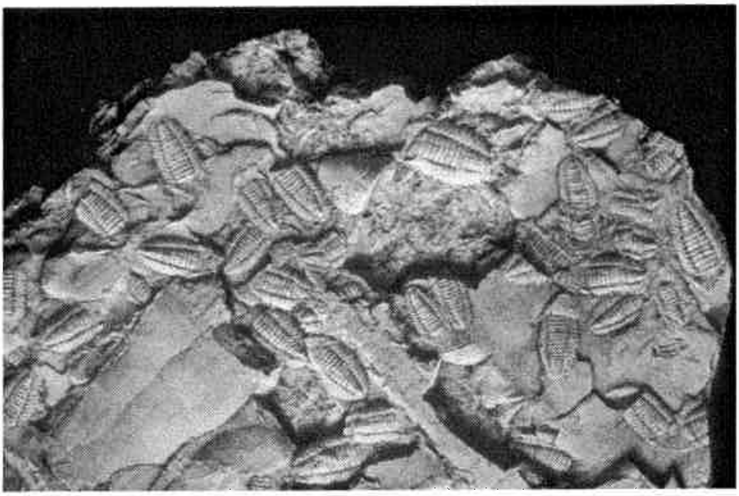




Aerial view of dramatic 'p-forms', unique meltwater sculpturing in the bedrock at the mouth of the French River. French River Provincial Park Additions. (PSK)



Georgian Bay coastal habitats are significant for populations of Great Lakes endemic and Atlantic Coastal Plain species. O'Donnell Point Provincial Nature Reserve. (PSK)



Palaeozoic exposures around the southern Great Lakes shorelines feature significant fossil exposures, such as these casts of trilobites (*Triarthus eatoni* Hall). Near Craigleith Provincial Park. (R. Ludvigsen, Royal Ontario Museum, OMNR Archive Photo)

Globally significant alvars adorn the extensive dolostone barrens around Belanger Bay on the south side of Manitoulin Island. Manitoulin Alvars. (TJB)

Alvar pavements and shrublands feature plants and animals well adapted to these highly stressed bedrock pavements. Misery Bay Provincial Nature Reserve. (TJB)

Blue Jay Creek enters Georgian Bay through a set of raised post-Nipissing offshore bars which support prominent ridge and swale communities. Blue Jay Creek Provincial Nature Reserve. (PSK)

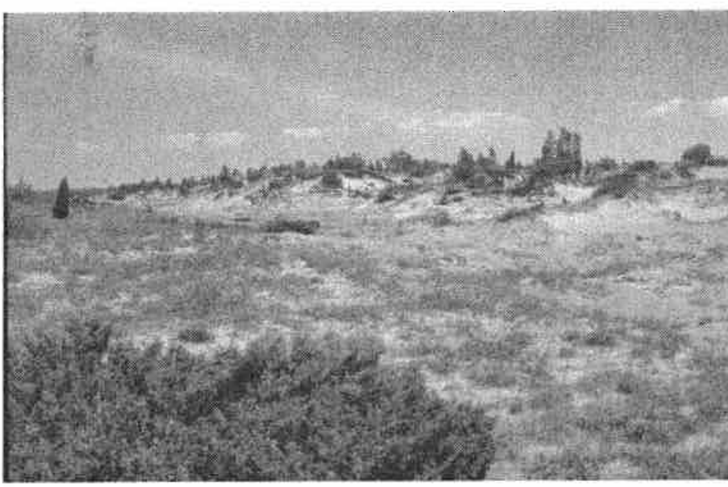
Boulder lags winnowed from thick till deposits populate shallow waters in many Great Lakes embayments. Great Duck Island. (TJB)

Northern tip of South Limestone Island showing the cobble/pebble spit and fossil-laden Paleozoic dolostone platform exploited by colonial birds. (PSK)

Escarpment and whale-back cuestas typify the eastern shore of the Bruce Peninsula and northern shore of Manitoulin Island. Bruce Peninsula National Park. (TJB)

Wave-washed glacial fluting of dolostone pavements mark the direction of ice flows and create habitat diversity on the west shore of the Bruce Peninsula. (D.Cuddy, OMNR Archive Photo)

Delicate calcareous gardens inhabit low, flat-lying bedrock shores, strewn with Precambrian erratics. West shore, Bruce Peninsula. (PSK)

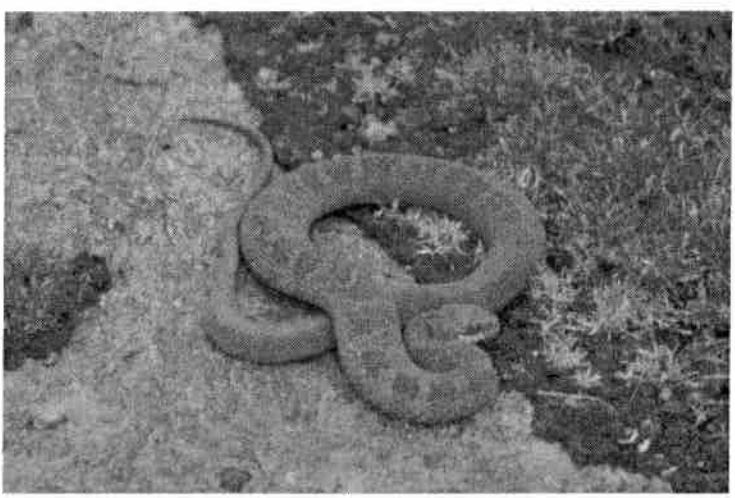


Dune systems trace the post-glacial development of shorelines and ecological succession around the Great Lakes. Pinery Provincial Park. (I.Macdonald, OMNR Archive Photo)

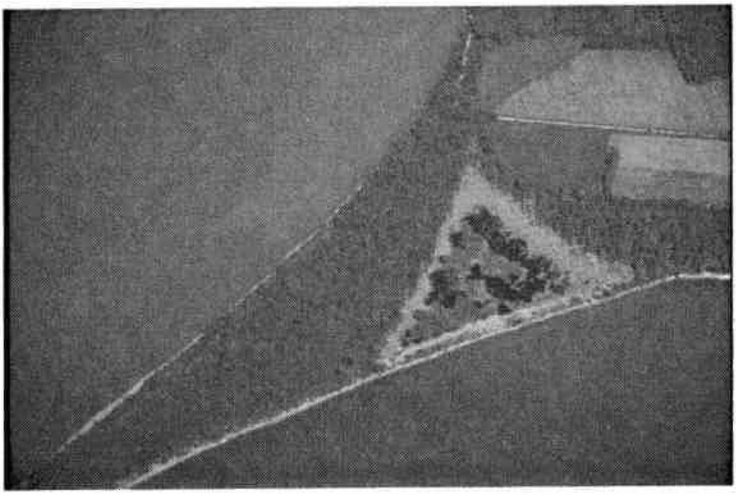
Boardwalks with bridges are utilized in many coastal dune systems to control pedestrian traffic and provide vantage points for viewing and interpretation. The Pinery Provincial Park. (TJB)

Rich lacustrine and alluvial deposits in southwestern Ontario harboured extensive luxuriant prairies and oak woodlands prior to white settlement. Walpole Island First Nation. (TJB)

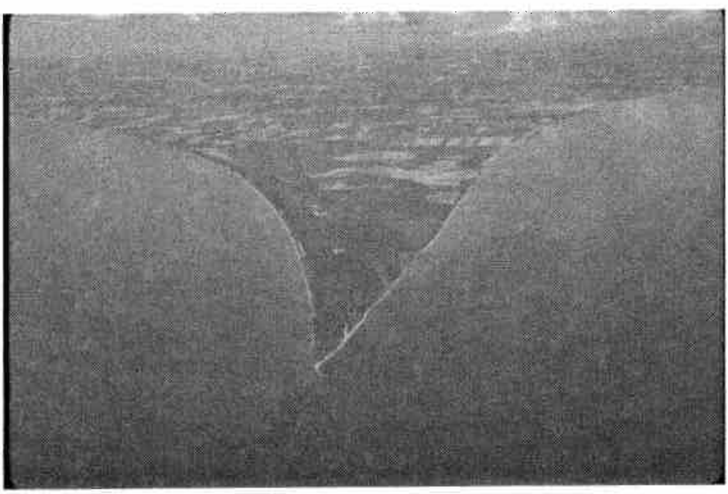
East Sister Island, one of the flat-lying limestone islands of the Lake Erie Archipelago, houses many Carolinian species. East Sister Island Provincial Nature Reserve. (J. Kamstra, OMNR Archive Photo)



Lake Erie water snake (*Natrix sipedon insularum*), a pale race of the northern water snake centred on the Lake Erie Archipelago. East Sister Island Provincial Nature Reserve. (P. Pratt, OMNR Archive Photo)



Fish Point, a sinuous sandspit on the southern tip of Pelee Island, features Carolinian forest and wetlands harbouring many southern plants and animals. Fish Point Provincial Nature Reserve. (J. Kamstra, OMNR Archive Photo)

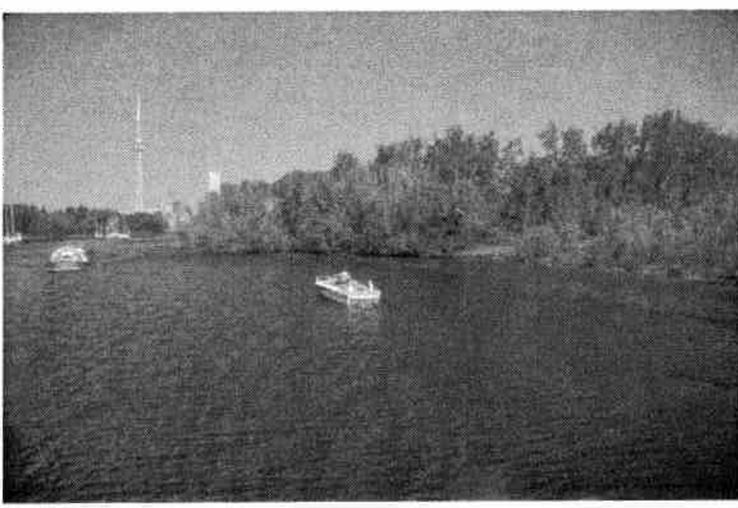


Point Pelee is one of three extensive sand spits on Lake Erie famous for highly significant Carolinian ecosystems and outstanding birding. Point Pelee National Park. (Anon. Parks Canada Archive Photo)

Clear Creek Forest, an extensive forest and riparian complex, recently acquired by The Nature Conservancy of Canada (NCC) to complement Rondeau Provincial Park. (NCC Archive Photo)

Abrasion tracks and sparse vegetation attest to hostile shoreline conditions in windswept exposures around the Great Lakes. Long Point Peninsula Wildlife Area. (TJB)

Parks and other protected areas in the coastal region provide important opportunities for scientific research and monitoring to better understand the natural world. (TJB)



Urban valleylands and pockets of woodlands and wetlands contrast sharply with the Toronto skyline. Toronto Island. (TJB)

Embayment beaches with wooded backshores characterize many shorelines in protected areas on the lower Great Lakes. Darlington Provincial Park. (PSK)

Finger sand bars with intervening wooded ridges and marshy swales provide an intricate ecosystem associated with the Presqu'ile tombolo. Presqu'ile Provincial Park. (Anon. OMNR Archive Photo)

Contemporary dunes, important for understanding shoreline evolution and ecology, are best developed on Lake Ontario in the Sandbanks-Outlet Beach complex. Sandbanks Provincial Park. (Anon. OMNR Archive Photo)

Acknowledgements

Pete Sorrill and Mike McMurtry, with the Natural Heritage Information Centre (NHIC), are acknowledged for compiling the basemaps of protected areas from the Natural Areas Database (NADb) of NHIC. Special thanks to Phil Kor, with Ontario Parks, for generously providing geological information and the images credited to him as (PSK). Archive slides of the Ontario Ministry of Natural Resources (OMNR), Parks Canada and The Nature Conservancy of Canada, featured in the article and on title pages throughout the volume, are gratefully acknowledged with photographers credits, while slides by the author are simply annotated as (TJB). Chris Lemieux is acknowledged for helping with the assembly and graphic layout of the maps, photos and the final manuscript. Review comments by Bob Davidson and Phil Kor, providing encouragement and advice on publishing the article, are much appreciated.

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Coastal Conservation in Europe, Especially the United Kingdom

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Abstract

This paper summarises some aspects of coastal conservation in Europe, especially the United Kingdom, to provide the basis for a comparison with the situation in Canada. First, the characteristics of European coasts are described, and the threats to them, which provide the motivation for conservation. Second, some multi-national approaches to coastal conservation are identified. Third, the main types of protected areas and designations used for coastal conservation in the U.K. are reviewed. Fourth, some of the problems encountered with these approaches to coastal conservation are noted. Finally, some lessons for Canada are suggested.

Introduction

This paper aims to provide a basis for considering coastal conservation and a comparative, perhaps guiding, perspective for coastal conservation in Canada. It summarises some aspects of coastal conservation in Europe, especially the United Kingdom (U.K.). First, the characteristics of European coasts are described, and the threats to them which provide the motivation for conservation. Second, some multi-national approaches to coastal conservation are identified. Third, the main types of protected areas and designations used for coastal conservation in the U.K. are reviewed. Fourth, some of the problems encountered with these approaches to coastal conservation are noted. Finally, some conclusions are reached and lessons for Canada suggested.

In much of Europe, especially the U.K., there are two treasured landscapes: the countryside and the coast. According to Byron, the renowned nineteenth century traveler and poet:

There is rapture on the lonely shore,
There is society where none intrudes,
By the deep sea, and music in its roar.

Corbin (1994) has documented "the desire for the shore" and the resultant "discovery of the seaside" that developed in western Europe at this time. More recently, the travel writer Paul Theroux recognised the importance of the coast in Britain when he stated: "Britain was its coast" and added that "nowhere in Britain was more than sixty-five miles from the sea," "people naturally gravitated to the coast" (Theroux, 1984: 6).

But, what is "the coast"? According to Carter, the coast is a zone that can be defined as follows:

> *"That space in which terrestrial environments influence marine (or lacustrine) environments and vice versa. The coastal zone is of variable width and may also change in time. Delimitation of zonal boundaries is not normally possible, more often such limits are marked by an environmental gradient or transition. At any one locality the coastal zone may be characterized according to physical, biological or cultural criteria. These need not, and in fact rarely do, coincide"* (Carter, 1991: 1).

For Europe, the following parameters and features have been used since 1996 to define the coastal zone:

- 12 miles seaward of the coastline (the territorial waters);
- 10 kilometers (km) landward of the land side of coastal structures or areas, or (if coastal structures or areas are not present) 10 km landward of the coastline;
- coastal structures include coastal water bodies such as estuaries and lagoons up to tidal propagation and terrestrial structures such as dunes; and,
- coastal areas include the area below sea level. (Laurens *et al.*, 1997: 4)

In examining the interaction between people and the coast of Atlantic Europe over thousands of years, Cunliffe (2001: 567) suggested an even wider zone, "allowing land within 50 kilometres of the sea to be considered maritime."

With respect to the geomorphology of the coast, Ritchie notes that "for low soft coastlines, the present practice of setting the boundary of the coast at high water or low water mark is unsatisfactory. Fundamental coastal geomorphological teaching emphasizes the need to define the system as beginning at wave base, or if that is not possible, the breaker zone" (1992: 49).

The United Nations Environment Programme suggests a flexible approach to the definition of the coastal zone. One of its Principles of Integrated Coastal Zone Management is that: "coastal zone management boundaries should be issue-based and adaptive" (UNEP, 2001: 1).

Whatever spatial extent of land and sea is selected to define the coast, the main thing is to recognize, "the great linkage between marine, coastal and terrestrial realms, which precludes the effective management of a marine area independent of managing adjacent land habitats." (Salm and Clarke, 1997: 2)

The Coasts of Europe

Characteristics

The coasts of Europe can be placed in a broader context and classified according to a global classification. Inman and Nordstrom (1971) have classified the world's coasts based on tectonic and morphological characteristics, as follows:

- Mountain coasts;
- Narrow shelf (headlands and bays, coastal plain);
- Wide shelf (headlands and bays, coastal plain);
- Deltaic coast;
- Reef coast; and
- Glaciated coast.

Europe has examples of many of the above coasts. It has mountain coasts, some narrow shelf headlands and bays, wide shelf headlands and bays and coastal plains, a few deltaic coasts, and glaciated coasts. Often regarded as a continent of peninsulas, Europe has a longer coastline in relation to its area than any other continent. The U.K. alone has more than 15,000 kms of coastline. According to Fisher: "The British coasts have indeed everything – from towering cliffs rising several hundred feet sheer from deep water to mud flats a mile or more wide uncovered by every tide; from restless shingle spits and moving sand dunes to granite headlands which see little change in a century" (Fisher *et al.*, 1963: viii).

The coasts are a product of geology, climate change, erosion, deposition, and human interference (Ashton, 1909). The shoreline of Great Britain is mainly a shoreline of submergence resulting from the melting of the Pleistocene ice sheets and the consequent rise in sea level. Steers, a pioneer of coastal geomorphology in Britain, emphasized the dynamic nature of coasts.

> *"A coast is far from static. Erosion is cutting back many parts, others are extending by the growth of sand or shingle banks and marshes, much is still slowly sinking partly as a result of isostatic movement, partly because of a slight recent rise in sea level following the melting of ice in polar regions. Parts, despite eustatic movements, are rising more quickly than is the sea level. There are abundant instances of raised beaches and submerged forests, and today's movements are but a continuation of those responsible for these features"* (Steers, 1964: 552-3).

Accelerated climate change in future decades, and rising sea levels, will make coasts even more dynamic, and pose new challenges to conserving them. Spenser and French affirm this in stating that "even the most recent downgraded predictions of global-warming related sea level rise imply a significant acceleration of the historical trend to which coastal landforms have responded over the present century. The nature of landform response is such as to render wide-ranging biogeographical inventories inadequate as a foundation for site-specific conservation management programmes. (Spencer and French, 2002: 73).

Values of Coasts

Coasts have a wide range of values. They include geological/geomorphological, vegetation, wildlife, scenery, amenity, and symbolic/spiritual values. And, of course, coasts are valued for ports, resource extraction, power development, urban development, waste disposal and military purposes. Unfortunately some values may conflict with others to the point of being regarded as threats. The United Nations Environment Programme (UNEP) acknowledges this in stating: "Almost all coastal and marine areas produce or support multiple products and services. Sectoral solutions usually 'transfer' the problem between resources, products and services. But coastal resources cannot be sustainably used by any interest group as their exclusive right... There is, therefore, a need to bring sectoral activities together to achieve a commonly acceptable coastal management framework" (UNEP, 2001: 1). Nevertheless, Salm and Clark (1984: 1) contend that "using resources in the coastal zone and ocean requires that some areas be retained in their natural states. Safeguarding critical habitat for fish production, preserving genetic resources, protecting scenic and coastal areas, and enjoying our natural heritage all may sometimes require the strict protection of natural areas."

The wide range of values of coasts is reflected in the potential reasons offered for conserving sites with special earth science features in Britain:

- preservation of our heritage for the future;
- research to advance science and industry;
- training of earth scientists;
- providing a teaching facility for schools;
- forming part of a leisure industry; and,
- for aesthetic, amenity, historical, cultural and wildlife value.

(Nature Conservancy Council, 1990)

Threats

In the 1960s the National Trust of the U.K., a non-governmental, charitable, environmental organization, had "become deeply concerned about the rapidly accelerating loss of outstandingly beautiful, hitherto unharmed coastline to unsuitable development. It was calculated that nearly three-quarters of the coast had been damaged beyond retrieval, most of it in the previous fifty years" (Soper, 1984: 9). At the same time, Steers noted some of the specific threats to the coast of England and Wales. "Many miles of the coast are already spoiled by ill-planned and ill-sited bungalows and villas. Other parts are ruined by unsightly mining and manufacturing development or by past and present quarrying. At the present time nuclear stations are an additional menace" (Steers, 1960: 13). Nevertheless, Steers did believe that "there is no need to spoil the coast when it is made more accessible to the visitor. But foresight and careful planning are required, especially in view of the greater popularity which the future constantly brings to the coast." He went on to stress that "more and more people wish to enjoy the *natural* beauties of the coast. They will be able to do so with greater satisfaction to themselves if systematic planning takes place, for without planning the spoiling of the coast will continue. But planning must include all tourist amenities, including car-parks. Every year the problem becomes more difficult, and it is largely because we have failed to take an overall view" (Steers, 1960: 13).

Concern about threats to the coast continued into the 1970s and 1980s. "The threat to the coast still comes from development, but there is another, perhaps more formidable threat that has been widely recognized in recent years – pollution. This is not only the pollution of building, of car parks, of trampling feet, of acid-laden rain, but pollution from the sea itself" (Soper, 1984: 9). Theroux also commented on this at the resort of Margate; "There were about ten people standing on the sandy beach, but no one was swimming. They were peering at an oil slick that was a smooth puddle in the sea" (Theroux, 1984: 16).

In 1991, Carter identified the following coastal issues:

- storm hazard mitigation;
- control of shoreline;
- recreational despoilation and destabalization of the coast;
- wetland and estuary reclamation;
- waste disposal into coastal environments;
- siting of power plants by the coast;
- uncontrolled exploitation and enrichment of coastal ecosystems; and,
- saline intrusion into coastal aquifers due to abstraction of groundwater.

He noted that "it is often said that France only became aware of the need to manage its valuable coastal resources after the Amoco Cadiz spilt 200,000 tonnes of oil onto the Brittany shoreline" Carter (1991: 5).

With respect to the impact of recreation on the coast Carter observed that:

> *"The widespread and often insensitive marketing of coastal recreation in the last 40 years has led not only to the ugly disfigurement of many previously scenic coasts, but also to the economic disruption of many previously balanced local economies. Nowhere is this more evident than in the Mediterranean, where many small island communities have been saturated by new service industries, displacing traditional trades and crafts. All too often, lack of foresight in recreation development has led to the destruction of fragile ecosystems. This is ironic, as it was often the attraction of these ecosystems that encouraged the initial development."* (Carter, 1991: 3)

With specific reference to the impacts of tourism on the Atlantic coast of France, Miossec (1988: 1) reported that: "beaches are losing sand because of seafront embankments, littoral dunes are deteriorating and marinas are becoming silted." He asked therefore, whether when faced with pressures from municipalities, tourism development groups and other interests, are "...those responsible for the protection of coasts still are provided with the suitable means that take into account the specific nature of the environment."

The Fifth European Community Environment Programme Towards Sustainability, for the period 1992-2000, in describing the state of the European environment, referred, amongst other things, to: "deterioration of the coastal environment," "pollution of marine waters," and tourism "leading to a deterioration of mountain and coastal regions" (European Community, 1998).

In 1997, the following were identified as "environmental issues relevant for the European Coastal Zone" (Laurens *et al.*, 1997: 4):

- eutrophication/saprobiation;
- heavy metal pollution;
- antibiotics;
- persistent organic compound pollution;
- oil pollution;
- loss and degradation of habitats;
- thermal pollution;
- resource depletion - groundwater;
- resource depletion – gravel;
- coastal erosion;
- climate change;
- waste;

- overfishing;
- loss of biodiversity and genetic resources; and,
- introduction of foreign species.

While living in the 1950s and 1960s besides the Dee Estuary on the north-west coast of England, I witnessed the steady encroachment on the estuary mudflats of one such foreign species, *Spartina townsendii. Spartina* first appeared on the south coast of England in 1870 and it has been spreading ever since, especially in muddy estuaries, such as Poole Harbour on the south coast and the Dee Estuary. Steers noted that "it makes those areas where it grows firmer and less liable to erosion, and because of its rapid increase it is, under control, a valuable ally and is introduced for the purposes of reclamation. But left to itself to grow in a wild condition, it is apt to spread too quickly and even to upset navigation" (1960: 10). The spread of Spartina in the Dee Estuary not only disrupted navigation but also reduced recreational beaches and fisheries, and encouraged proposals for land reclamation.

As recently as 2001, English Nature warned that "the last of our coastal wilderness is being squeezed out of existence," "our estuaries are being strangled and our coast eroded due to last century's flood defence technology," so "our children will no longer enjoy the wonders of coastal wildlife." "We have to do a deal with nature" (English Nature, 2001: 1).

Given the increasing threats to the long valued coastline of Europe, more and more effort has been made in recent decades, at regional, national and local scales, to protect the coastline.

Regional Coastal Conservation in Europe

In 1975, the United Nations Environment Program (UNEP) started the Regional Seas Program (RSP) with an inaugural project on the Mediterranean Sea. Carter summarized the situation to be addressed by the project thus: "The Mediterranean is surrounded by 18 nations with over 200 million inhabitants, and attracts 100 million visitors every year. Declining environmental standards in water quality, biological production, aesthetics, etc., were combining to produce a crisis, presaging environmental and ultimately economic collapse."

An Action Plan has "led to numerous attempts to clean up the coast, and to reduce further degradation" (Carter, 1991: 4). While the emphasis has been on reducing pollution, in 1982, a Specially Protected Areas Protocol was adopted, and a Centre established that "provides training and advice on the creation and management of protected areas and works on the implementation of specific action plans for the protection of endangered species..." In 1995, a new protocol was adopted which called for "The establishment of a list of Specially Protected Areas of Mediterranean Importance (SPAMI) in order to conserve biodiversity and to contain specific Mediterranean ecosystems" (MAP, 2002).

An evaluation of various integrated coastal management (ICM) projects in the Mediterranean in 1997 indicated that more than half were successful. However, integration had proved difficult and governance and participation, especially of the general public, were weak in all projects. Furthermore, most projects, especially those in the developing countries, had poor financial prospects for ensuring the sustainability of coastal conservation (Trumbic, 1997: 13-14). Many more regional coastal conservation initiatives have been taken in Europe, especially since the creation of the European Union (E.U.). These include:

- 1982 Declaration on Wadden Sea. The three countries around the Wadden Sea declared their intention to coordinate their activities to implement legal instruments to protect the natural environment (de Jong, 1997);
- Blue Flag Scheme. UNEP and WTO set standards for, and recognize clean Beaches (UNEP, 1996; Anon, 2002a);
- 1992, E.U., Natura 2000, Special Areas of Conservation declared to maintain biodiversity;
- 1993, E.U. Integrated Management in Coastal Zones, 35 Demonstration Programmes;
- 1994, E.U. Convention on the Protection of the Baltic Sea, to reduce pollution;
- 1995, MAP, Protocol on Specially Protected Areas of Mediterranean Importance; and,
- 1999, World Wildlife Fund (WWF) Proposal for Marine Protected Areas in the North-East Atlantic - European Environment Agency, Centre on Marine and Coastal Environment, State of Europe's Coast Report.

In contrast to comprehensive coastal zone management in the United States, impelled by the United States Coastal Zone Management Act (1972), many states, such as Britain and France, have had a more ad hoc approach (Carter, 1991: 5). "The grafting of coastal management onto existing administrative, judicial, and legislative structures is not easy and often results in inter-agency conflict. Resolution of such conflicts inevitably requires compromise solutions, so that the coast suffers from less effective management." In Europe engineering approaches to solve coastal problems seem more entrenched than in the U.S.A. (Carter, 1991: 8).

Coastal Protected Areas in the United Kingdom

In 1960 Steers, writing about the coast of England and Wales, felt obliged "to call attention to the importance of preserving a most valuable national heritage. There is no need to spoil the coast when it is made more accessible to the visitor" but "foresight and careful planning are required" (Steers, 1960: 13). In 1969, Steers also noted that we "must appreciate that conservation means the right use of the coast for the benefit of all; it does not mean indiscriminate development of any sort, nor does it mean prohibition to use the coast and enjoy it. In recent years there has been a considerable increase in the attention given to coasts. This has come about in several ways, the chief of which are: the consequences of the great storm surge of 1953, the ever-increasing demand for coastal holidays, and the large number of scientific studies of the coast" (Steers, 1969: v, vi).

In 1963, the Ministry of Housing and Local Government asked local planning authorities in England and Wales to make a special study of their coastal areas, and to write into their development plans a policy which would be their answer to four questions:

1. Which parts of the coast need safeguarding so that their natural attrac tions may be enjoyed to the full?
2. In which parts of the coast should facilities for holidaymakers and other developments be concentrated?
3. What steps should be taken to restore lost amenities and to create new ones?
4. What areas of scientific interest are there which need special consider- ation in relation to the use of the coast?" (National Parks Commission, 1968: 1).

In 1965, the National Parks Commission arranged a series of "coastal regional conferences" to provide the Minister with "a map and statement, demonstrating coastal planning policy, to be drawn up and acted upon (National Parks Commission, 1968: 1). The maps prepared by the local planning authorities showed the location of coastal built up areas and of coastal land allocated for development, the locations of maximum pressure of holiday use, and the degree of protection afforded unbuilt coastal areas by various forms of designation. The Commission also initiated three special studies, including one by the Nature Conservancy to identify and classify coastal places of scientific interest. Over ten Acts of Parliament were identified which allowed for the acquisition or appropriation of land for public open space and other recreational purposes. Some of these Acts enabled the creation of protected areas.

Protected Areas in General

In 1997, Bishop *et al.* identified 29 different types of protected areas used for the conservation of wildlife and landscape in the United Kingdom (Bishop *et al.*, 1997: 81). They defined a protected area as "an area of land and/or sea especially dedicated to the protection and management of scenic, wildlife, heritage and/or other environmental values." The types of protected areas and the region of the U.K. where they apply are given in Table 1 (Bishop, *et al.*, 1997: 86).

Table 1. Geographical application of protected areas.

Protected Area	Regional Application
Area of Outstanding Natural Beauty	E, W
Area of Outstanding Natural Beauty (Northern Ireland)	NI
Area of Special Protection	E, S, W
Area of Special Scientific Interest	NI
Biogenetic Reserve	E, NI, S, W
Biosphere Reserve	E ,NI, S, W
Countryside Stewardship	E
Environmentally Sensitive Area	E, NI, S, W
European Marine Site	E, NI, S, W
Forest Nature Reserve	E, NI, S, W
Forest Park	E, NI, S, W
Heritage Coast	E, W
Local Nature Reserve	E, NI, S, W
Marine Consultation Area	S
Marine Nature Reserve	E, NI, S, W
National Park	E, NI, W
National Scenic Area	S
Natural Heritage Area	S
Nitrate Sensitive Area	E, NI, S, W
Ramsar Site	E, NI, S, W
Regional Park	S
Site of Community Importance	E, NI, S, W
Site of Special Scientific Interest	E, NI, S, W
Special Area of Conservation	E, NI, S, W
Special Protection Area	E, NI, S, W
Tir Cymen	W
Water Protection Zone	E, W
World Heritage Site	E, NI, S, W

(E=England, NI=Northern Ireland, S=Scotland, W=Wales)

"Most of the protected areas operate indirectly through the planning system and/ or voluntary agreements. However, a distinction is drawn between systems for nature conservation and landscape protection with the former relying more on direct controls (ownership and/or legal force)" (Bishop, *et al.*, 1997: 81).

Coastal and Marine Protected Areas

In the 1960s a survey led to the conclusion that "only some 900 miles of the 3000 miles round the shores of England, Wales and Northern Ireland were worth preserving" (Soper, 1984: 9). At this time, the National Trust owned or protected about 165 miles. In May 1965, Enterprise Neptune was launched by HRH The Duke of Edinburgh and the National Trust. Its aim was to raise L2 million to "purchase, endow, improve or buy covenants over desirable coastlands as and when they came on the market" (Soper, 1984: 9). By 1984, Enterprise Neptune had raised nearly L7 million and was half way to its target of 900 miles of protected coast. The following year, the National Trust re-launched Enterprise Neptune "to enable us to own and protect permanently those outstanding and precious stretches" of coast still worth preserving (Gibson, 1985: 12). After acquisition by the National Trust, most such stretches of coast have been designated as protected areas of one type or another.

Many of the 29 types of protected areas identified by Bishop *et al.* in 1997 are used to protect land with a coastal frontage. Some examples of these types of protected area that have coastal frontage will now be provided.

National Parks

National Parks have been designated since 1951 in England and Wales by the Countryside Commission. They are intended to protect natural beauty and provide opportunities for recreation, while allowing various rural land uses such as agriculture, forestry and villages to continue. Most land, at least 50% in each park, is owned privately or by the National Trust. The local authority must consult the Countryside Commission when reviewing plans for development in the parks and "take any action that will aid the purposes of the designation" (Countryside Commission: 1970). Six of the 11 national parks have a coastal terrestrial component, however only one, the Pembrokeshire Coast National Park in Wales, is entirely coastal in its emphasis. It covers 58,300 ha and has various coastal habitats such as the exposed cliffs of St. David's Head and the sandy beaches of St. Bride's Bay (Gubbay, 1986). Other national parks have a terrestrial emphasis but may have short sections of coast. For example, the Lake District National Park, in north-west England, includes three sections of coast totaling 20 miles. Major towns and areas of development on the coast were left outside the boundary of the park when it was designated, so most of the coast within the park is relatively natural and free of major development pressures.

Areas of Outstanding Natural Beauty

Areas of Outstanding Natural Beauty (AONB) have been designated since 1956 in England and Wales by the Countryside Commission. They are intended to conserve natural beauty while allowing recreation compatible with this objective and safeguarding agriculture, forestry, other rural industry as well as the economic and social needs of the local communities (Gubbay, 1986: 247). Local authorities were encouraged to develop, planning and management policies for AONBs, set up advisory committees to guide them, and review planning applications for proposed developments. However, given that in 1999, the Countryside Commission deemed the protection and management of AONBs "largely unsatisfactory and insufficient," steps are now being taken by the government to strengthen the legislation, financing and management of these areas (Anon, 1999b). Over half the 37 AONBs border the coast, especially of East Anglia, Isle of Wight, Dorset and Anglesey. The South Downs AONB, which includes sections of the south coast of England, is now being turned into a national park, though with major debates over which inland and coastal areas should be included (South Downs Campaign, 2002).

National Scenic Areas

In Scotland, the Countryside Commission for Scotland designated areas of scenery "which best combine those features which are most frequently regarded as beautiful" as National Scenic Areas (NSAs) (Countryside Commission for Scotland, 1978). Applications for development within NSAs are dealt with by the local planning authority with advice from the Countryside Commission for Scotland, which can only be ignored with the approval of the Secretary of State for Scotland. Twenty-nine NSAs covering over 1 million ha have frontage on the west coast of Scotland, especially in Ross and Cromarty and the Island of Harris. After decades of debate, Scotland is now designating some areas of scenic and ecological value as National Parks, but so far these have not been coastal areas.

Special Areas of Conservation

Special Areas of Conservation (SACs) were called for in the European Habitats Directive of 1992. These are intended primarily to protect important wildlife habitats, including coastal ones, throughout Europe. Accordingly, since 1997, English Nature has identified 12 Marine SACs, including areas in the Shetland Islands, east and west coasts of Scotland, east, west and south coasts of England, and the coasts of Wales and Northen Ireland. Information is now being obtained to develop management schemes that will conserve these areas. Key local stakeholders are being consulted and a national conference to discuss such areas has been held. It remains to be seen how effective this European initiative will be.

World Heritage Sites

World Heritage status has now been given by UNESCO to several coastal sites in the U.K., namely the Scottish island of St. Kilda, and the Dorset and East Devon

Coast of England (Anon, 2002a). The former site comprises 853 ha of a volcanic archipelago including some of the highest cliffs in Europe which have colonies of rare and endangered species, especially puffins and gannets. It is owned by the National Trust for Scotland which leases it to Scottish National Heritage which manages it. The latter site has approximately 155 km of coastal cliffs that provide an almost continuous sequence of Triassic, Jurassic and Cretaceous rock formations and internationally important fossil beds that have received scientific attention for over 300 years. The majority of the site is under private ownership, but the National Trust, two County Councils and Ministry of Defence own parts.

In Northern Ireland, the 70 ha Giant's Causeway, with over 40,000 spectacular black basaltic columns forming a causeway into the sea, was designated a World Heritage Site in 1986. Most of the site is owned by the National Trust, so it manages the site together with the Moyle District Council and the Department of the Environment for Northern Ireland (World Conservation Monitoring Centre, 2002). While World Heritage status is invariably an overlay status designation to an existing protective designation, it is beneficial because a management plan must be prepared for the area, and monitoring undertaken to ensure that the values recognized by World Heritage designation are being protected.

Special Coastal Designations

Only a few types of protected area are primarily intended to protect coastal and marine areas, namely:

- Heritage Coast;
- Marine Nature Reserve;
- European Marine Site; and,
- Marine Consultation Area.

These types of protected areas have a variety of objectives. Heritage Coasts are intended to protect the landscape and provide recreation and access. Marine Nature Reserves are intended for nature conservation and education and research. European Marine Sites are intended primarily for nature conservation. Marine Consultation Areas are intended primarily for nature conservation. The first two types of protected area, being the longest established, most numerous, and most extensive, are described in more detail below.

Heritage Coasts

The Heritage Coast scheme has no statutory basis and mainly defines the finest stretches of undeveloped coastline with high scenic quality although these boundaries are incorporated in local plans (Countryside Commission, 1970). In many cases Heritage Coasts were originally only defined laterally (minimum 1 mile) and no attempt was made to fix an inland boundary. Ceredigion District Council (Wales) has recently defined a Marine Heritage Coast extending one mile offshore (Allan, 1997). This would probably have been impossible if Heritage Coasts were defined in statute because most terrestrial designations cannot be applied at sea (Bishop, *et al.*, 1997: 92). The Countryside Commission helped local authorities to define the extent of Heritage Coasts advised them on effective planning approaches and management plans, and gave grants towards staff (such as Heritage Coast Officers and Wardens), and schemes to promote conservation or public enjoyment (Glyptis, 1991).

The first and longest Heritage Coast, designated in 1973, is the North Northumberland Coast. Within four years, a further 30 were designated, including much of the coast of Devon and Cornwall (Anon., 1999a). There are now 43 Heritage Coasts, encompassing 1460 kms, or 33% of the coast of England and Wales.

Marine Nature Reserves

The U.K. Wildlife and Countryside Act of 1981 provided for the establishment of Marine Nature Reserves. Such Reserves can cover "any part of the sea within territorial waters adjacent to Great Britain, or any area in Great Britain between high and low water levels, or a combination of the two" (Nature Conservancy Council, 1982). They are to be managed by the Nature Conservancy Council for the purpose of:

- conserving marine flora or fauna or geological or physiographical features of special interest in the area; or
- providing, under suitable conditions and control, special opportunities for the study of, and research into, matters relating to marine flora and fauna and the physical conditions in which they live, or for the study of geological and physiographical features of special interest in the area. (Wildlife and Countryside Act, 1981: Section 36)

Marine Nature Reserves are protected through bye-laws, most passed by bodies other than the Nature Conservancy Council but with their advice. Such bye-laws can, for example, restrict the entry of vessels and persons, and prohibit the killing or disturbance of animals or plants, and the depositing of garbage in a reserve. It was anticipated in 1981 that the first set of seven reserves would be established within one or two years; however after 15 years there were still only three reserves, namely Lundy, Skomer and the Marloes Peninsula, and Strangford Lough designated in 1986, 1990 and 1995 respectively (Bishop, *et al.*, 1997: 93). The Lundy Reserve comprises the volume of sea and area of sea bed around the island of Lundy in the Bristol Channel defined by latitude and longitude, and extends shoreward to include all land covered continuously or intermittently by tidal waters or parts of the sea (Nature Conservancy Council, 1987). 1100 acres of the island is also designated as a Site of Special Scientific Interest. Special features of the reserve are the cliffs with bird colonies, inter-tidal caves and boulder beaches used by grey seals, rare species of vegetation on rock pinnacles, and shipwrecks (Langham, 1970). Six bye-laws define the reserve, regulate activities in it, and specify fines for infractions. There is a "Code of Conduct" for shore visitors, divers, boat operators, anglers and fishermen, salvage operators and underwater archeologists. Protection of Skomer and the Marloes Peninsula, off the coast of Wales was initiated in 1968 when the West Wales Naturalists' Trust proposed measures to conserve the area. In 1974 a committeee was established that produced a plan for managing the reserve, and with input from the fishing industry began administering the reserve on a voluntary basis (Huff, 1985).

Problems with the System of Protected Areas

According to Bishop *et al.,* "Most people are unclear as to the purposes of the various types of protected areas". This is a universal problem, hence, the work of the World Conservation Union (IUCN) to develop and gain general acceptance of an international classification and descriptions of protected areas, and the efforts made by specific agencies and at individual areas, through policies and interpretive materials, to explain the purpose of each type of protected area. This problem is compounded by the multiple designation of many areas.

Even when Heritage Coasts were proposed in 1970, it was noted (Countryside Commission, 1970: 2) that: "35 of the 43 defined heritage coasts already coincide with the coastal frontages of national parks and AONBs and the management measures are generally successful in looking after them." Nevertheless, multiple designation of areas has become more and more common. Furthermore, Bishop *et al.* (1997: 101) note that "the majority of overlapping protected areas occurs on the coast, most notably in estuaries." For example, in Wales, the Lleyn Peninsula (including Bardsey Island) contains a Heritage Coast, an Area of Outstanding Beauty, an Environmentally Sensitive Area, a number of Sites of Special Scientific Interest and National Nature Reserves, a possible Site of Community Importance, a European Marine Site, and a proposed Marine Nature Reserve. Another example is Chichester Harbour, 35 miles of the south coast of England, which has an Area of Outstanding Natural Beauty, a Site of Special Scientific Interest, A Ramsar Site, and two local nature reserves (Tittensor and Beale, 1990).

Not only is there concern about the proliferation and overlapping of designations but also about variations in which parts of the U.K. they can be applied. Some types of protected areas apply to only part of the U.K. and there may be separate initiatives in Scotland and Wales. Bishop *et al.* (1997: 81) concluded that "there is scope for some rationalization of the system. Ideally, this would involve replacing existing protected areas with broader based ones, but considerable simplification could be obtained in practice by making the powers of agencies more flexible and changing the administrative arrangements for managing the various protected areas." Increasingly all parts of the U.K. will have to comply with directives from Europe.

The problem of having numerous conservation agencies and designations is rendered more complex because of the many other stakeholders with different interests in, and plans for the coast. Ritchie (1992: 49) has noted that: "Coast conservational management often encounters two closely related obstacles. First, there is an exceptionally large number of bodies with legitimate interests in the coastal zone. Many of these agencies and bodies have conflicting interests and conservation is but an additional factor. Second, planning exists within administrative boundaries which rarely coincide with natural coastal units..." He therefore advocates "enhanced cooperation between adjacent administrative units."

The continuing difficulty of including both marine and terrestrial environments in a single coastal protected area is exemplified by the recent debates over the new South Downs National Park. "A number of arguments were put forward for a marine area to be included within the boundary, beyond the mean low water mark at Seven Sisters. This would require new legislation. However, a number of voluntary methods for conserving marine areas could be considered by a national park authority" (The Countryside Agency, 2002: 2).

Referring to the coastal zone in general, the United Nations Environment Programme concluded in 2001 that "although there have been many attempts to protect coastal areas and to encourage sustainable forms of coastal development, few have been successful. The main reason is that they have largely been sectoral, and there is fierce competition for coastal resources in may areas... (UNEP, 2001: 1).

Conclusion

Europe has a long and varied coastline with many ecological, amenity and resource values. Historically its coast has been modified and degraded in various ways, and pressures to change the coast persist. Global warming and the attendant sea level change are raising interest and concern. Multi-national, regional, national and local initiatives have been taken, mostly in the last fifty years, to protect coastal areas and their values. Protected areas have been an important mechanism, as have been planning controls. However, much less attention is paid to protecting marine areas along the coast. Most protected areas are only terrestrial, few are marine, and very few both. There is a lack of integration of planning and management to protect the terrestrial and marine areas adjacent to the coast. Unfortunately, according to Doody *et al.*, even as recently as 1998, "the desirability of an integrated approach to management has yet to be accepted by all the players active in the coastal zone" (Doody *et al.*, 1998: 6). The European government is now bringing a more consistent, Europe-wide approach and providing incentives to protect the coast. For example, the European Community in its Environment Action Programme for 2001-2010 calls for "the protection and restoration of marine habitats and the coast and extension of the Natura 2000 network (of protected areas) to include them" (European Community, 2002: 3).

In the U.K. there is very heavy pressure on the coast, especially England's more accessible and used coasts, and ongoing threats to nature from pollution. There is a lot of emphasis on the scenic and amenity values of the coast and their protection. Considerable attention has also been given to the identification and protection of geosites, sites of geological or geomorphological significance. Numerous agencies and categories of protected area are serving to protect the coast. Furthermore, non-government organizations, especially the National Trust, have been important in raising interest in coastal conservation and acquiring coastal land for protection.

However, as elsewhere, there has usually been a split between the jurisdiction over, and management of the terrestrial and marine components of the coast, with few agencies and protected areas covering both. The numerous conservation agencies and many overlapping designations are confusing and may be unnecessary. Regional coastal planning and European directives should help to address this issue.

There have been decades of progress with coastal conservation, the designation of numerous protected coastal areas, and increasingly regional and integrated strategies for coastal zone management. Still, many threats to the coast remain, complicated by the likely rise of sea level. So, more effective means for coastal conservation are still needed, as is some rethinking of the role and impact of protected areas in this endeavour. While international comparisons are problematic and the application of procedures used in one country to another must be considered carefully and implemented cautiously, I am sure those of us involved in coastal conservation and protected areas in Canada can learn something from the strengths and weaknesses of coastal conservation in Europe.

Lessons for Canada

The European situation and experience suggests that Canada should:

- Protect the coast while it is still relatively natural;
- Prepare a State of the Coast report regularly;
- Pay more attention to the implications of climatic change for coastal change, degradation and protection;
- Plan coastal conservation on various scales from the continental to the national, regional and local;
- Use a variety of protected area designations, but avoid excessive multiple designations;
- Place more emphasis on marine conservation areas;
- Designate areas with both land and water components;
- Identify and protect sites of geological and geomorphological interest;
- Encourage conservation groups to buy coastline for protection;

- Adopt large scale partnership approaches to integrated planning and conservation;
- Offer financial and tax incentives for coastal conservation; and,
- Increase public education about coastal conservation.

Acknowledgements

Trent University for providing a sabbatical research grant. Department of Geography, The University of Reading University, U.K. for providing a base for undertaking this research.

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Great Lakes Heritage Coast: Opportunities for Protection and Community Development

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Abstract

As a result of a major Crown land planning exercise in the late 1990s, the Province of Ontario established the Great Lakes Heritage Coast concept. This concept applies to 4200 km of coastline and about 1.5 million ha of land from Port Severn in Georgian Bay to the Pigeon River on Lake Superior. It includes 71 parks and protected areas covering approximately 45% of the total area. The overall management intent established for this area is to protect its outstanding beauty and natural ecosystems; to promote its recreational and tourism potential; and to foster cooperation and partnerships in its planning and management. It was recognized that further work was required to determine how this should occur. The challenge is to determine what needs to be done to meet the management intent for the area in a manner that is both participatory and accountable. The presentation will discuss what has happened to date with the Heritage Coast, opportunities and needs identified through initial consultations and the multi-step, iterative process being used to develop future direction for the Heritage Coast . It will discuss ideas and the range of opportunities present on the coast as well as challenges identified to date.

Introduction

The Great Lakes Heritage Coast (GLHC) is a special initiative of the Ontario Government designed to examine requirements for long-term natural resource protection and tourism promotion and development within the coastal area of the upper Great Lakes in Ontario. This is to be done in collaboration with the many different stakeholders, First Nations, municipalities and government agencies now active on the coast.

The GLHC includes all Crown lands, waters, lakebeds, Crown islands, and intervening coastal areas along the Great Lakes shoreline from Port Severn in Georgian Bay, through the North Channel of Lake Huron, to the international border on the Pigeon River south of Thunder Bay on Lake Superior. The designation varies in width generally from 2 to 5 km inland along the shoreline.

The Heritage Coast spans approximately 4200 km of shoreline and covers in excess of 1.5 million ha. of land. There are 25 Indian Reserves and more than 20 communities, including the cities of Thunder Bay and Sault Ste. Marie, within or adjacent to the coastal area with a total population of approximately 300,000 people. Private land is concentrated around Thunder Bay, Sault Ste. Marie, Manitoulin and southern Georgian Bay. Approximately 48% of the Coast is Crown land, 39% patent and 13% Indian Reserve. Thirty-six percent of the total area falls within 51 parks and 27 conservation reserves.

Ontario's Living Legacy Land Use Strategy provides the framework for the planning and management of Crown lands. It establishes the GLHC as a premier Signature Site that has a range of highly significant values that warrant special strategies. In addition, the Land Use Strategy indicates that the coast contains extremely significant tourism and recreation potential that merits increased planning, management and promotion, and that further work is required to define the scope of the Heritage Coast, the associated policies, and a management structure (OMNR, 1999)..

Ontario's Living Legacy Land Use Strategy establishes ecosystem protection, tourism promotion and partnerships as being the long-term goals for the coast. It also identifies the permitted use for Crown lands and conditions for further development. It provides the ground rules for the Heritage Coast initiative (OMNR, 1999).

Great Lakes Heritage Coast Initiative

The GLHC initiative began in February 2000. The Minister of Natural Resources requested his Parliamentary Assistant, Mr. Ted Chudleigh, to undertake consultation with communities and stakeholders on the coast to determine what was required to meet the protection, tourism and partnership objectives. Consultations over a six month period including many meetings with individual stakeholders and more than 30 community meetings, resulted in a report *Charting the Course* being recommended to government (Chudleigh, 2001). Cabinet adopted the report and its recommendations in June of 2001

Among the seven main recommendations of the Chudleigh report, were recommendations for:

- the development of a GLHC Strategy;
- continued promotion of cooperation and partnerships; and,
- a commitment for implementation of the Strategy.

The GLHC is a large scale regional planning exercise attempting to define implementation strategies for potentially conflicting ecological and tourism development objectives; focusing on cooperative management amongst various levels of government, First Nations and a variety of stakeholders; while retaining the appropriate level of accountability.

The approach provides an example of the provincial government participating with others in the co-management of natural resources, ensuring overall co-ordination of government programs, and supporting alternative, perhaps non-traditional delivery mechanisms. This approach should have application to other regional planning situations where there is the opportunity for co-operative management amongst various governments and stakeholders.

Strategy

Public discussion confirmed that a strategy should be developed for the GLHC.. This strategy would identify actions that are both consistent with the Vision for the Heritage Coast and in keeping with the Guiding Principles for planning and management. The strategy should focus on ecosystem protection, tourism development and implementation.

While maintaining the wilderness characteristics, beauty and ecosystems of the Heritage Coast, the strategy would build upon the existing economy and identify opportunities for increased tourism and recreation, tourism promotion, and required infrastructure and facilities. It would include a distinct Aboriginal tourism component developed in cooperation with First Nations.

Partnerships

The success of the Heritage Coast Strategy, including both its development and eventual implementation, requires the active involvement of stakeholders, including existing resource industries, the various provincial ministries and the federal government. At the same time, there must be recognition of the considerable efforts undertaken by existing non-government organizations on activities along the Coast and support for the efforts of these organizations to protect and promote the Heritage Coast.

There are opportunities for enhancing the involvement of First Nations in the future direction of this initiative. Early discussions indicated an interest in both the protection and tourism components of the Strategy. The specific approach to involvement with First Nations is to be discussed with the Union of Ontario Indians and worked out with communities themselves.

A partnership approach will also be required in pursuing protection of resources on private lands, which may be important to Heritage Coast conservation and protection objectives. Partnerships and cooperative working arrangements will be important with educational institutions, existing community and non-government organizations, industry, local communities and provincial and federal governments and their agencies.

Implementation

The vast scale of the coast, its distance from markets, the presence of many small communities and a dispersed population necessitates a special effort to provide coordination, encouragement of partnerships, advice and assistance in resource protection and tourism development and promotion. There is a need to build linkages among communities, organizations and people that are dedicated to the future of the coast and to facilitate the focusing of government programs.

Community consultations confirmed the need to examine initiatives to help coordinate activities on the Heritage Coast. Such action will assist in establishing a network of support, expertise and advice to municipalities and landowners to encourage private land stewardship and support local decision-making.

There may be a variety of ways of meeting these needs. Accordingly, as the Heritage Coast Strategy is developed, special implementation needs and common opportunities will be assessed and appropriate delivery mechanisms identified.

There is very little downside to the initiative as it has the broad support of the public and various government agencies as demonstrated through public consultations to date (see Charting the Course Report). It is consistent with overall government direction re partnering. There is a desire and recognized need to address environmental, tourism and delivery needs from an overall coastal perspective.

There are a large number of programs, agencies and jurisdictions active within the Great Lakes Heritage Coast. While there appears to be agreement on the direction for environmental protection, tourism promotion and partnership building, there will be a major challenge in determine how this is to be delivered and maintained amongst the many agencies, jurisdictions and stakeholders within the coast.

Current Work

In March of 2002, consultants were hired to assist the development of a strategy for the coast as recommended by Mr. Chudleigh. The strategy is to build on the information learned in earlier consultations, and focus on identifying actions necessary to protect the natural resources of the coast, realize tourism opportunities and potential and ensure successful implementation. Natural resource, tourism, social and economic information will be collected and analyzed; comparable cases studies studied; and government programs analyzed and gaps identified. There will be ongoing discussions with each of the First Nation communities to determine how they wish to participate in the initiative, meetings and focused workshops with stakeholders and broader public consultation once a draft strategy is prepared.

Once complete, the strategy will be presented to government with an action plan identifying short-term actions, which could be undertaken to initiate implementation of the strategy. This will include recommendations on any necessary administrative structure (e.g., secretariat, commission, foundation) to facilitate successful delivery of the recommendations.

Key Opportunities

The GLHC is a spectacular natural landscape running through the central portion of the province within driving distance of large populations in Ontario and the U.S. It contains developed areas as well as significant stretches of undeveloped coast. Communities of different sizes are scattered throughout its length including the cities of Thunder Bay and Sault Saint Marie. These centres provide a range of services for travelers as well as educational institutions providing information and research capabilities. Twenty-five First Nation communities account for thirteen percent of the area. Highways #69 and 17 provide access throughout its length, while retaining the remote character of a considerable amount of its shoreline.

There are a number of stakeholder organizations committed to protection and complementary recreational use of the coastal environment, and there is significant interest in promoting complementary tourism activities. There are existing government programs directed to the protection and management of natural resources as well as to the development and promotion of resource-based tourism. There is international cooperation and active management programs directed to the resources of the Great Lakes.

Thirty-six percent of the coast is in formal protected status in the form of national and provincial parks or conservation reserves. These protected areas are generally distributed throughout the coast, and in many instances, are located close to existing settlements.

The Great Lakes Heritage Coast provides significant opportunities for increased recreational and tourism use. Market analysis indicates a growing demand for natural resource based experiences such as hiking, cruising, touring, viewing, nature and cultural appreciation, canoeing, kayaking, camping and fishing, activities for which the coast is well suited. As well, coastal communities are well located to provide services to these tourists and recreational users and to benefit from increased economic activity.

In terms of protection, existing institutions whether federal, provincial or municipal, have the mandate and in many cases programs to ensure the resources of the Great Lakes are protected. Coastal communities and stakeholders are committed to the protection and tourism objectives of the Great Lakes Heritage Coast and would participate cooperatively in implementation.

The Challenges

While there are many opportunities for the GLHC, there will be many challenges in working to meet its resource protection and tourism objectives. One concern, which has been raised by many people, is the apparent dichotomy between the protection and tourism objectives. How is it possible to both protect the quality of the natural resource and its wilderness characteristics while promoting tourism development and use? This is an extremely important question, as it is possible to impact the very qualities of the coast which make it most desirable.

It has been pointed out many times that future tourism depends on a healthy natural environment on the coast. To ensure the natural values are maintained as tourism is promoted, it will be necessary to clearly understand and be able to manage our relationship to the environment. There are many questions that require answers before we begin to promote greater use of this resource. What are the natural values on the coast? Where are they? What are the critical habitats? How much use/disturbance can different resources sustain? Are they sensitive to type, extent, frequency and time of use? What level of inventory is necessary to be confident in making decisions on use? What should be monitored and how? Are there effective mitigating measures?

Also important in considering additional recreational and tourism use is the perceived character of the coast. The Vision statement in *Charting the Course* refers to preserving the coast "in its wild and pristine state" and to protecting its "scenic beauty". While most would agree with this Vision, retaining or protecting the character of the coast will be challenging, as people perceive the character of the coast differently. What is wilderness or pristine conditions to some people, will not be to others. The important questions for management of the coast become, how do you measure its present character? What are its wilderness qualities or attributes? Who is the audience? How can this be monitored?

Conclusion

The GLHC initiative presents a unique opportunity in Ontario to ensure protection of a high quality wilderness resource, and to provide an important economic contribution to coastal communities through increased tourism activity and development. This can be achieved through cooperation and partnerships in management among communities, First Nations, stakeholders, government agencies and educational institutions; the proper use of scientific, economic and social information; and the commitment of resources from all parties in working towards the Vision for the coast.

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Threats to the Development of Heritage Coast Planning

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Abstract

The protected areas (parks and Conservation Reserves) within the Great Lakes Heritage Coast, have added significantly to the protected areas system in Ontario. However, the standard of care applied to these sites remains inadequate for the key ecological, recreational and cultural role that they play within the Coast designation. Like other Provincial Parks and Conservation Reserves, they continue to be burdened with "non-conforming uses" that threaten the very values that they were established to protect. In 2001 there is more land in the system, increased pressures for revenue generation, and new scientific knowledge at our disposal. As part of moving forward with the management of the GLHC we need to think about the advantages of a renewed Provincial Parks Act as a key tool to securing true protection for the Great Lakes coast in Ontario.

Recent Developments in Protected Areas Planning in Ontario

In February of 1997 the Province of Ontario began a land use planning process to decide the fate of 40 million ha of public land. Known as *Lands for Life*, it soon highlighted the need to bring the conservation perspective to the planning process as protected areas covered only 6% of the public land within the undertaking.

Soon after, the World Wildlife Fund, the Federation of Ontario Naturalists and the Wildlands League formed the *Partnership for Public Lands* (PPL) to bring the voice of the conservation community to the table. PPL worked to create protected areas in a manner that was science based using ecological representation in determining potential candidate sites.

In the end, PPL was successful in moving the amount of protected area from 6% to 12% (within the area of the undertaking). Known as *Ontario's Living Legacy* (OLL) these protected areas translate into 378 new parks and conservation reserves totaling 2.4 million ha.

The OLL strategy also initiated the *Ontario Forest Accord* and the *Living Legacy Trust*. The Accord spells out the amount of wood available for the forest industry while stipulating that any increase in the amount of wood consumed (within the area of the undertaking) must correspond to a comparable increase in the amount of protected area. The *Living Legacy Trust* is a $30 million fund used by the province to fund natural resource management projects that bring economic, social and recreational benefits to Ontario

While OLL has brought about large changes on the landscape, a unique approach to another protected area is currently being played out at the O'Donnell Point Provincial Park on Georgian Bay south of the Massasauga Provincial Park. Here the park separates three portions of the Potowotami of Moose Deer Point First Nation Reserve. Originally designated as an Indian Reserve in the early 1900s, the First Nation has proposed that 120 ha of the park be de-regulated and added to the reserve to unite the community once again. The land transferred will be placed into a 'protected' status by the band while the province and forest license holder on other crown land are considering an extension to the park to make up for the area officially de-regulated. It is hoped that this proposal, when completed, will result in a net increase in protected area within the region and the introduction of a stewardship council that would look at the greater ecosystem including the Provincial Park, First Nations, protected areas and private lands within environmentally sensitive areas. Truly an innovative approach to protected areas.

Threats to the Development of Protected Areas Planning

Ontario's Living Legacy brought with it increases in the protected areas within the Great Lakes region. Unfortunately many of them suffer from an inadequate standard of care for the key ecological, recreational and cultural roles that they play. Non-conforming uses threaten the very values that protected areas were established to protect. These threats include roads/snowmobile trails, mining, forestry, hydroelectric and cottage development.

As an area is opened to motorized vehicles, degradation of the natural environment can soon follow through habitat fragmentation, erosion, pollution, garbage, trail and habitat damage, increased hunting, angling pressures and other development.

One such threat is an all weather road proposed for the Black Bay Peninsula Enhanced Management Area (EMA) on the north shore of Lake Superior. The status of EMAs within the OLL strategy appears to be somewhat vague. While forestry is a permitted use, the designation is supposed to mean a higher standard of care than the surrounding crown land. Currently a forest company operates a winter access road for some of its logging operations in the area. However, it wants to expand this use year round. While the MNR, hunters, anglers and conservation groups all oppose this proposal, the company is continuing to write this road into its Forest Management Plan (FMP). With the potential to have a significant impact on the peninsula's ecosystem, this scenario clearly questions the status of EMAs within the parks and protected areas system of Ontario.

Port development threatens another north shore area, Neys and Rainbow Provincial Park. Here the province is considering a proposal to permit a deep-water port in a designated wilderness zone within the Park. The mining activity outside the park, that would benefit from the port began operation long after Neys was regulated in the 1960s. This proposal is currently being considered within the context of the park's management planning process.

East of Neys, a proposed hydro development threatens the White River near the White Lake Provincial Park additions. Logging, roads and bridge construction are also being proposed within the White River Forest Management Plan. Clearly these developments will have effects on the Provincial Park and potentially Pukaskwa National Park downstream.

Mining constitutes a significant threat throughout the coast and the rest of the province. The *Provincial Parks Act* itself permits mining in 23 specific Provincial Parks. These are:

Kesagami	Lady Evelyn-Smoothwater
Opasquia	Wabakimi
Woodland Caribou	Butler Lake
Slate Islands	Michipicoten Island
Cranberry Lake	Lola Lake
Spruce Islands	Lake of the Woods
Makobe-Grays River	Abitibi-De Troyes
Agassiz Peatlands	Craig's Pit
Edward Island	Gravel River
Thompson Island	Wanapitei
Divide Ridge	Red Sucker Point
Winnange Lake	

Combined, these parks cover over 2 million ha of protected area. In comparison, the entire amount of land added through Ontario's Living Legacy amounted to 2.4 million ha. Regulation 954 (1990) *Provincial Parks Act* stipulates that:

> *"No person shall engage in prospecting, the development of mineral interest or the working of mines in a provincial park except in a provincial park listed in the following table or under licence of occupation or a lease issued under subsection 176 of the Mining Act."*

Within the new Lake Superior Conservation Reserve there are over 600 mining claims. Located east of Pukaskwa along the Superior shoreline, mining exploration has led to oil spillage, vegetation trampling and skidder road construction. In late 2001, the Wildlands League, Federation of Ontario Naturalists and the Sierra Legal Defence Fund jointly requested a review of this and other mining conflicts under the Environmental Bill of Rights. The Environmental Commissioner's response in

September 2002 included the recommendation that *"the Ministry of Natural Resources create a new legislative framework for provincial parks and protected areas, including conservation reserves, with the mandate of conserving biodiversity."*

Killarney Provincial Park, referred to by many as the crown jewel of the Ontario Parks system, currently has 62 active claims within its new additions. Their small relative size underestimates the threat that they pose to the park. Additions to a provincial park like Killarney must offer high quality recreational experiences while maintaining biodiversity. Mining has the potential to threaten the park's very existence. Within Ontario over 90% of crown land is available to mining interests. Protected areas need to be free from the threat of mining.

In the southern reaches of the province, Rondeau Provincial Park is one of our last vestiges of Carolinian Canada. It has a long history of cottage development that has unfortunately stressed the natural ecosystem to a point where development and the introduction of exotic invasive species have had significant impacts on the remaining Carolinian habitat. Ontario Parks has engaged in intensive management of the park in an attempt to re-establish a pre-European settlement ecosystem including the use of prescribed burns and culling the deer herd that had grown well past the carrying capacity of the Rondeau area. As invasive species move in and top predators are extirpated from an ecosystem, intensive wildlife management becomes increasingly necessary. Today approximately 300 private cottages remain in the park. The cottage leases were designed to end in 2017 with the full knowledge and approval of leaseholders. Unfortunately, there is currently a movement afoot amongst many of the cottagers to extend these leases indefinitely.

System wide economic development remains an ongoing threat to the coastal protected area system. Within Park Management Plans, 'maximizing economic benefits' continues to be an underlying criterion completely inconsistent with the primary objective of the parks system, which is to protect natural and cultural values.

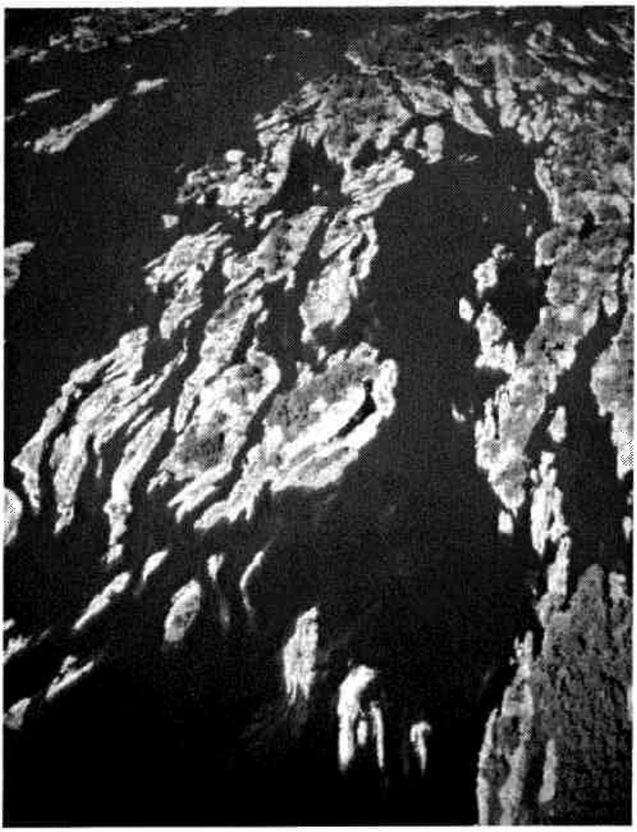
How did this happen? The existing 1950s era *Provincial Parks Act* has been modified over time. However, the original assumptions under which it was written are no longer valid. Indeed, a patchwork of changes has been made that in some cases, like Regulation 954, have actually made the system worse.

We need a *Provincial Parks Act* that has a clear protection mandate, addresses Aboriginal issues and requires completion of an ecologically representative parks system. Park management plans must be produced and regularly reviewed within the context of a clear process for public input entrenching legal standing for all members of the community.

There must be a government commitment to preserve, in perpetuity, the natural and cultural values of provincial parks including broad ecological principles incorporating a greater ecosystem approach.

The Wildlands League has a vision for the future that sees Ontario's parks and protected areas supported by a *Provincial Parks Act* that entrenches ecological integrity.

Responding to the Challenges: Panel Commentaries on Invited Papers



The Bustard Islands at the mouth of the French River, French River Provincial Park (P. Kor)

Panel Commentary
The Heritage Coast Planning Approach

Michael Troughton
University of Western Ontario

My task is to comment on the three papers in this initial session on *'The Heritage Coast Planning Approach'*. The paper's topics divide between that of John Marsh, which deals with the nature and problems of coastal protection in the U.K. and Western Europe, and those by Brian O'Donoghue and Evan Ferrari, which deal with coastal conservation stemming from Ontario's 'Lands for Life' exercise, with special reference to 'The Great Lakes Heritage Coast' (GLHC). Thus, we have examples of approaches to coastal heritage, differentiated in space and time, but with the potential for overlap, especially with respect to what might be learned in Ontario from the European experiences.

I knew that the U.K. has had considerable involvement in conserving parts of a highly varied coast; several friends have walked along coastal paths in southwest England and Wales. Similarly, I knew that the people of many Western European nations have strong attachment to their coastal areas, albeit for a wide range of purposes, and that conditions of ownership, designation and protection are variable, despite common membership in the European Union. Marsh's presentation provides us with more precise information on factors that threaten coastal integrity, and the institutional and legislative frameworks that have been applied in Europe and, specifically, in the U.K.

Of the cited eight 'Threats to the Coasts', all but the last (saline intrusion) can be identified with respect to the Great Lakes in Ontario, albeit more widely associated with regions of greatest population concentration around the lower lakes. Marsh's review of 'Coastal conservation in Europe' highlights a process going back to the mid-1970s, and including two enclosed seas (Mediterranean, Baltic), which have experienced problems similar to those affecting the Great Lakes system (IGU-UNESCO, 1986; Colborn *et al.,* 1990). Furthermore, various E.U. and other protocols suggest the complexity of managing coasts under shared jurisdiction-also a parallel with the Great Lakes.

Turning to the U.K., Marsh notes early coastal protection as part of National Parks, the subsequent array of national and international protocols, and the four types of protected area that are contributing to coastal protection. What emerges is a process that has grown piecemeal over 40 years, to accommodate changing requirements and threats to an often fragile resource, and which is only now being operated in a more consistent manner through E.U. protocols.

Marsh concludes with a set of suggested 'Lessons for Canada', in which he recognizes the varied nature of coasts from a protection standpoint, and suggests the need for a range of proactive measures, including public and private cooperative involvement in taking responsibility for coastal protection. The lessons are particularly appropriate to guiding the initial stages of a coastal protection endeavour and, hopefully, avoiding problems experienced elsewhere. As such, Marsh provides a valuable entry into consideration of Ontario's recent designation of the 'Great Lakes Heritage Coast.'

Brian O'Donoghue's and Evan Ferrari's papers focus on the initiatives resulting from the 'Lands for Life' (now 'Ontario's Living Legacy') initiative, with particular reference to the GLHC. Here, I also refer to the document *The Great Lakes Heritage Coast: Charting the Course* (2001). My overall impression, which the two papers and the document seem to confirm, is that the designation and proposed protection of 4200 km. of the shorelines of Lakes Huron and Superior as the GLHC is currently a statement of political intent, rather than a tangible reality. Because of this, rather than highlight instances of particular 'threats' or the appropriateness of specific 'lessons', I want to concentrate my comments on the consideration of the problems of establishing coastal protection from the viewpoint that stresses the complexity and often contradictory nature of the term *heritage;* the many meanings of which, embedded in the proposal, I see as a problem focus.

At first thought, one might imagine that identification of a coast as heritage means that we are talking about a natural environment landscape of intrinsic worth, regardless of the human environment. However, as Marsh has made clear for the European context and as *Charting the Course* states, we are talking about something where heritage is as much human, as geological or ecological.

The GLHC 'Vision Statement' identifies it as:

> " *an area of outstanding scenic beauty, with wild natural landscapes and cultural values that provide high quality experiences. The outstanding natural resource must be protected to ensure that it remains special and available to the people of Ontario. The coast should be preserved in its wild and pristine state and its ecological diversity and scenic beauty protected and restored for the benefit of current and future generations.*
>
> *The outdoor recreation and tourism opportunities along the coast can contribute to stronger, more diversified economies within coastal communities. Through cooperation among different levels of government, communities, Aboriginal peoples, resource industries and interest groups, the Great Lakes Heritage Coast will remain an outstanding, high quality natural resource and become one of the primary tourist destinations in the world*". (Lands for Life, 2001 : vii)

This statement indicates that, although the Heritage Coast may be presented first as a natural landscape, its heritage is defined in much wider, cultural and economic terms.

In addition to the natural landscape, the statement variously identifies 'cultural values', 'restoration', and 'diversified economies' based on 'recreation and tourism opportunities', and a political context, that includes various levels of government and stakeholder groups, as well as globalization.

In a recent text, Graham *et al.,* (2000) explore heritage from a mix of cultural, economic and political standpoints and they raise questions, which seem relevant here. Definition(s) are crucial. The simplest *definition* of heritage is as 'the contemporary use of the past'. In this case we may ask, whose past?; defined for what group, to what purpose? In cultural heritage terms, the Great Lakes, especially the upper lakes, are pre-eminently part of First Nation heritage, accumulated over thousands of years. How is First Nation culture and its set of 25 reserve lands, to be incorporated into the provincially designated area? Will Aboriginals continue to be marginalized, or be empowered by the process?

A second, much shorter, but currently dominant cultural heritage is that of Europeans, who have plied the lakes and occupied the shoreline for less than 400 years. Their coastal heritage of fur trading, fishing, mining and logging (protection), plus the facilities to support these activities, has created a highly differentiated coastal zone (Environment Canada, 1993, 1994). Many elements, however, have been in decline for decades. Is it planned to reconstruct the many fishing stations, ghost settlements such as Spragge or Depot Harbour?

Besides First Nations, and other permanent residents, there are many seasonal residents and visitors. What about today's cottagers, many of whose association with the coast goes back generations. How inclusive will the cultural definitions be? Whose past(s) will be celebrated, and/or reconstructed, along this coast?

Each group has different attachments to and images of the coastal zone, some of which are not necessarily compatible (viz; 'Group of Seven' landscape versus beach condos). I was fortunate, recently, to be an examiner for an excellent PhD dissertation in environmental history, which explored the succession of land uses and users, and the images held, of the island and mainland shore zone between the Severn River and the North Channel in Georgian Bay (Campbell, 2001). What this study revealed was both the complexity of, and the contestation between different groups with different attachments to that region, and not least, the varied viewpoints as to the need for, or wisdom of, placing specific designation and/or regulation on segments of the region.

Turning to the economic context of heritage; as noted, the vision guiding the establishment of the GLHC sees it as an engine of economic growth and as a major contributor to the world's second largest industry, tourism. This reflects economic and political reality. Northern and Shield Ontario is a 'have not', resource-based region. It is hard to imagine the population wanting to forego any potential economic benefits of this heritage resource. Many shoreline communities are declining; they will press for tangible development, to incorporate it, to access it, to promote and exploit its values.

Additionally, this coastal zone is politically complex; it includes many separate jurisdictions. It is fragmented between 20 non-native and 25 native communities, by public (provincial and federal) and private (individual and company) land jurisdiction and ownership. Will attempting to place all of these currently distinct units within a unifying 'heritage' framework resolve or exacerbate the problems? If attempts to integrate and protect a similar linear zone, i.e., the Niagara Escarpment, are a guide, then, at the very least, there will be conflict

In summary, what I think both Marsh's review of the European coastal protection efforts, and the stated vision of the GLHC suggest is that, despite the worthy goal of protection of a physical element of intrinsic value, what one faces (on an ongoing basis) are the paradoxes and dualities of heritage. Graham *et al.,* (2000) note the frequent occurrence of 'heritage dissonance', namely the lack of agreement and consistency to its meaning. The likelihood of dissonance in the case of the GLHC seems highly likely; partly as the outcome of an overtly political process, partly because of conflicting goals, and partly because of the mix of cultures over 4200 km of shoreline.

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Panel Commentary
The Great Lakes Heritage Coast: Opportunities for Protection and Community Development

Brian Craig
Ecological Monitoring and Assessment Network (EMAN), Environment Canada

The Great Lakes Heritage Coast initiative demonstrates a concerted attempt by the Ontario Ministry of Natural Resources (OMNR) to balance the protection of a spectacular natural landscape with tourism and recreation development. Mr. O'Donoghue recognizes that there will be many challenges. The most obvious succinctly expressed in his question: "How is it possible to both protect the quality of the natural resource and its wilderness characteristics while promoting tourism and development use?" He aptly points out that "it is possible to impact the very qualities of the coast which make it most desirable."

If the OMNR is indeed serious about protecting the quality of this natural resource and its wilderness characteristics – a characteristic valued by many stakeholders-then it should follow Mr. O'Donoghue's recommendation that the number of pertinent questions he poses be answered before greater use is promoted and permitted. The Great Lakes Heritage Coast initiative does present a unique opportunity to ensure protection of a high quality wilderness resource while providing important economic contributions to coastal communities, and the OMNR should be complemented for initiating consultations with communities and stakeholders. However, much ecological information remains to be gathered and presented to communities and stakeholders to allow informed decisions. In the absence of this information it would be best to apply the precautionary principle and avoid promoting development until the necessary information is in place.

Biosphere Reserves have proven themselves as a good tool to engage stakeholders and communities in adaptive ecological management. Several agencies and organizations in the Honey Harbour to Parry Sound area are currently seriously working towards the nomination of this area as a United Nations Educational, Scientific and Cultural Organization (UNESCO) designated Biosphere Reserve – the Georgian Bay Littoral Biosphere Reserve.

Biosphere Reserves are areas of terrestrial and coastal ecosystems promoting solutions to reconcile the conservation of biodiversity with its sustainable use. They are internationally recognized, nominated by national governments and remain under sovereign jurisdiction of the states where they are located. Biosphere Reserves serve in some ways as 'living laboratories' for testing out and demonstrating integrated management of land, water and biodiversity. Each Biosphere Reserve is intended to fulfil three basic functions, which are complementary and mutually reinforcing:

1. Conservation function - to contribute to the conservation of land scapes, ecosystems, species and genetic variation;
2. Development function - to foster economic and human develop ment which is socio-culturally and ecologically sustainable; and,
3. Logistic function - to provide support for research, monitoring, education and information exchange related to local, national and global issues of conservation and development. (UNESCO, 2002)

As of May 2002, 94 countries have established 408 Biosphere Reserves. Canada has established 11 Biosphere Reserves (Canadian Biosphere Reserves Association, 2002)

The UNESCO Biosphere Reserve program may be an appropriate tool to apply to the entire Great Lakes Heritage Coast for at least two reasons. Firstly, to provide a solid vehicle to engage communities and stakeholders in cooperative adaptive management planning, and secondly to engage the scientific community in designing integrated research and monitoring programs that will deliver the necessary information to decision-makers.

Canada's Ecological Monitoring and Assessment Network (EMAN), supported by Environment Canada, has developed a suite of indicators for the early detection of ecological change (EMAN, 2002). Monitoring protocols have been developed, in consultation with Canadian experts, for the majority of the indicators. These protocols are being used at many EMAN sites across Canada to monitor ecological change. Georgian Bay Islands National Park and the Georgian Bay Association are establishing terrestrial vegetation monitoring stations throughout the Honey Harbour – Parry Sound area that will collect information and track change in tree, shrub and ground cover diversity, salamander abundance, epiphytic lichen diversity, and soil decomposition, among other indicators. The establishment of these terrestrial monitoring stations will make a valuable contribution to tracking ecosystem change along a portion of the Great Lakes Heritage Coast. Forming collaborative partnerships with other agencies and organizations along the entire coast to establish additional stations would be an effective means of gathering pertinent information on ecological change.

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Panel Commentary
Key Issues in Heritage Coast Planning and Conservation

Dick Hunter[1] and Jim Faught[2]
[1] Conservation Ontario
[2] Federation of Ontario Naturalists

The background paper by John Marsh (Trent University) on Heritage Coasts in the U.K. and Europe and panel presentations on protected areas and the coastal zone by Evan Ferrari (Wildlands League) and Brian O'Donoghue, and others, have covered a very wide range of experience and perspectives which it is impossible to discuss in any comprehensive way in this summary and response. We have made the choice therefore to highlight some issues that we think are salient as a result of the presentations. In selecting these issues we have been guided not only by their significance to protected areas and conservation generally, but also by the need to address them in research, the principal interest of the Parks Research Forum of Ontario. With this in mind we put the issues in the form of questions meriting study by concerned persons in government, the universities and the private sector, particularly students.

- To what extent should preservation, protection, restoration and other approaches have roles in planning and managing protected areas in the coastal zone? Why, and how?

- Is a wide range of types of protected areas more effective, efficient and equitable than a narrow range of types? Can evidence be derived in regard to this question from comparative studies of different protected area systems in the U.K., the U.S.A., Canada, Australia and other areas?

- What are the optimal boundaries for protected areas in the coastal zone? To what extent should they be linked to marine environments and to what extent to watershed and other terrestrial environments? Why, and how?

- From both a theoretical and a practical standpoint, how can protected areas relate or contribute to biodiversity and nature conservation, as well as recreation and tourism and other forms of development in coastal areas? What challenges do these different roles pose and how can these challenges be dealt with?

- What roles do protected areas have in addressing threats to the environmental quality of coastal areas, where these threats include: flood, erosion and other hazards; degradation of wetlands, dunes and other significant coastal ecosystems; oil spills, waste disposal and other pollution; agricultural runoff, nitrate and other enrichment; exotic species; outfall from nuclear power plants; climate change; and fluctuating water levels? In what ways can the addressing of such threats be improved?

- What roles do protected areas have in conserving and sustaining fisheries? What uses should be permitted and what regulations or other incentives applied and why?

- How effective are protected areas in managing for nature conservation and environmental quality in areas where they have been in place for some time? What monitoring and assessment research has been carried out in this regard, what does this research tell us? What more is needed and why?

- What research results are available on the relative roles and contributions of public and private stewardship in protected area planning and management? Is more monitoring, assessment and research needed? If so, why and in what ways and where should it be carried out?

- To what extent and in what ways have protected areas linked nature conservation with protection of water quality and other roles in the context of a broad ecosystem perspective on coastal planning, management and decision-making?

- What economic and other studies of the human dimensions of protected area planning and management have been conducted in Ontario and other countries, especially with respect to the coastal zone? What do they tell us? What more is needed?

- What research is available on interrelations and co-ordination among government agencies with responsibilities for nature conservation and sustainability in the coastal zone? What does this tell us? What additional research is needed along these lines in Ontario and the Great Lakes?

- What research is available on linkages and roles among non-government organizations and between these organizations and government agencies and citizens? What does this research tell us? What more is needed and why?

- What research has been done on the roles and values of First Nations in the broad field of coastal planning, management and decision-making? What more is needed, why, how should it be carried out and by whom?

- To what degree do we understand fish ecology and the dynamics of the Great Lakes? What are the key areas requiring research, why, and how should the research be conducted?

- How clear to citizens are the concepts and systems used in science, planning, management, and decision-making of protected areas in the Great Lakes? How does this understanding contribute to their support for conservation and active participation in it?

- How do protected areas and conservation systems compare among Superior, Huron, Lake Erie and the other Lakes? What are the advantages and disadvantages of these systems? How can experience be shared more effectively and efficiently among planners, managers and citizens responsible for or living in these basins? More particularly how do conceptual, planning, management and decision-making systems compare across the boundary between the U.S. and Canada? What are the advantages and disadvantages of these systems and how can experience be shared and reconciled?

The foregoing list raises some of the significant research questions arising from the presentations and discussion on protected areas in the coastal zone. However, others may find that some key issues have been missed in this commentary. Our principal intention is to highlight key research issues and stimulate the identification of others, the general aim being to encourage more vitally needed research on protected areas, conservation, environmental quality and sustainable development in the coastal zone of the Great Lakes, particularly Ontario.

Note:
This commentary was summarized by the Editors from notes taken by Dick Hunter and Jim Faught at the PRFO 2002 meeting.

Protected Areas, Human Ecology and Planning

Maple leaf frozen on the edge of the St. Lawrence River, Mallorytown Landing, St. Lawrence Islands National Park (C. Lemieux)

Human-Environment Interactions in Prespa National Park, Greece

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Abstract

Prespa National Park, located in the northwest corner of Greece, is a unique environment with significant natural and cultural elements that are being seriously threatened. The past symbiotic relationship between the local communities located within the park boundaries and the natural environment has changed with the advent of agricultural intensification and the switch from mixed farming methods to a bean monoculture. Irrigation works have drained valuable wetland area and favoured agricultural land use next to the wetland versus previous upslope plots. The local communities face many remote rural area problems, such as depopulation; inadequate services; sense of social isolation; impoverishment of biodiversity; a low level of professional skills; and difficulty marketing products. Park infrastructure is non-existent and there is a lack of cooperation among the many agencies and levels of government that have jurisdiction over the park. This case study attempts to examine stakeholder perspectives and human ecological interactions in order to better understand the interrelationships between environmental protection and cultural preservation.

Introduction

Resource and environmental management is characterized by problem solving and decision-making in regards to natural resources, which includes the management of human interactions with these resources. The process of understanding and managing the interrelationships between the biophysical and socio-economic environments leads to complex and probabilistic problems. Slocombe (1993) asserts that understanding the state and dynamics of the ecological and institutional aspects of an ecosystem is essential for determining the obstacles against more sustainable management practices. Nelson and Serafin (1997) state research is needed into the interrelationships among ecological approaches, land use, institutional arrangements and environmental education, especially as they relate to environmental conservation, sustainable development, and public and private stewardship. According to McNeely (1994) detailed knowledge of the people whose lives are affected by the establishment and management of protected areas is as important to protected area management as the information on the plant and animal species to be conserved. This paper addresses key groups' perspectives concerning park management in Prespa National Park, located in northern Greece, in order to better understand the basis of environmental problems and conflicts in the area.

Case Study Background

The Greek government officially declared Lake Mikri Prespa and a peripheral zone as a National Park in 1974 (IUCN, 1987). Prespa National Park is located in the northwest corner of Greece bordering the former Yugoslavian Republic of Macedonia (FYROM) and Albania (Figure 1). Lake Mikri Prespa is one of 11 Greek wetland complexes designated as Wetlands of International Importance under the Ramsar Convention (IUCN, 1987). Prespa National Park is also recognized as an Area of Exceptional Natural Beauty (Greek Ministerial Decision A/931/23211/1747/1975), a Special Protection Area under the 79/409 European Economic Community (EEC) Bird Directive, and a constituent of the Natura 2000 network under the 92/43 European Union (EU) Directive for the conservation of natural habitats and wild fauna and natural flora. Byzantine churches, monasteries, 15th century wall paintings, hermitages and traditional stone buildings survive as evidence of Prespa's long cultural history.

Figure 1. Prespa National Park located in the northwest corner of Greece. The shaded area on the map represents the core of the park while the rest of the area is considered the peripheral zone (Trakolis, 2001: 229).

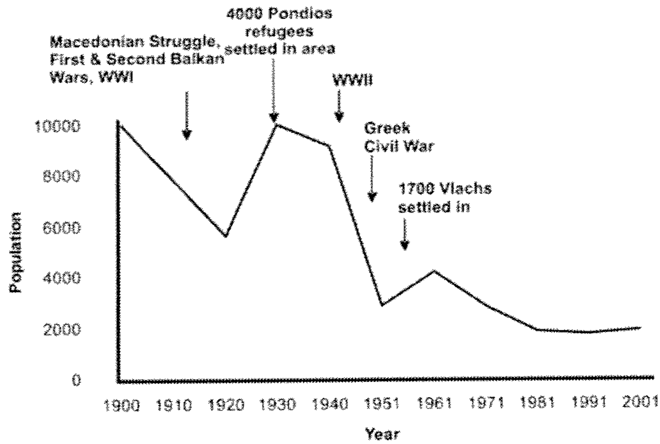
Prespa National Park covers 256 km^2 of which approximately 43.5 km^2 and 37.64 km^2 are the Greek portions of Lake Mikri Prespa (shared with Albania) and Lake Megali Prespa (shared with Albania and FYROM), respectively (Pyrovetsi and Gerakis, 1987). The park lies in a mountainous region where the altitude ranges from 853 m to 2177 m above sea level. The climate shows characteristics of a hot and dry Mediterranean type during the summer (July 23.6°C) and Mid-European type during the winter with long periods of high rainfall, snow, increased cloudiness and low temperatures (January 0.8°C) (Hollis and Stevenson, 1997).

The number and diversity of animal species in Prespa is commonly attributed to the high variety of habitats, the existence of relatively large areas with shallow water around the lake and the existence of mountainous habitats nearby (Catsadorakis, 1997a). Prespa contains over 1300 species of plants (Pavlides, 1997) and more than 40 species of mammals, including brown bear (*Ursus arctos*), wolf (*Canis lupus*), chamois (*Rupicapra rupicapra*), and wild boar (*Sus scrofa*) (Chaini, 1999). Extensive areas of common reed (*Phragmites australis*) and many shallow lagoons in Prespa create important marshlands for large colonies of breeding birds. Among the 261 bird species that have been observed in the Prespa area since late 1960s, 164 breed in the park including the internationally important Dalmatian Pelican (*Pelecanus crispus*), Great White Pelican (*Pelecanus onocrotalus*) and Pygmy Cormorant (*Phalacrocorax pygmaeus*) (Catsadorakis, 1997b).

Human activities, over many centuries, have played a key role in shaping the natural environment of Prespa National Park. Currently there are 13 communities in the park with a resident population of approximately 1300 people (Catsadorakis and Malakou, 1997). Prespa National Park is located in a contentious border area and the twentieth century proved to be quite a difficult time for the people of the area with conflict and depopulation as a result of the Macedonian Struggle, the First and Second Balkan Wars, the two World Wars and then the Greek Civil War. Some abandoned villages were resettled at a later date while others were deserted for good. The Greek government attempted to repopulate the area by settling 4000 Pontios Black Sea refugees in the mid-1920s and then 1700 Vlach shepherds in the 1950s. The population has still decreased significantly from the approximately 10,000 inhabitants present at the beginning of the twentieth century and the other 5700 people who were resettled in the area (Figure 2).

The Prespa region had a traditional subsistence economy that combined crop farming with livestock breeding, fishing, and collecting from nature following the end of the 1940s (Valaoras, 1998). This drastically changed in the early 1960s when a surface irrigation network was established to convert rain fed crops to irrigated ones in order to increase production and farmer's incomes (Catsadorakis and Malakou, 1997; Valaoras, 1998). The increasing intensification of agriculture gradually displaced the subsistence economy. By 1986, the monoculture cultivation of dry white haricot beans had begun to replace mixed farming methods and then dominated the agriculture in the park throughout the 1990s.

Figure 2. Population changes in the Prespa area (after Daoutopoulos *et al.*, 1999: 65-68; NSSG, 2002: 48).



The designation of the area as a National Park did not affect land ownership status and most of this land is still privately owned (Pyrovetsi and Gerakis, 1987). However, since about 40% of this land belongs to absentee landowners, a significant percentage of farmers' income is being transferred to other regions in the form of rents (Catsadorakis and Malakou, 1997). Currently, the Prespiot farmers cultivate a total land area of approximately 5 ha spread out on about six plots (Pyrovetsi and Daoutopoulos, 1999).

Soil erosion is severe in the area. There has also been considerable human modification to the hydrology of the region. Loffler *et al.* (1998) state the water level of Lake Megali Prespa has dropped 6 m since the 1950s and attributes the drop to the steady expansion of irrigation networks. Lake Mikri Prespa is believed to have entered a critical stage of eutrophication due to agricultural runoff (IUCN, 1987; Loffler *et al.*, 1998; Michaloudi *et al.*, 1997; Tryfon and Moustaka-Gouni, 1997), however more research and better testing of the water quality of the lakes is required (Golterman, 2001).

Fisheries have existed on the two Prespa lakes since time immemorial, but only the inhabitants of the village of Psarades on Megali Prespa were, and still are, full-time fishermen (Crivelli *et al.*, 1997). The others are mainly farmers who fish in their spare time. Since 1945, the number of active fishermen has constantly decreased and it is difficult to know how many currently continue fishing on the Prespa lakes (Crivelli *et al.*, 1997). Some fish are sold by the fishermen themselves but most are sold to merchants who drive around locally and sell their fish (Catsadorakis and Malakou, 1997). Fishermen sometimes supplement their income by taking visitors on their boats for trips on the lake and others keep fish taverns where they cook part of their catch.

In 1991, the Society for the Protection of Prespa (SPP), a federation of seven Greek environmental organizations and three from elsewhere in Europe, was founded (Chaini, 1999). The SPP mission is to conserve Prespa's natural environment and cultural heritage, as well as to promote sustainable development (Chaini, 1999). In 1992, an Information/Visitor Centre was established in Prespa by the SPP, the first of its kind in a Greek National Park (Valaoras, 1998). The centre, which is visited annually by more than 6000 people, is run by five young local people who were trained as eco-guides and work in an environmental education programme which attracts more than 5000 students annually (Catsadorakis and Malakou, 1997). Other SPP activities have included the support of organic farming and the marketing of local products, such as woollen socks, herbs, dried beans and preserves, through information centres (Valaoras, 1998).

Key Perspectives

Inhabitants' attitudes toward the Prespa National Park designation have varied from indifference to hostility due to the fact that the decision was made without any previous discussion or consultation with the communities (Pyrovetsi and Gerakis, 1987). Local people related conservation not only with prohibitions and restrictions, but also with a loss of control in any decisions made for their future (Chaini, 1999). Various efforts to sustain the rural economy have not been successful and there is a general tendency to blame the mere existence of the park for social and economic problems which are actually common in most other isolated rural areas of Greece (Pyrovetsi and Gerakis, 1987). Remote rural area problems in Greece include depopulation; sense of social isolation; low level of farmers' and cattle raisers' professional skills; difficulties in marketing local products; inadequate services; and impoverishment of biodiversity (Chaini, 1999). Generally, the 13 communities are concerned with their survival and economic well being; believe the natural resources are theirs to use; and are ignorant of environmental impacts.

Although some of the local people are still hostile toward the park, the majority seem more indifferent to its existence and see the park as a separate entity not involving them. Trakolis (2001) found that 15% of Prespiots interviewed did not know whether they lived in the National Park or beside, while the locals in the sample who answered their village was inside the park was less by 28% than those who actually lived in the park. The local inhabitants expressed similar feelings towards the environmental NGO. Even though there are locals who are still hostile towards the environmental group, for the most part the local people ignore them. The SPP has been working in the park for over 10 years, so the locals have become accustomed to their presence, but disregard them unless the NGO attempts to do something that the locals feel will affect them negatively, especially in economic terms. Some locals do think the SPP does do some 'good things' for the birds, while I witnessed others blame the SPP for social and economic problems beyond their control, such as the lack of visitors to their community.

The Managing Director of the SPP, Myrsini Malakou, states their priority objectives are as follows: (1) water level in Lake Mikri Prespa; (2) appropriate legislation for the park; (3) establishing a park management authority; (4) organization of the trans-boundary Prespa park (with Albania and FYROM); and, (5) management of the wet meadows (personal interview, 16 August, 2001). Malakou asserts that these objectives should not be seen as separate from the local people and since primary sector activity is very important in the area, it is also a concern of the SPP (personal interview, 16 August 2001). The SPP is focused on protecting Prespa's natural environment and preserving its cultural heritage. However, there is little evidence of the SPP really trying to involve the local people in decision-making. The intense hostility the NGO encountered from the local inhabitants when the SPP began may be a contributing factor to the minimal local involvement. Nonetheless, after over a decade of working in the area I would have thought the relationship between the SPP and the local people would be somewhat stronger. The SPP does have some young locals who have been trained as eco-guides for Prespa's Information Centre, who are very helpful and knowledgeable concerning the Prespa environment; however some individuals exhibited limited awareness and understanding of broader environmental issues. The members of the SPP are a tight knit group and tend to mostly socialize with each other, with some having contact with only a small number of the local inhabitants.

Although Greece's acceptance as a full member of the European Union in January 1981 set the environment high on the government's agenda (Kazakos, 1994; Lekakis, 1995), Greece's ultimate national policy objective is rapid economic growth, as a means of converging with the northern EU member states (Fousekis and Lekakis, 1997). The Greek state is supportive of the economic development of Prespa and does not tend to enforce or push forth conservation measures (Chaini, 1999). Papageorgiou and Brotherton (1999) state scarce funding, insufficient staff, who are inadequately trained in park management, and the lack of a special independent park administration are bottlenecks in effective environmental protection in Greece. The Prespa region has had at least eight different government authorities of local, regional and national level prepare separate development plans for the National Park or for a larger area including the park since various aspects of the park fall under the jurisdiction of different authorities (Trakolis, 2001). For example, Ramsar wetlands fall under the jurisdiction of the Ministry of Environmental Planning and Public Works, while National Parks are the responsibility of the Forest Service under the Ministry of Agriculture.

Over the past couple of decades, the EU has given quite a bit of funding to Greece for Prespa's development, however often times the money has been used by the

State for inappropriate works, such as a disastrous Integrated Mediterranean Programme in the mid-1980s (Pyrovetsi, 1989). Although the EU has a number of directives and policies that are aimed at preserving the environment, others such as the Common Agricultural Policy (CAP) are a major driving force in the continuing technological revolution and intensification in Greek farming. The CAP has led to drastic changes in the natural environment of Greece and altered the socio-economic dynamics of Greek rural society (Kasimis and Louloudis, 1997).

Discussion and Conclusions

Conflicts in resource and environmental management are usually over values, either ecological or human, rather than clashes over numbers (Sexton, 1998). Frequently, there is a serious incompatibility of views among regulatory agencies, affected communities, businesses and environmental groups (Grimble and Wellard, 1997). Table 1 demonstrates the general viewpoints of four key stakeholder groups affecting Prespa National Park. The four groups have different priorities, interests and objectives from which conflict may arise. Understanding these differences can help in balancing conflicting purposes and aims, determining tradeoffs and developing a common vision, all of which are essential to Prespa's future environmental integrity.

Although the SPP has a great environmental education program for those visiting the area, very little seems to have been done to educate the local inhabitants, possibly due to past hostility and fear of confrontation. The locals' mistrust of authority and fear of losing their autonomy is a major obstacle to the promotion of environmental education in Prespa. Hence, a slide show telling villagers of the natural assets of the park is not likely to be very successful on its own. The local people desperately want their voices and opinions to be heard. The approach to environmental education will have to be dynamic and interactive, such as series of public meetings in each of the villages where at first the environment may not be the major focus. The meetings will need to have themes that are important and socially relevant to the people of the area, so they will wish to participate. It will also be imperative to demonstrate how these meetings would be beneficial to those involved by perhaps establishing short- and long-term goals for community projects. Environmental concerns, such as improper fertilizer and pesticide practices and disposal, could eventually be discussed in terms of their impact on water quality and human health.

While large-scale initiatives like the creation of the Balkan park are important for the entire region's future, smaller scale projects also need to be implemented. More of a grassroots approach towards environmental protection should be undertaken. For example, litter is a large problem in the park, so possibly litter pick-ups could be organized through the communities and schools.

Table 1. Current perspectives and roles of Prespa stakeholders (adapted from Sexton *et al.*, 1999: 8).

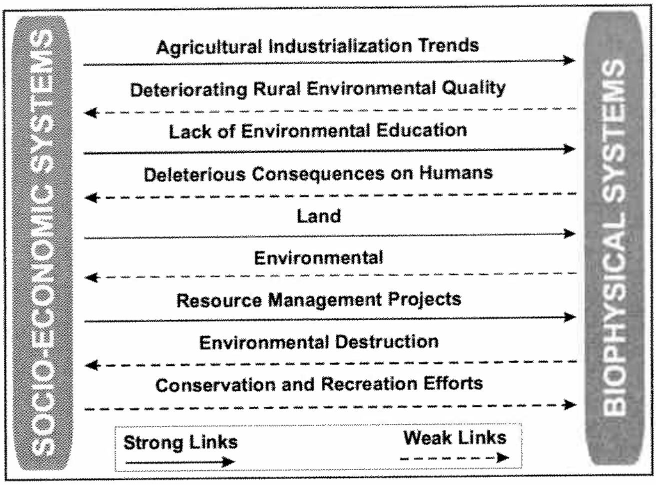
	Greek Government	European Union (EU)	Prespa Communities	SPP (Environmental NGOs)
Communities Imperative	Implementing regional/transnational policies; forming trade partnerships; strengthening global identity as a conglomerate	Boosting economic growth; implementing laws; concern for social welfare of citizens (not equitable)	Protecting community and individual well-being; meeting basic needs	Preserving and protecting the natural environment
Legitimization	Accession of member states	Legal authority and power	Group identity and social justice	Principles and passions
Basis for Decisions	Bureaucratic precedent; political wills and realities	Legalities, political realities and bureaucratic precedent	Short- to medium-term preservation of community and economic well-being	Long-term preservation of natural systems
View of Natural Resources	Use and protect within the confines of EU policy	Means to achieve an end; little protection offered by statutory mandates	Use to benefit community	Ends unto themselves; use only within prescribed limits
Approach to Environmental Protection	Agendas, policies and agreements; member state pressure tactics	Very weak mandates; protection in name only	Hostility to indifference; ignorance of environmental issues/impacts	Legislative prescriptions, political will, ethical values
Attitude Toward Economic Growth	Generally desirable within the context of EU policy	Very important priority	Desirable in the context of benefits to the community	Only desirable if it balances environmental, economic and social factors

Coordination of local projects and plans by the municipal government, local communities, environmental NGOs, and the local forest service is essential, however much of this problem is at the national level with inter-ministerial competition and government structure. Comments by Slocombe (1993) that overlapping jurisdictions, competing agencies, varied goals of multiple actors and existing management frameworks tend to lead to conflict rather than cooperation definitely apply to the situation found in Prespa National Park. An integral step toward cooperation in Prespa, which will most likely involve conflict, is for the different groups of people to recognize one another, instead of ignoring each other's existence. A sense of community needs to be restored in the area following the belief that if the local people care about where they live, they are more apt to want to protect it. The bitterness and self-interest that has developed is as destructive to the environment's health as it is the area's social sustainability. A recently formed cultural NGO called The Cultural Triangle of Prespa, could potentially play a major role in fostering community spirit through its local initiatives which have included the establishment of a library and an arts festival which involved art workshops in each of the Prespa villages.

Dynamic change in systems may be addressed by the patterns of interactions. Berkes and Folke (1998) assert that the analysis of interactions requires a focus on feedback mechanisms and social-ecological linkages. Patterns of interaction produce certain outcomes such as 'the biophysical environment may or may not be used sustainably; the functional performance of the ecosystem may or may not be damaged; and benefits may or may not be shared equitably or fairly (Berkes and Folke, 1998). Some key interactions between the socio-economic and biophysical systems in Prespa National Park are demonstrated in Figure 3. Feedbacks from the biophysical systems to the socio-economic systems are rather weak, whereas the forward links from the socio-economic system to the biophysical system are much stronger and disruptive of the existing natural cycles (Bowonder, 1987). For example, historical human practices in the park, such as cutting and burning the reeds surrounding Lake Mikri Prespa, altered Prespa's biophysical environment by inhibiting the terrestrialization of the small lake. This human practice in turn led to optimum spawning grounds for the fish in the lake, which fed the bird species. However, this balance was disrupted with the park designation when the cutting and burning of reeds was banned resulting in rapid reed growth and infill, which affected fish spawning grounds and accelerated eutrophication. Now measures are being taken by the environmental NGO to reverse these trends by different forms of reed management in order to return to the previously human induced balance.

Prespa National Park is a unique environment with significant natural and cultural elements that are being seriously threatened. Although the environmental NGO has been successful in many of its initiatives, it has failed to attain support and cooperation from the majority of the local people. The centralizing character of the Greek government has led to funds being spent on inappropriate development in the region, which has often been economically and environmentally costly. A cohesive social identity and cooperative spirit in the local communities is integral to improving Prespa's social health, which fundamentally impacts the park's biophysical environment.

Figure 3. Some key interactions between the socio-economic and biophysical systems in Prespa (after Bowonder, 1987).



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Coastal Values and Quality of Life: A New Zealand Case-study

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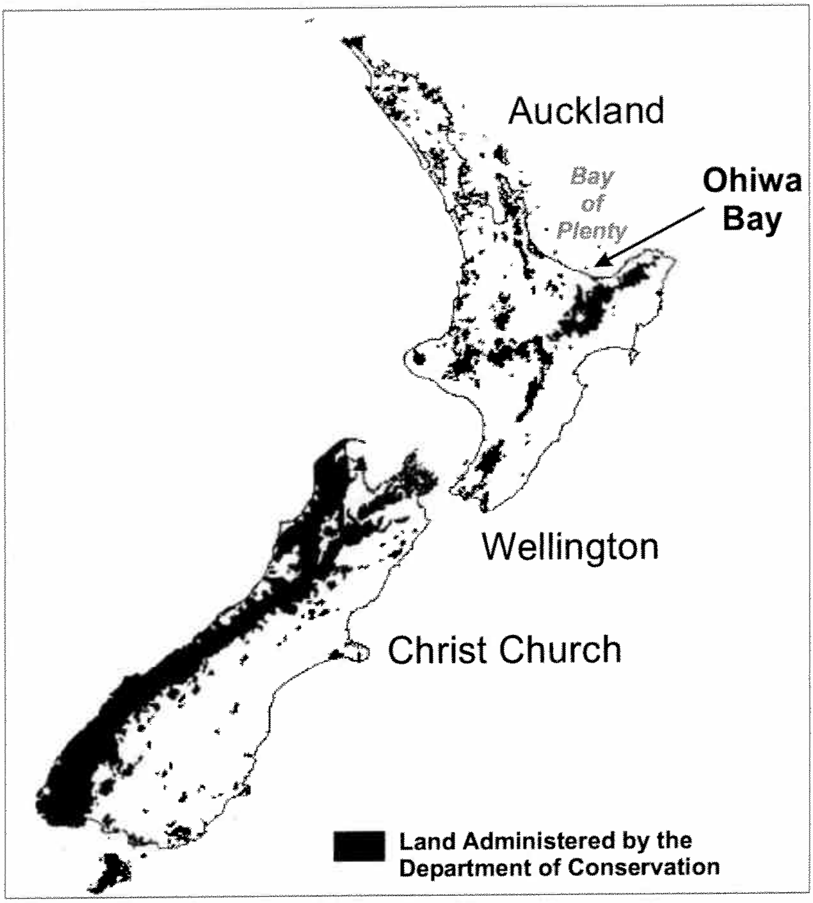
Abstract

An important input into the management of coastal areas is the values ascribed to such areas by those people who live close to, visit and use the amenity opportunities provided by the beaches and adjacent waters. This presentation discusses a process used to elicit values from residents of Ohiwa Bay on the east coast of the North Island of New Zealand. A series of focus groups involving local citizens was used to elicit key value categories and value statements. The focus group discussions centred on the key question " What makes Ohiwa Bay a good place to live?" Specific 'value statements' were used subsequently to develop a questionnaire, which was distributed to randomly selected individuals throughout the community. A preliminary synopsis of the results of the study is provided.

Introduction

New Zealand has a long coastline, estimated at some 15,000 km. With no towns more than 120 km from the coast, it plays an important part in the recreational and vacation life of New Zealanders (Rennie, 1993). The coastline is extremely diverse and major development is sparse with extensive areas of wild coastline especially in the southern part of the South Island (Figure 1). However, in common with coastal areas around the world, especially those in close proximity to large urban centers, many in New Zealand are increasingly under threat from tourism and residential development. As a result of city-dwellers seeking their little piece of paradise in the sun beside the sea and sand, sleepy, once remote hamlets are now the focus of beach-home development and beach-hut conversion. While this can provide residents with enhanced employment and business opportunities, escalating costs, overused facilities, loss of privacy and reduced amenity are also a common part of such development scenarios.

Figure 1. Map of New Zealand.



Government agencies and local authorities charged with planning and management are drawn into complex and often acrimonious debates over the future of particular regions. The multiplicity of jurisdictions involved in the planning of development and the maintenance of natural amenity in these coastal areas further complicates the prospects of finding solutions. Such solutions, to be judged appropriate, must not only minimize the impacts of development on the environment but must also meet the often conflicting demands among local interests and between them and seasonal residents.

A key challenge for decision-makers in coastal areas is to develop a decision-making process that takes into account the relative importance placed on various uses of the same area by different stakeholders. Identifying the various values that are assigned to different uses provides one way of assessing the relative importance of one use over another (RAC, 1992). 'Held' values or ideals influence the 'assigned' values or worth of a place and both can influence the attitude taken towards a particular use of that place. In a sense, attitudes are values in action. Positive or negative attitudes can be expressed or action taken with respect to a class of places (e.g., wilderness) or a specific place (e.g., Quetico Provincial Park). Hence, in issues involving land-use planning, a value-based perspective is being introduced as a central part of the community consultation process (Wight, 1998). Such an approach can reveal the broad areas of agreement in the community (i.e., what must be sustained) and enable managers and community to focus on those issues where division exists.

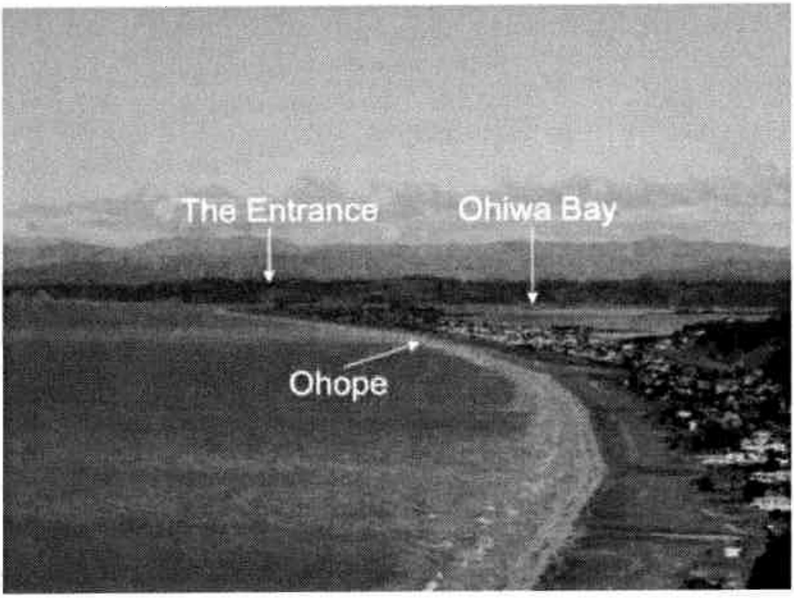
This paper details an approach to elicit values ascribed to a coastal region and uses a study from New Zealand to illustrate the use of the approach in a particular context.

Study Area

Ohiwa Bay is a small coastal community in the Bay of Plenty on the East Coast of New Zealand (Figure 1). The main settlement, the town of Ohope (Figure 2), has a resident population of 2760 (2001 Census). Although still dominated by older style beach cottages (baches), development of modern condominiums is on the increase and the once sleepy little hamlet now boasts a modern development on the site of the old shipping wharf and a number of controversial residential developments are proposed. Most of the landscape surrounding the Bay is dominated by agriculture and forestry operations but there are an increasing number of 'alternative lifestyle' inhabitants moving into this area as agricultural activity declines. The large township of Whakatane (population about 14,000) is a major summer tourist destination and lies approximately 5 km away on the other side of a prominent ridge. Ohope and district have become dormitory suburbs for Whakatane and suburban development is gradually encroaching.

The Bay of Plenty Regional Council and the New Zealand Department of Conservation are currently involved in the preparation of a development plan for the Ohiwa Bay District with a number of coastal developments at the initial proposal stage. There is much division within the community as to the future of the region and a sense on the one hand, that the natural and aesthetic values of the Bay are being compromised and on the other, that tourism development will bring prosperity and much needed employment to the area. The study described in this paper is one part of this planning process and was aimed mainly at eliciting the relative importance of quality of life attributes of the Ohiwa Bay district as perceived by permanent and seasonal residents.

Figure 2. Ohiway Bay district.



Methods

The initial stage in the development of the survey instrument was the elicitation of values attached to Ohiwa Bay and District by means of a series of focus groups. Participants in these focus groups were nominated by the Department of Conservation. In total, three relatively homogeneous focus groups were conducted.

- Conservation interests;
- Ohope residents; and,
- Catchment and Harbour residents.

All focus groups' discussions were tape-recorded and transcribed. Open and axial coding of the transcripts was conducted independently by two of the authors. This process resulted in the development of a series of value themes and value statements, which defined various quality of life attributes.

Value Themes and Statements

Five broad value themes were derived from the analysis of the focus groups. Each of the themes is listed below with an example of a value statement:

- Natural values (e.g.,"The variety, the wetlands, the coastlines, the pohutakawa, the sandy shores…");
- Economic values (e.g., "The ability to make a living");
- Recreational values (e.g., "The diversity of recreation, kayaking, fishing, jet-skiing, picknicking, boating…);
- Cultural values (e.g., "The spiritual connection with the land that restores and sustains you"); and,
- Social values (e.g., "The size of the community…its relatively low population).

30 value statements encompassing all aspects of the themes were derived from the analysis of the focus group transcripts (13 "Natural"; 6 "Recreational"; 5 "Social"; 4 "Economic" and 2 "Cultural").

Survey Instrument

The 30 value statements were then used to develop a survey instrument to explore the relative importance of the value statements in the Ohiwa Bay community. Respondents were asked to rate the importance to them of the 30 value statements derived from the focus group transcripts. Each item was rated on a five-point Likert scale (5 = very important to 1 = very unimportant). Respondents were asked to indicate a number of demographic characteristics including: years of residence in the Ohiwa Bay District; age; gender; place of residence; education level and ethnicity.

Data Collection

A mail-out survey was distributed to a randomly selected sample of 1000 residents in the Ohiwa Bay District. The modified Dillmann Method (Dillmann, 1983) was used to design and distribute the surveys. A total of 404 useable responses were returned (40% response rate).

Results

Sample Characteristics

Respondents comprised people who had lived in the Ohiwa District for less than a year to those who had been there for up to 66 years. The average time living in the region was 18 years with a standard deviation of 15 years. There were more male (57.7%) than female (41.5%) respondents. The average age was in the range 46 to 55 years with some 25% of the sample over 65 years. Education level of the sample was slightly skewed towards tertiary level qualifications (53%), the other 47 per cent having either "High School" or "Trade" qualifications.

The sample was dominated by Pakeha respondents (88.5%), with 7.4% Maori and 4.1% mixed race (Maori/Pakeha). Most indicated their place of residence as "Ohope"

(34.3%). "Harbour Front (not Ohope)" accounted for 20.7%, 17.8% nominated the "Catchment" and 27.2% indicated that they were "Non-resident Property Owners". Almost half (47.1%) of this latter group had residences in Ohope, with 28.1% in the "Harbour" and the remainder (24.8%) in the "Catchment".

Data Reduction

The 30 value statements were reduced to six principle factors (Table 1) using Factor Analysis. This statistical procedure allows a large number of related items to be grouped into similar conceptual categories. This procedure is similar to the thematic analysis used to derive the initial items for the survey. However, rather than being based on researcher 'judgement' the factors are derived mathematically from the level of correlation between the individual items.

Table 1. Factor analysis value performance.

	Development Tourism	Nature Spiritual Connection	Nature Amenity	Community	Recreation	Nature Managed
Development	.867					
Tourism	.845					
Capital Gains	.780					
More people attracted	.731					
Sophisticated society	.591					
Amenities at the wharf	.585					
A sense of being where I belong		.764				
Spiritual connection		.748				
Timelessness		.683				
Maori history		.631				
Sounds of nature		.609				
Natural variety		.476				
Huge un-impacted coastline			.725			
Low population			.579			
Combination harbour/sea/bush			.578			
National Park Ohiwa harbour			.548			
Community different from city				.753		
Community caring/sharing				.751		
Diverse range of cultures				.721		
Harbour place of relaxation/recreation					686	
Diversity of recreation					.667	
Seeing people use/enjoy harbour					.593	
Catch Seafood					.491	
Mix of forestry and farmland						.698
Non-native species						.623

Value Clusters

Six value clusters were identified by the Factor Analytic procedure. Factor 1 was named *Development/Tourism* because it was made up of value statements, which referred to aspects of development and amenities associated with tourism. In essence, it comprised those value statements which were classified as "Economic" in the original thematic analysis.

The Factor Analysis indicated that the original "Natural" values category consisted of three sub-sets namely:

- *Nature Spiritual Connection* combined value statements on place attachment, aesthetics and culture;
- *Nature Amenity* combined those statements, which referred to the relatively uncrowded and high natural amenity of the district; and,
- *Nature Managed* combined value statements, which referred to the rural and human altered nature of the district.

A fifth Factor, named *Community,* comprised valued attributes of the Ohiwa community including its perceived difference from the 'city', its ' cultural diversity' and supportiveness. The sixth and final Factor focused on the *Recreational* values of the Ohiwa District including the 'harbour', diversity of recreational opportunities and recreational harvesting of 'seafood'. One value statement "The native bush and the abundance of wildlife" loaded equally (.510) on the *Nature Spiritual Connection* and *Nature Amenity* attesting to the contribution made by the 'bush' and 'wildlife' to both the natural amenity and spirituality of people in the area. While the Factor Analysis aids in the understanding of the value clusters shared by the people of the Ohiwa District, it does not in itself indicate the relative importance of these values.

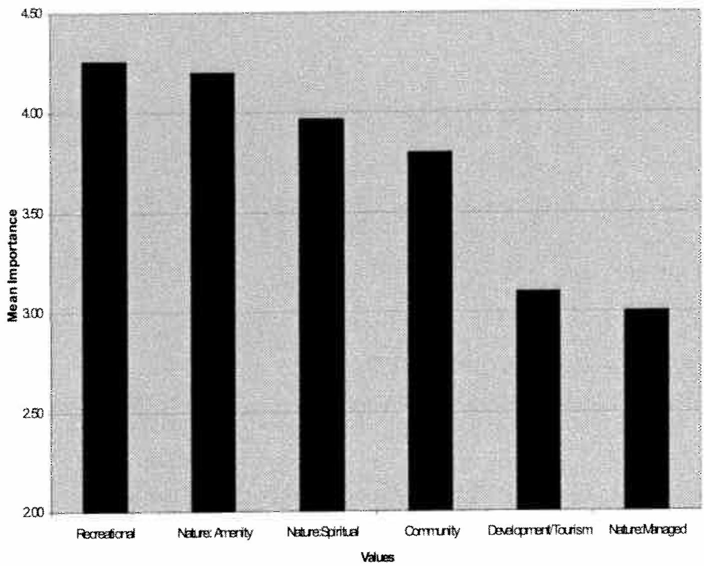
Relative Importance of the Values

To understand the relative importance of each of the value clusters to the people of Ohiwa District, it is necessary to calculate the mean (average) score of each of the value clusters.

It is evident from Figure 3 that the most important value of Ohiwa District is its *Recreational* opportunities (mean score = 4.25). This is closely followed by *Nature Amenity* (mean score = 4.19), *Nature Spiritual Connection* (mean score = 3.96) and *Community* (mean score = 3.79). All of these would be rated as "important" to the people of the Ohiwa District. On the other hand, two value clusters are rated as neutral, namely *Development Tourism* (mean score = 3.09) and *Nature Managed* (mean score = 3.00).

The analysis indicates that there are three distinct value groupings. The first is comprised of recreation and nature amenities (i.e., use values). The second, of only slightly less importance, relates to spiritual and community values and finally, the third least valued grouping refers to human alterations of the natural environment.

Figure 3. Relative importance of the value-clusters.



Conclusions

This paper has detailed a method for eliciting the value positions of different groups within a community, using focus groups to explore the variety of value positions and derive verbatim value statements, which were subsequently used as a basis for a community-wide survey. The results revealed a general consensus as to the high importance of recreational use, spiritual, and community values but demonstrated the relatively lower importance and greater diversity of opinion in relation to economic values related to development and tourism.

Acknowledgements

This study was funded by the New Zealand Department of Conservation.

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Management in a Planning Vacuum: Co-operation in the Quetico-BWCAW-Voyageurs International Boundary Region

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Abstract

This is a report of a workshop on shared management issues faced by Quetico Provincial Park in Ontario, and the Boundary Waters Canoe Area Wilderness (BWCAW) and Voyageurs National Park in Minnesota. In the absence of an integrated planning framework across the U.S.-Canada border, protected areas management issues tend to be tackled informally. Issues addressed in this report include fire management, tourism, and species-at-risk. The different political environments of the three areas have compounded problems of co-ordination in this biophysical region. The parks have common interests in fire management and species-at-risk management. For example, the 1999 blow-down requires co-operation by U.S. and Canadian authorities, as does any attempt at woodland caribou re-introduction. However, visitor management priorities inevitably differ: BWCAW is operating near capacity, whereas Quetico and surrounding communities need to stimulate more tourism. Suggestions are offered for improved management through enhanced co-ordination between these areas.

Introduction

Parks and protected areas do not exist in isolation of their regional context; they are perpetually being influenced by activities and management initiatives occurring around their borders (Dearden, 1988; Nelson, 1993). Activities that conflict with protected area mandates, such as forest harvesting adjacent to reserves, influence ecological, tourism and other values important to protected area sustainability and management (Woodley *et al.*, 1998). Reserves that neighbour one another also have a dramatic influence on the characteristics of adjacent land units. As a result, it is often in the best interest of protected area managers to work together on shared issues. This is not a simple task, as cross-jurisdictional management can be very challenging; this is primarily due to the differing values, management systems and a diversity of political objectives. However, issues that face one reserve will invariably influence others. An excellent example of cross-jurisdictional management issues occurs in the centre of North America, straddling the Canada – United States border; here lies one of the largest intact protected regions on the continent. It is comprised of Quetico Provincial Park in Ontario, and Boundary Waters Canoe Area Wilderness and Voyageurs National Park in Minnesota. The region functions as an ecological unit where diverse ecosystems meet; the area is in a transition zone where the Great Lakes-St. Lawrence and Boreal forests meet the eastern edge of the prairies. This region is very diverse and is home to a multitude of species, Unfortunately there is very little integrated management of the vast regions, and most attempts at cooperative management and solutions are informal and ad hoc.

For this research paper we have informally named this region (comprised of the three protected areas) as the Northwoods Wilderness Frontier (Figure 1).

The purpose of this paper is twofold. First, we examine the individual reserves and identify priority management issues. Second, we identify shared management concerns and strategies to deal with them.

Managing Beyond Boundaries

The management of protected areas is a challenging endeavor; strategies are often complex, and in certain cases contradictory (Killan, 1993; Priddle, 1982). Even so, managers must approach these tasks with vigor and from a resource protection perspective. Conflicts within a single jurisdiction are sufficiently complex; the complexity of protected area management is compounded if management decisions are to be embraced by managers from multiple jurisdictions. Management efforts across international borders further complicate things.

The Parks

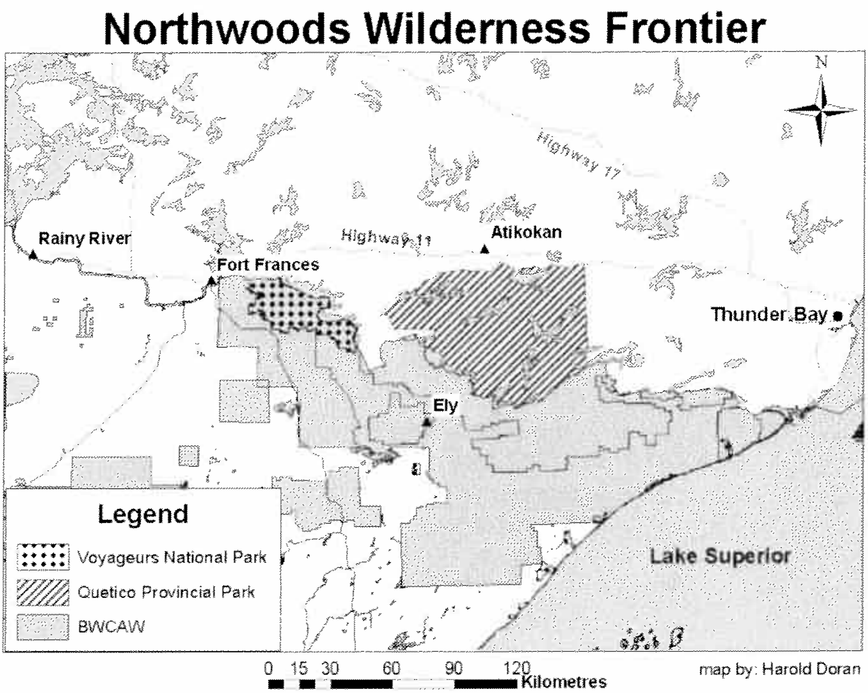
Quetico Provincial Park

Provincial parks in Ontario are classified into six categories: natural environment, waterway, nature reserve, historical, recreation, and wilderness. One hundred thousand hectares is the minimum area a wilderness park is to occupy (Ontario Parks, 2001). At 475,000 ha, Quetico Provincial Park, which lies along the Ontario-Minnesota border approximately 160 km west of Thunder Bay, is the third largest wilderness park in Ontario. It is characterized by hundreds of lakes, beautiful Canadian Shield topography, and vast unspoiled wilderness. This landscape was formed by ancient geological processes and later glacial activity and has since evolved into an area with a unique composition of Great Lakes St. Lawrence, boreal, and even

prairie plant species. The area has a rich history of use by First Nations people and Euro-Canadians.
Several issues that park managers face today include the re-introduction of fire as a natural component of the regional ecology at appropriate temporal and spatial scales.

Balancing between the needs of recreational users and meeting conservation targets is an ongoing management dilemma. In addition, managers must incorporate First Nations rights and values into park management policies and boundary zone issues.

Figure 1. Map of the Northwoods Wilderness Frontier.



Boundary Waters Canoe Area Wilderness

The Boundary Waters Canoe Area Wilderness (BWCAW) forms a ribbon of protected areas along much of the Ontario-Minnesota Border. The reserve represents a significant portion of the Great Lakes-St. Lawrence and boreal forest regions in the U.S. It is also the largest Northwoods lakelands region in the U.S. Due to its unique characteristics within the U.S., with rugged Precambrian shield and vast waterway system, and its proximity to large mid-western urban centres, it is the most heavily used backcountry area in North America. The BWCAW is the second largest protected area in the lower 48 states (434,000 ha). Even with its considerable size, high summer visitation by canoe trippers is posing a threat to the ecological integrity of heavily used routes, and to people seeking solitude and wilderness values (Stankey *etal.*, 1990).

Fire management has long been identified as a management priority ever since the early 1950s when fire suppression was the accepted management regime. In recent years, the role of fire has been identified as a priority in maintaining ecological processes and vegetation mosaics. Prescribed fire is also being used to reduce fuel loads in the large 1999 blowdown area (USDA, 2000).

The management of species-at-risk is also a major issue in this region, with many threatened species living in the Northwoods Wilderness Frontier such as the Bald Eagle (*Haliaeetus leucocephalus)*, and Canada lynx (*Lynx canadensis*). Woodland caribou (*Rangifer tarandus caribou*) once roamed the wilds of this boundary region, but were extirpated in the 1940s (Heinselman, 1996; Racey *et al.*, 1998). Studies have also been undertaken to look at the potential of woodland caribou reintroductions (Jordan *et al.*, 1996). Any species reintroduction would need the cooperation of all land managers in the Northwoods Wilderness Frontier region for success to be realized, especially for wide-ranging animals such as caribou.

Voyageurs National Park

Voyageurs National Park, located adjacent to International Falls/Fort Frances on the Ontario-Minnesota border is considerably smaller than the two other reserves, at only 89,034 ha it does not have the wilderness character of Quetico or BWCAW. Voyageurs does have other special values, such as a booming recreational industry (both summer and winter), and unique vegetation mosaics, comprised of Great Lakes-St. Lawrence and boreal forests, with significant influence from the nearby prairies. These two unique features are also what potentially pose the greatest threats to this national park. Heavy use from recreational house and motorboats in the summer, and snowmobiles in the winter are having significant impacts on the natural values associated with this national park. Due to its close proximity to dry prairies, Voyageurs National Park is particularly prone to vegetation community alterations as a result of climate change (Suffling and Scott, 2002). Some mitigative approaches such as fire control can be used in the short term to address vegetation change, but other longer-term and more appropriate management decisions will have to be made regarding sustainable vegetation management.

Shared Issues

Visitor Management

All of the reserves have visitor management issues; on the American side of the border issues arise from overuse and associated recreational impacts on native flora and fauna, with both BWCAW and Voyageurs N.P. operating near capacity during the summer months. Quetico, although heavily used in certain areas, receives many of its visitors from the U.S. as Americans cross the border from the BWCAW. This has resulted in a little economic stimulus for communities such as Atikokan in Ontario. Plans should be devised to distribute the visitors more evenly, with an increasing number entering the region from the Canadian side of the border.

Species at Risk

Addressing issues relating to species-at-risk cannot be undertaken by individual protected areas. Any form of effective management or re-introduction (in the case of woodland caribou) must be done in a coordinated fashion. Modular approaches to these issues will result in the source – sink phenomenon, in which one area may act as a source for threatened species, whereas adjacent jurisdictions with less protection will be where species are lost. In this case, the total area protected in these reserves is greater than the sum of their parts.

Fire Management

Fire is the dominant driver of change in this ecosystem (Heinselman, 1996; Ontario Parks, 1998). It has dramatic effects on all terrestrial species, their distribution and densities. Although fire suppression activities have been successful since the 1950s, their ecological impacts outweigh any benefits. This form of management is inappropriate for wilderness areas such as these, where ecological values should be the top priority. Small scale prescribed burns are a good start, but controlled disturbance events cannot replicate the stochastic nature of large natural fires, which are needed to maintain ecological systems such as Jack pine (*Pinus banksiana*) forests in this part of the world (Heinselman, 1973; Schaefer and Pruitt, 1991; Schindler, 1998). Management strategies must address this serious issue, as the ecological integrity of the area depends on a diverse fire regime. Management between reserves, especially Quetico and the BWCAW, could promote larger fires by combining management efforts and establishing a large core natural fire zone in the heart of the two reserves along the international border.

Conclusions and Recommendations

This report has outlined some of the issues facing the trans-boundary protected area in Northern Minnesota and Northwestern Ontario: the Boundary Waters Canoe Area Wilderness, Quetico Provincial Park, and Voyageurs National Park. While threatened and endangered species management, fire management, and visitor use and distribution are only a select few of these matters, their examination has led to several general conclusions which can further enhance the management of the region. These recommendations are outlined in the following paragraphs.

1. Recognize the region

The three protected areas form a unique, contiguous environment, and many issues facing individual parks are common throughout the region. Currently, the three parks are not recognizable as a regional core. A first step in recognizing the region is to agree on a name that represents all three areas (i.e., the Northwoods Wilderness Frontier). Given the breadth of trans-boundary issues facing park managers, the three protected areas also need to formalize an inter-jurisdictional committee in order to jointly address the regional issues. Such a committee would include protected area managers from all three parks and representatives from all governing agencies. This committee would oversee sub-committees that would address more specific issues such as fire, rare and endangered species, and tourism. Initiatives that could be developed at a sub-committee level could include:

- Establishing a strategy that would focus on managing the ecological role of fire throughout the region. A less restrictive political environment in Canada allows Quetico Provincial Park managers to coordinate this effort;
- Developing interpretative outreach programs and projects to raise awareness of species-at-risk in the region. Managers of the BWCAW and Voyageurs should take a leading role with these initiatives because of greater experience with threatened and endangered species management and greater funding, resulting in increased data availability; and,
- Marketing and promoting regional recreational opportunities using the new name.

2. Identify and act upon regional opportunities

There are various regional opportunities that should be pursued to help realize the goals of the area as identified by the inter-jurisdictional committee. Educational field seminars could be organized to raise awareness among the local population, lobby groups and decision-makers, with a few days spent in each protected area, to examine the differences between the biomes and their species. This program could help participants better understand ecological interrelationships and the need to protect endangered and threatened species. The participant fees could go towards paying the guide's salary and/or into a fund for species protection and recovery. The U.S. should share its considerable experience with comprehensive programs and data collection initiatives.

Opportunities, with respect to fire, include the promotion of ecological values and integrated research across inter-jurisdictional boundaries, which can then be used as a model of collaborative work.

The opportunity exists to promote and market the Northwoods Wilderness Frontier because of its unique, unspoiled character. This can be achieved through direct marketing (i.e., travel media) and indirect marketing (i.e., visual and literary art).

3. Identify shared interests and develop common goals

Managers of the three parks have indicated that maintaining the ecological integrity of the region, while providing recreational opportunities is an integral part of their responsibilities. With respect to fire, learning opportunities include understanding the dynamics of fire at multiple spatial and temporal scales.

The three protected areas need to form a regional partnership to conserve wildlife populations and their habitats. A charter or agreement on threatened and endangered species can be drawn to clearly indicate common interests and determine appropriate goals. The "Framework for Cooperation" for species protection and recovery between the U.S. and Canadian federal governments may act as a model from which a regional approach could be organized.

The three parks should also strive towards recognizing the complex as a prime tourist destination. This can be achieved by enhancing existing tourism attractions and services in the region and by marketing to domestic and international audiences that demand such wilderness.

4. Identify and work to resolve shared problems

While some problems are park specific, others are regional in scope. Identification and resolution of such problems needs to be addressed by the regional committee. A lack of information has hindered ecologically sound fire management policies. Co-operating on research initiatives and improved sharing of information related to fire could result in improved fire management practices.

A common problem regarding threatened and endangered species is habitat loss and fragmentation. The three protected areas should work together to safeguard existing wildlife corridors between the parks from major human disturbance and development.

Inter-park travel is another shared regional problem. Existing transportation infrastructure in the region does not effectively connect the parks. New and innovative ways of facilitating visitor movement within the region need to be developed by the joint committee.

5. Identify and resolve tensions

Due to the inter-jurisdictional nature of the region, specific management objectives will at times conflict with one another. In order to work together more effectively, it is important for committee members and park staff to understand the commonalities and differences among the three protected areas.

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Volunteer Capacity-Building for Horticultural Activities: A Model for Small Ontario

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Abstract

The observations and processes of this research are more the record of experiences than the comparison to work in other municipalities or jurisdictions. This project was originally implemented under the mandate of the Sustainable Rural Communities research program, University of Guelph (SRC, 2002), as part of the development of sustainable responses to municipal restructuring, and of sound economic activities, in rural communities of Ontario. It was furthermore seen to be a unique continuation of educational activities at Ridgetown College, with the JJ Neilson Arboretum offering to diploma graduates practical work experience opportunities and career advancement potential. The results have been more outstanding than anticipated - the communities involved have moved from none or little organized horticultural activity to participants in a Communities in Bloom project begun this year, and interns involved in the program from 1999 to 2001 have benefitted greatly, and thus help prove the value of structured post-diploma employment partnerships.*

Volunteerism

Volunteers undertake a great deal of the horticultural and gardening activities in smaller communities across Ontario. Horticultural societies, garden clubs, and various service clubs and interested individuals work with (or without) municipal departments, to help create and maintain sometimes extensive beautification projects. This has been experienced in Ridgetown, Ontario, in the ongoing relationship between the College and the local Horticultural Society. The involvement of these volunteers comes from their avid interest in horticulture and community beautification, and from the declining budgets of many communities where these municipally-managed activities were gradually reduced or eliminated. The decline in available volunteers, due in part to an over-abundance of opportunities for volunteering, to the aging of the population, and the increasing responsibilities shouldered

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* *Much of the background informatin may be anecdotal, either from conversation with local volunteers, or from personal experiences of the author.*

by these groups, has resulted, in many cases, in a need for professional assistance and direction. The Ridgetown experience resulted in College staff taking a leading role in horticultural programs in the community, and in providing student workers on occasion for specific projects. Funding came from local sources (service clubs) rather than municipal coffers. This experience of nearly two decades duration was somewhat typical of many of the smaller communities in southwest Ontario.

Studying the Horticultural Activities

Within the Sustainable Rural Communities research program (SRC) at the University of Guelph, supported by the Ontario Ministry of Agriculture and Food (formerly OMAFRA), a mandate to address rural issues led to approval of a specific research project in 1999. Since "The overall objective of the SRC Research Program is ... addressing vital research issues in rural Ontario that have been defined ... as significant for community prosperity." (SRC, 2002), then the beautification of rural communities, done in many instances by volunteers, could be considered a viable study. Quality of life experiences relating to nature (as observed by most people to mean plants, including flowers) bonds humans and other living things (Kaplan and Kaplan, 1989). For the local resident and for the tourist, pedestrians in the core areas of smaller communities, having "...nature at the doorstep..." (Kaplan, 1985) is a tie to the natural environment and an important 'aesthetic experience' (Chenowith and Gobsten, 1990). Volunteers understood this, and were endeavouring to keep up traditions and a cared-for appearance with horticultural improvements.

The project fit into the first two goals of the SRC: "... to strengthen economic growth, entrepreneurship and business efficiency... while achieving improved standards of living." and "... to understand, facilitate and assist rural communities ... in response to change and restructuring." (SRC, 2002). The amalgamation of twenty-three communities into the Municipality of Chatham-Kent in 1997 was one such restructuring, where many services previously provided locally were now either centralized or missing altogether. These included horticultural projects, already reduced in previous years through cutbacks, and now managed in many instances by volunteer groups.

From Pilot Project to Full Study

A pilot project in Ridgetown that included volunteers, grade-school children and college graduates, and involved the 'downtown' core area planter boxes and flower beds, evolved into examining many of the twenty-three communities that were amalgamated into Chatham-Kent. This was undertaken at the request of the Municipality, when requests for funding for the Ridgetown projects was in discussion. Funding for the close look at the communities came partly from the SRC research program, and partly from the JJ Neilson Arboretum (JJNA). Information on each community's projects, funding, personnel, and groups involved was pulled together, for presentation to Municipal Council. The result was that four of nine localities with a defined horticultural component were organized in 2001 under the leadership of the JJNA. Existing volunteer groups were represented in Community Beautification Committees, and included Booster Clubs, Horticultural Societies, Kiwanis Clubs, BIA's and Chambers of Commerce, and Community Associations, among others.

Municipal Council authorized an area-rated local improvement budget allocation for each of the four projects, based on a November 2000 submission by the JJNA on behalf of the Committees. The local committees then took responsibility for project operations and management, overseen by JJNA staff using horticulture student Interns. Project work included the preparation and maintenance of annual planting beds, planter boxes, and hanging plants, the installation of landscape features and their subsequent maintenance, and additional discussion regarding future developments and planning for horticultural activities. A fifth locality took its own proposal to Council and was approved, operating outside of the JJNA program.

Several meetings took place at which local representatives gathered to discuss the overall possibilities. Local meetings were also held throughout the season, to keep on top of the project work and any problems that developed, and to help the groups manage the workload. Payroll management and project specific aspects (purchasing, scheduling, labour allocations) were completely handled by JJNA staff, and directed through the local committees. A tour in late summer of all four communities by representatives from each locality created a further excitement and acknowledgment that the projects should carry on into the following year. The JJNA prepared summaries for each locality, followed by a detailed proposal submission to Council for the next year's seasonal activities. Each locality's projects were shown separately, and a letter from the local committee requested funding based on the individual summaries.

Results

The four projects of this segment of the study were successful, and the submission to Council for the 2002 season received approval. Results of the first year of the program's operation included the successful hiring of two student interns, the planting and maintenance of over 10,000 annual plants, and the installation of new landscape features in one location where little had previously existed. Local committees grew in their understanding of their relationships to the Municipality, and also learned more about the coordinated efforts that made formerly individual horticultural projects a larger, more manageable entity. The funding permitted the hiring of interns, who showed a great deal of interest and enthusiasm for the aspects of horticulture that had previously been poorly addressed, such as weeding and watering.

Details of the four projects were presented to Council in a November 2001 submission, where funding was requested for 2002 and subsequently approved. A measure of the volunteerism could be shown, and was calculated as 900 hours (a value of $10,800), and local contributions amounted to nearly $40,000. Municipal tax allocations of just under $50,000 were raised in each locality under the separate heading of 'horticulture'. For the four projects, a total of over 2,500 paid hours was invested, and two pickup trucks with self-contained watering systems and hand tools were provided. Each of the four 'original' committees has evolved to manage their own contracted personnel, and with an ability to carry more responsibility in dealing with the Municipality directly.

The volunteerism aspects, once valued (using a modest $12 per hour and adding estimated mileage, telephone, and other costs), were compared with the 'real' costs of the projects in each community. This component included local volunteer time and costs, and management/overseeing aspects by JJNA staff, for each project, and averaged an impressive 35% of the total ($90,000) calculated value. Of the $60,000 actual funding received, 83% came from Municipal tax bases and the remainder from local sources (service clubs, etc.). The overall project consisted of 55% labour and 10% materials costs along with the volunteered components of labour 28%, materials 4%, and other costs 3%. Budget outlines for the 2002 season were almost identical to 2001, with slightly more local funding expected, more expenditures due to increased work loads, an increased volunteer labour component, and a drastically decreased JJNA management component. The volunteer aspects overall were forecast to decrease by almost 5% of the total budget, however, the expectation is that this will actually increase.

Overall, there were six main results of note in these projects:

- local Community Beautification Committees were established;
- an area-rated local improvement taxation system was implemented;
- community involvement in (previously) municipal horticultural as pects increased;
- local committees increased in their management capacities;
- trained and interested horticulture graduates were involved in com munity projects and performed well; and,
- career development opportunities for graduates were provided.

A New Dimension for 2002

In late Fall of 2001, Council approved the funding for a Communities in Bloom (CIB 2002) project for Chatham-Kent. This was to be an initial attempt at organizing and implementing much the same beautification project work as had been undertaken in the study previously, but with a broader scope. It was also intended to bring the amalgamated communities closer together in a common cause. Funds for the hiring of a Community Beautification Coordinator to oversee these four projects and several others, and to develop new projects and increased community involvement as part of the CIB proposal, was set aside. The total package of $150,000 in funding would also cover student wages, judging costs, training, and assistance to communities where (new) projects would be undertaken. The CIB project was set over the existing beautification projects, where nothing really changed except for some additional student worker assistance during the summer, although the help was intended for additional work not already existing.

Hiring of the coordinator was delayed, and finally in early April the research assistant for the beautification projects studies of 2000 and 2001 was given the position. With an already well established background in the horticultural projects, and with in-depth knowledge of the local groups and their structures, this individual could readily fit into the program even with a late start. A steering committee of four (Municipal representatives from Public Works, Horticulture, and Social Services, and the JJNA research leader) was established, with a larger committee chaired by the coordinator and including representation from each of the nine communities involved.

Integration of the summer students and the existing programs was slightly unsteady at first, due to unclear mandates and the slow start in spring. Not until late May were eleven students hired and in place, and some horticultural training set up at the JJNA. Additional municipal training in safety and specific workplace protocols were handled by the Municipality. Each locality received instructions on chains of communications, and project work commenced. A flyer outlining the Chatham-Kent Communities In Bloom project was created, and posters available from the CIB office were put on display in public places in the various communities. Presentation of the overall project has been planned for each locality over the summer, and the late-summer judging serves as a dry-run for a full involvement in the competition in the future (CIB, 2002).

The Model for Small Ontario Communities

The model as developed in the communities of Chatham-Kent is presented for other small localities across Ontario, under a mentorship program of the JJNA. While Ontario's small communities may not be any different than those in other provinces or even US states, the mandate of the SRC research program is provincial. No formal activity in preparing the model for use outside of Chatham-Kent was underway as of the date of this presentation, however, it is expected to be implemented in 2003.

A format for the model, developed as of Spring, 2002, consists of six main points, each achievable in small communities. The ranges for the financial arrangements have been based on the Chatham-Kent experiences.

1. Volunteer Organization - 'Community Beautification Committee'
• consists of representatives from interested groups and service clubs, such as:
  - Horticultural Societies, Garden Clubs and/or related groups;
  - BIA and/or Chamber of Commerce;
  - Master Gardeners; and
  - service clubs and organizations.
• requires a formal committee structure and banking arrangements

2. Trained and Interested Leadership
• horticulturally trained graduates of diploma or degree programs:
  - are already committed to horticultural projects;
  - are experienced in horticulture-related activities;and,
  - bring expertise and professionalism to volunteer activities.

3. Private Funding Opportunities - 20% to 50% of total
• involve individuals, local groups and businesses in project funding:
  - gives incentive to municipality to assist; and,
  - creates an atmosphere of ownership of projects.

4. Municipal Funding Opportunities - 50% to 80% of total
• may be very specific arrangements with (new) area-rated taxes, or through existing departments and budgets; and,
  - specifically allocated towards these projects.

5. Management Assistance by Impartial Experts - +/- 5% of total
  - may be required if in-house expertise is not available; and,
  - is the basis for the JJNA Mentorship program.

6. Sustainability Program
  - funding needs to be ensured over several years;
  - volunteer organization needs to have recruitment and growth programs;
  - projects need to be viable for the long term;and,
  - mentorship aspects should be able to phase out over time, with responsibilities and expertise developing with the organization.

Development and refinement of this model will be undertaken over the 2002 season, as the Chatham-Kent projects progress. The CIB program is not necessarily the final goal of the model, however, it lends itself very well to that eventuality. Enhancing the local environment through horticultural efforts is a popular item, judging by current trends (increased retail spending for lawn and garden of 11% in 1999 (TGO, 2000); horticultural business activities increased 14% to 17% between 1999 and

2001) (Nentwig, 2002). It is hoped that this model will also lead to enhanced career development for students in horticulture-related programing in Ontario, through the integration of education and on-site skills development.

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Landscape and Bioregional Planning

The La Cloche peninsula on the North Channel,
La Cloche Park Addition (Phil Kor)

Landscape Change, Land Use History and Planning for the San Pedro Riparian National Conservation Area, Arizona, U.S.A.

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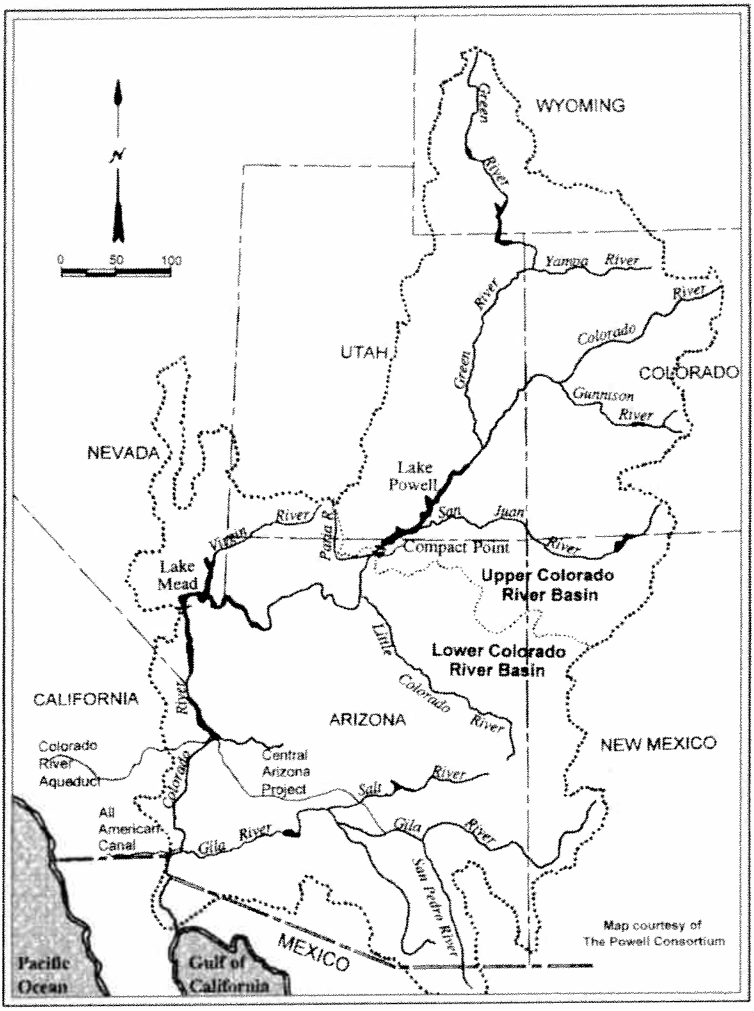
Abstract

This is an overview of landscape and land use history and some planning implications for the San Pedro Riparian National Conservation Area (NCA), Arizona, U.S.A. The overview is organized in terms of an Abiotic, Biotic and Cultural (ABC) approach which integrates the natural and cultural history of the San Pedro Riparian NCA and surrounding country. The overview reveals the highly significant history and character of the San Pedro landscape geologically, biologically and culturally. The unique aspects of the NCA include several Paleo-Indian sites dating from approximately 11,000 BP as well as the rare gallery forest and riparian habitat along the San Pedro. The overview ends with some planning implications of the study including more widely disseminating the success of the NCA in protecting and restoring habitat in the face of grazing, mining and other pressures and in planning for associated water resource conservation in the surrounding region. The success of the San Pedro National Riparian Conservation Area to date merits careful attention in other watersheds elsewhere in North America.

Introduction

River valleys or riparian areas are increasingly recognized as important for the conservation of migratory fauna and flora as well as habitat for many resident wildlife populations. Riparian areas are also increasingly of commercial interest for aggregate mining, irrigation projects, hydroelectric power facilities, livestock grazing and other enterprises. In few places is the conflict between these two broad sets of values and interests more apparent than in the American Southwest, including the State of Arizona. In the close to five centuries since the invasion of the area by Spanish, and later other Caucasians, the river valleys have been subject to growing pressure for development. By the 1980s, few major river valleys in Arizona remained in anything close to what might be called a natural state. One of these was the San Pedro River corridor, which had not been nearly as heavily exploited as other desert stream habitats along the Gila, the Salt and the Santa Cruz (Figure 1).

Figure 1. The San Pedro and the Colorado River watershed (courtesy of Water Resources Research Center, University of Arizona, Hanson, 2001).



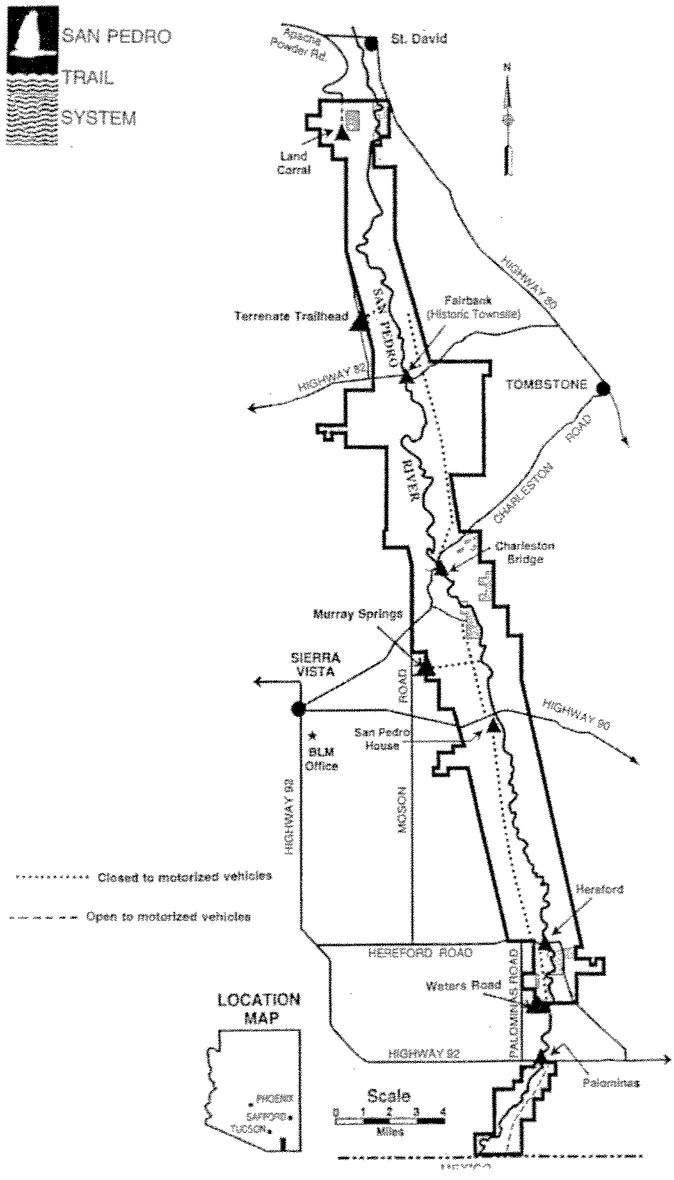
Concern about the future of the San Pedro rose sharply in the 1980s as a result of increasing pressure for grazing, gravel mining and housing developments for the growing influx of immigrants and visitors. On November 18, 1988, the U.S. Congress responded to this concern by passing an Act setting up the San Pedro Riparian National Conservation Area (NCA) to be managed by the U.S. Bureau of Land Reclamation (BLM) (Friends of the San Pedro River, San Pedro Riparian National Conservation Area, n.d.). This NCA was established to conserve, protect and enhance the desert riparian ecosystem, a rare remnant of what once was an extensive network of similar riparian systems throughout the Southwest. The San Pedro Riparian NCA supports over 350 species of mammals, two indigenous and several introduced species of fish, more than 40 species of reptiles and amphibians, as well as thousands of species of plants (Friends of the San Pedro River, n.d.; BLM, 1989; Hanson, 2000).

Although some in-holdings still exist, the San Pedro Riparian NCA consists of approximately 56,000 acres of public land assembled by the BLM along about 40 miles of the upper river between the Mexican-US border and St. David, a Mormon settlement dating from about the turn of the 19th century (Figure 1). The headwaters of the river are in Mexico where the catchment is exploited for cultivation, grazing, mining and other uses. Efforts have been underway for several years to co-operate with the people of Mexico in introducing more effective conservation measures in their part of the watershed. According to the Friends of the San Pedro River (2002), a group of concerned citizens in Mexico has formed an association similar to the Friends. This group hopes to protect the San Pedro River from its source in Mexico to the US border. The Friends of the San Pedro and BLM have agreed to serve on the Board and act as consultant to the new Association.

The main management measures put in place by BLM since 1988 include controls on grazing, gravel mining and housing developments, as well as roads and other facilities. Various types of recreation are encouraged including hiking and naturalist activities, notably birding. All Terrain Vehicles (ATVs) and other recreation technology are subject to controls. Although birders visit the area from throughout North America, much of the recreational use is local and involves family hikes, picnics and other evening and weekend activities. A hiking trail parallels the full length of the Riparian NCA and seems to be used frequently by locals and visitors alike (Figure 2). An excellent guide to the upper San Pedro has been prepared by the naturalist and Executive Director of the Sky Islands Alliance (Hanson, 2001). The guide is built around a hike from the beginning of the NCA, near the Mexican border, to St. David. No reliable data are available on the number of visitors to the NCA. The collection of data is difficult because of the numerous points of entry to the NCA and also because of the limited staff and other resources available to manage the river.

Thousands of birders visit the area annually as it is renowned for the high population and diversity of its avifauna. The focal point for birders is the San Pedro House, a historic cabin occupied and renovated by the BLM and The Friends of the San Pedro River, a volunteer non-profit, non-political organization providing support for the Bureau in the stewardship of the NCA. The San Pedro Riparian NCA was designated as the first Globally Important Bird Area in North America in 1995, being joined not long thereafter by the Long Point Biosphere in Ontario and a site in southern Mexico.

Figure 2. The San Pedro National Conservation Area trail network (BLM, n.d.).



A wide range of conservation activities has been introduced by the BLM and it's supporters to enhance the degraded habitat of the NCA since its creation in 1988. The removal of cattle grazing and hay production has led to the restoration of extensive floodplains and grasslands. Areas disturbed by plowing, surface mining and other similar activities are returning to grass and other cover. Growth of cottonwood, willow, sycamore and other trees and shrubs along the stream banks and adjoining floodplain areas has been impressive. Such changes have been evident to me since my first visit to the NCA, in 1994. Mesquite has begun to encroach onto the floodplain areas, with some constraints on this as a result of accidental and controlled burning. Water quality is also said to have improved. The difficulty, however, is limited systematic monitoring of the ecosystem changes has been undertaken, largely because of lack of resources by BLM and others. Lack of such data could pose problems when some aspects of the agreement for the San Pedro Riparian NCA come up for review and possible renewal. A key example is the pending review of the prohibition against livestock grazing which ends in 2003.

This leads to the basic reason for presenting this paper, which is to review the land use and landscape history of the valley and assess some of the implications this has for future planning, management and decision making for the San Pedro Riparian NCA. The paper is based on six annual field visits to the area between 1995 and 2002, and interviews and conversations with numerous people from relevant government and non-governmental organizations as well as numerous tourists and local residents encountered during visits. Extensive research was also undertaken in libraries, notably the Bisbee Mining Museum and the Douglas Public Library. The natural and cultural history of the San Pedro is quite complex and cannot be considered in detail here. The San Pedro Riparian NCA is affected not only by activities and processes occurring within its more immediate vicinity, but also by those in more distant parts of the watershed and beyond. It is, however, possible to highlight San Pedro's history by focusing on some key aspects of its evolution from early geologic times to the end of the last field research for this study, in spring, 2002.

The ABC Approach

The San Pedro valley and surrounding area are of outstanding interest for a number of interrelated natural and cultural reasons. From the natural standpoint the area is highly significant in terms of both earth science and biological attributes. From a cultural standpoint the area is highly significant in terms of the great length of human occupancy, the diverse array of changing ethnic and cultural groups, and their frequently profound impacts on vegetation, wildlife, landscapes and ecosystems generally. These ecosystem changes are a result not only of human activity but also post glacial climatic and natural changes and their interaction with human activities.

In organizing this paper to describe, analyze and assess such changes, it has been useful to follow the ABC or Abiotic, Biotic and Cultural method (Bastedo et al., 1984). This method was developed to facilitate comprehensive resource and environmental surveys and assessments for planning purposes. The method provides a broad framework for organizing, describing, mapping, analyzing, assessing and integrating diverse information from an array of disciplines and sources. The method is useful in dealing with historic as well as current information and ongoing research.

The ABC method can be undertaken in considerable technical detail as well as in a more general way. The latter approach is the one followed here – the aim being to produce an integrated overview of the natural and cultural evolution and current character of the San Pedro area, its significance and challenges, especially in planning from a conservation and sustainable development perspective.

Accordingly, the following text considers salient aspects of the geology, hydrology and climate, or 'Abiotic', the plants, animals and habitats or 'Biotic', and the human or 'Cultural' characteristics of the San Pedro area. In the general sense, the cultural characteristics include land use, economics, social, institutional and other aspects of learned human behaviour and activities. In a brief overview such as this however, some selectivity or judgment is required about what is significant for the purposes at hand. Such selectivity is reflected in the following text. The salient Abiotic and Biotic characteristics are considered first, followed by a general discussion of changing human activities, their interaction with the surrounding environment, and some implications for planning, especially conservation planning.

Abiotic

The San Pedro watershed and surrounding country are located amid the great desert of the U.S. southwest and northern Mexico. The desert lies in the general vicinity of 30° north latitude, a dry zone subject to strong seasonal shifts in atmospheric circulation and storm trends (Shreve and Wiggins, 1946; Larson, 1977). In the winter, storms and weather originating in the west over the Pacific move eastward and inland. These moisture-laden systems encounter and are pushed upward and cooled by the Coast Ranges, the Sierra Nevada and inland mountains. The result is that the western part of the desert receives predominantly winter precipitation.

In the spring the atmospheric circulation and storm trends move north with the sun. The eastward flow from the Pacific becomes weaker. Monsoon-type circulation and storm tracks move into the increasingly hot interior from the southeast and the Gulf of Mexico. In consequence, much of the precipitation in the eastern part of the southwestern desert falls in the summer in contrast to the winter peak in the west.

In the central parts of the desert, the two seasonal precipitation patterns overlap. These areas receive both summer and winter precipitation. This is true for the country around the San Pedro watershed. Tucson, about 100 miles west and north of the San Pedro NCA, receives about one half its 275 mm (11 inches) annual average in winter and about half in summer (Larson, 1977: 35). The availability of this precipitation is reduced by high evapotranspiration rates which result from temperatures often exceeding 40°C (100°F) in summer. Temperatures tend to fluctuate considerably around the mean. Temperatures and precipitation have also varied as a result of past climate changes. Weather and climate also vary in accordance with variations in geology and topography. Some details on the geologic and topographic variations are presented in the following discussions which set the stage for consideration of significant historic and current climatic and biotic patterns in the study area.

The geological history of the southwest U.S. and adjoining parts of Mexico is a very long and convoluted one. About 1600 million years ago, the region was covered by sedimentary and volcanic rocks (Drewes and Thorman, 1978: 291). An array of tectonic episodes included: a Paleozoic period of relative stability; Late Triassic to Late Jurassic magmatic arc activity; an intense period of deformation and magmatic arc activity in the late Cretaceous to Early Tertiary (Laramide); evolution of middle Tertiary calderas and metamorphic core complexes; and Late Tertiary Basin and Range rifting.

Much of the structure of the present landscape arises from the Middle Tertiary and Later Tertiary phases. According to Coney (1978: 288), the mid-Tertiary was "the most bizarre and varied period of tectonic activity in the entire history of the region". The bedrock was deformed, domed, extended and metamorphosed. Of special interest is a Cordilleran-wide sequence of volcanism which extended from the Pacific Northwest to southern Mexico (Sierra Madre Occidental Mountains), leaving a landscape buried in ash and punctured by calderas (Coney, 1978: 288).

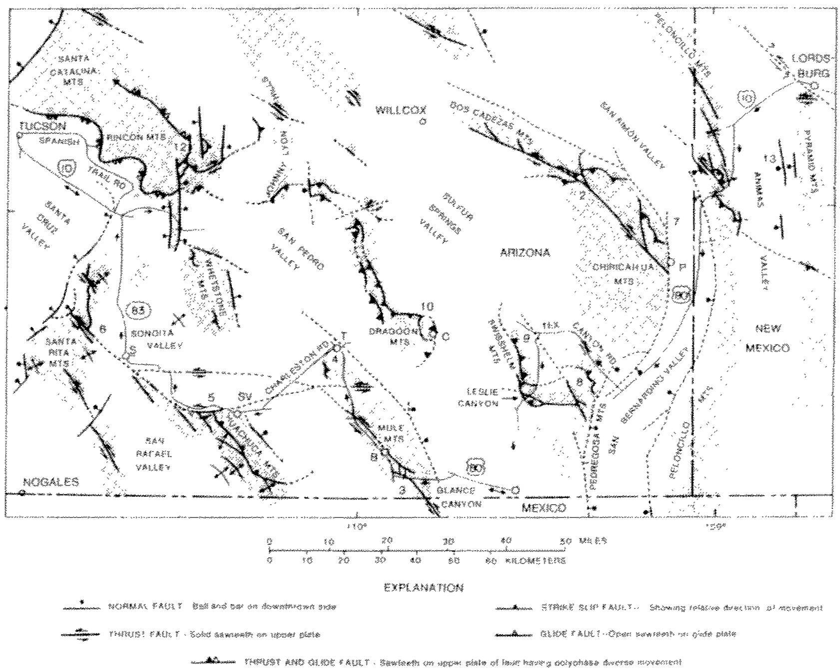
In Late Tertiary, between about 15 million and 6 million years ago, widespread faulting and extensive vulcanism produced the characteristic southern Arizona and northern Mexico landscape of fault-block mountains. These are separated by basins, such as Sulfur Springs and the San Pedro Valley, filled with thousands of feet of sediment (Drewes and Thorman, 1978: 291). Figure 3 is a sketch map showing the major kinds of structured features making up the region (Drewes and Thorman, 1978: 292).

In addition to its location in pronounced Basin and Range topography, the San Pedro area is of unusual interest because of its Quaternary history of the last several million years. Huge ice sheets advanced across Canada and the U.S. a number of times, causing changes in climate throughout the continent. In the southwest U.S., ice advances resulted in alpine cool-wet, or pluvial climates, and ice retreats in interpluvial or semi-arid climates.

Evidence for these changes is found in remnants of formerly extensive lakes in the basins of the region. An example is pluvial Lake Cochise which was located in what is now called The Willcox Playa near the town of that name in the Sulfur Springs Basin on the western fringe of the Chiricahua Mountains (Schreiber, 1978: 277).

Schreiber and some students did research on this former lake between 1962 and 1965. Using core analysis and other field studies, they determined that former Lake Cochise covered about 190 km^2 around the present smaller and ephemerally flooded playa. Using surrounding old beach ridges as indicators of the extent and elevation of the former lake, they estimated it was about 18 km x 32 km and 11 m (35 ft) deep.

Figure 3. Sketch map of southeastern Arizona and southwestern New Mexico, showing major structural features of the region (Drewes and Thorman, 1978: 292).



A 43 m core from the middle of the former lake was examined by P.S. Martin, a pollen expert. C14 dates were also obtained on carbon from this core. According to Schreiber (1978: 281), Martin interpreted high pine counts in the core as indicating more extensive growth of forest and woodland and a cool-wet climate. He interpreted low pine pollen counts, or poor pollen preservation and oxidized sediment, as indicating drier interglacial or interpluvial climates. Martin placed the upper 23 m (77 ft) of the core in the Wisconsin glacial interval. The pollen in the sediment below 2 m (6 ft) was 99% pine pollen. A C14 date of 22,000 BP was secured at the top of this pine pollen zone. Martin put the lower 23 - 29 m (77-96 ft) section of the core in the drier Sangamon interglacial interval and concluded that the base of the core represented pluvial conditions of the Illinoian glacial interval.

Similar evidence of former lakes has been found elsewhere in the southwest and has been interpreted as indicating widespread fluctuations in climate, flora and fauna in the Basin and Range region during the Pleistocene (Bezy, 2001: 22). The general picture in the pluvials is one in which upper level Spruce, Fir and Pine forest are seen as moving downslope along with mid and lower level Oak savannah and grasslands. In the drier interpluvials these vegetation zones are interpreted as moving upslope again. Such fluctuations continued until about 12,000 years ago when the ice sheets underwent massive retreat and climates and vegetation patterns generally similar to current ones were established. Today Willcox Playa, the descendant of Lake Cochise is one of only two active Playas in Arizona (Bezy, 2001: 22)

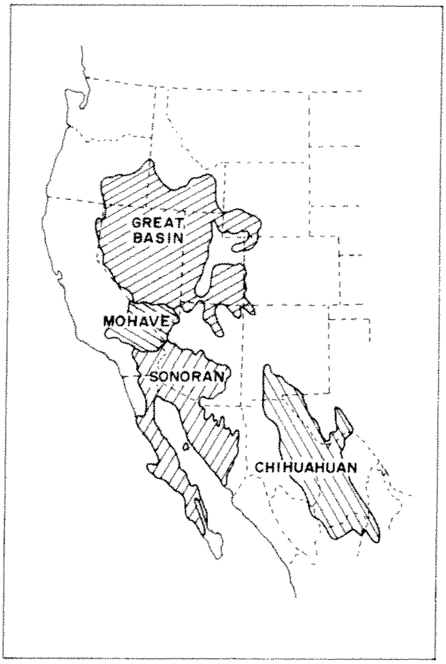
According to Bezy (2001: 22), glacial or pluvial Lake Cochise was present in the Sulfur Springs Basin, which is located immediately east of the San Pedro Valley (Figure 3), as recently as 10,500 years ago. At that time, the basin had open stands of ponderosa pine and herds of mammoth, horse and camel. This interpretation is in line with evidence from the San Pedro basin to the west, where excavations have revealed such early fauna in association with human artifacts. In fact, the lower San Pedro Valley is generally considered to have the highest number of early man or Paleo-Indian sites of any comparable area in North America. Of particular note are the Naco and Double Adobe sites on the east fringe of the San Pedro as well as the Escalupe, Lehner and the Murray Spring sites in the San Pedro Valley NCA, just north the Mexican border. Archaeological excavations at all three sites reveal bones of now extinct Pleistocene animals in association with stone tools and debris interpreted as having been worked by humans. All these sites have also been dated by C14 and other geologic methods as about 11,000 years BP (Bromtzky and Merritt, 1986: 54-55).

Biotic

Today the western and southwestern deserts of the U.S. can be subdivided into types on the basis of differences in their weather and climate, their geology and land forms and most especially, their vegetation. The four main types of deserts are the Great Basin, the Mohave, the Sonoran and the Chihuahuan, as shown in Figure 4 (Larson, 1977: 31). These in turn, can be divided into various subtypes or subdivisions (MacMahon, 1985: 63). The San Pedro area has been considered to be in the Sonoran zone but also can be seen to occupy an intermediate position among several of these desert types and subtypes. The San Pedro area's location in an upland area close to high fault block mountains such as the Huachucas also adds to its biodiversity potential.

According to MacMahon (1985: 65-69), the San Pedro area lies toward the eastern edge of the Arizona Upland, in the Sonoran desert region. Many shrubs occur at various heights in this upland. In very general terms, one vegetation layer is less than eighteen inches high, another is about three feet, and beyond that is an upper layer of sub-trees. This array of plants includes Creosote Bush, Foothill Palo Verde, Iron Wood and many species of cacti whose diversity is high. They include Prickly Pear, Barrel Cactus, and various species of Cholla such as Buckthorn, Cane and Jumping Cholla.

Figure 4. North American deserts (Larson, 1977: 31).



This vegetation assemblage is associated with an array of animals, of which birds are of special interest for scientific, recreational and other reasons. According to Nabhan and Holdsworth (1998: 15) at least 500 bird species have been reported in the Sonoran, approximately half the number of birds reported for the continental U.S. or Mexico. In the desert shrub and semidesert grassland habitats, however, the per unit area diversity of breeding birds is not especially noteworthy, approximately 30-150 pairs per 40 ha. According to MacMahon (1985: 76), typical Sonoran desert sites generally have less than 25 breeding species. However, wooded and shrub lined valleys or riparian corridors may play host to as many as 400 species for breeding, overwintering and migrating. This constitutes approximately 75 percent of all the bird species which migrate between the U.S. and Mexico (Nabhan and Holdsworth, 1998: 15).

Nabhan and Holdsworth (1998: 16) note that deciduous riparian gallery forests of the Sonoran, such as those along the San Pedro, harbour 304 to 847 breeding pairs per 40 ha, possibly the highest breeding bird densities on the North American continent. In terms of breeding bird diversity and productivity, Sonoran riparian habitat such as the San Pedro, appears to be among the richest in North America.

Species diversity and productivity are also high for species other than birds in the Sonoran. Overall, the species richness of mammals known for the San Pedro Riparian National Conservation Area is estimated at 86 species including 12 at risk. This richness is thought to be unsurpassed for any landscape of similar size in the US (Nabhan and Holdsworth, 1998: 13). The Sonoran region's reptile diversity also is high although the same cannot be said for amphibians and fish.

Cultural

Early Humans

Previous discussion of the natural history and character of the San Pedro Valley and surrounding areas included references to archaeological evidence of early human artifacts at Lehner, Murray Springs and other sites. The Lehner and the Murray Springs sites have been carefully excavated and studied by professional archaeologists and other scientists and the results highlight the significance of these finds (Anonymous, 1982; BLM, Lehner Mammoth Kill Site, n.d.; BLM, Murray Springs Clovis Site, n.d.; Bronitsky and Merritt, 1986). In 1952, Ed Lehner, a rancher, discovered extinct mammoth fragments in terrace deposits at a locality on his ranch, now known as the Lehner Mammoth Kill Site. It was excavated in 1955-56 and again in 1974-75. The archaeologists identified 13 worked stone points similar to the Clovis points found earlier in New Mexico. In addition to these points, which were likely used on long lances to kill mammoth, the archaeologists also found stone butchering tools, chips and other stone debris as well as fire hearths (BLM; Lehner Mammoth Kill Site, n.d. and Hanny *et al.,* 1959). These hearths contained carbon, which was dated at about 11,000 BP. Animal bones identified at the site included those of twelve immature mammoths, one horse, one tapir, several bison, one camel, one bear, several rabbits and a small snake. Botanists identified pine, ash and oak in the charcoal from the hearths. From this and other evidence, they deduced that the site was used by humans in the interval between the end of the Pleistocene and the beginning of recent drier times.

The Murray Springs site is located just north of the Lehner site on the edge of a terrace above the San Pedro floodplain. The site was excavated by archaeologists and other scientists from 1966-71 (Kardeka, 1982; BLM, Murray Springs, n.d.; Bronitsky and Merritt, 1986; Amann *et al.,* 1998). The findings were generally similar to those for the Lehner Site. Sixteen projectile or Clovis points were found along with other worked stone and bone tools and debris. Bones of several extinct animals included mammoth, North American horse, camel, bison, lion and dire wolf. The stone artifacts and bones were found several feet below the surface, beneath a dark organic layer or "black mat." This yielded C14 dates of approximately 11,000 BP, similar to those of the Lehner site.

The evidence from the Lehner, Murray Springs and similar sites near and beyond the San Pedro indicates that ancient people, the so-called Paleo-Indians, were big game hunters who moved in pursuit of mammoth and other sources of food. They were successful in killing large Pleistocene animals and are considered by some scholars to have been largely responsible for their extinction (Martin and Klein, 1984; Amann *et al.,* 1998). Others are of the view that the change from a cool-wet or pluvial climate to a drier post-glacial one damaged or destroyed habitat, thereby leading to extinction. Still others have concluded that extinction was due to several causes, including both climate change and over-hunting (Amann *et al.,* 1998). The high number of young or immature mammoth at sites such as the Lehner has been interpreted by some scientists as indicating that extinction likely was caused by these early people preying heavily on more vulnerable, younger animals. On the other hand, faunal extinctions at the end of the Pleistocene included some animals and plants not known to have been used by humans, who do not therefore seem likely causes of their extinction (Amann, 1998: 8).

Paleo – Indian Times to Arrival of the Spanish

This long interval extends from the end of the Paleo-Indian times, about 10,000 years ago to the entrance of the Spanish into what later became Mexico and the American Southwest by about 1540. This very lengthy period has been subject to confusing and uncertain interpretations by archaeologists and other scientists (Bronitzky and Merritt, 1986: 100). Hundreds of relevant sites have been excavated in the Southwest and the general region of the San Pedro Valley.

These sites have been interpreted as representing various complexes and stages of what are generally thought of as Archaic or Desert cultures. They developed a range of stone, bone and other tools that permitted a hunting and gathering lifestyle in the Southwest, including the San Pedro Basin. A small amount of evidence indicates that Archaic people (Sulfur Springs) hunted mammoth and may have overlapped to some extent in time with the people identified by archaeologists as Paleo-Indians; although this possibility has been challenged by Waters (1986) on the basis of his excavations in Whitewater Draw just to the east of the San Pedro Basin. For the most part, the Archaic or Desert Cultures pursued a migratory lifestyle, hunting deer, coyote, rabbit, antelope and other currently existing animals, as well as gathering, grinding, and processing mesquite, beans and other plants. They may have moved about in bands of about 20-30, although their overall numbers in the Southwest and the San Pedro area are unknown.

Hundreds of Archaic sites have been identified in the San Pedro area. The sites include ancient hearths showing use of fire for cooking and domestic purposes. Fire may also have been used in burning grass and vegetation to drive deer and other game, as was done in more recent times by people living with similar technology and lifestyles (Cornett, 2000: 26; de Golia, 1993: 6; Hanson, 2001: 84). It has also been suggested that these people might have encouraged the growth of wild plants to collect for food, introducing a kind of incipient or early stage of agriculture

(Bronitzky and Merritt, 1986: 113). Cumulatively through hunting, plant selection and other activities over about 7500 years or approximately 400 generations (10,000 BP - 2,500 BP) these early people probably caused many unappreciated changes in the fauna, flora and ecosystems of the San Pedro and other areas.

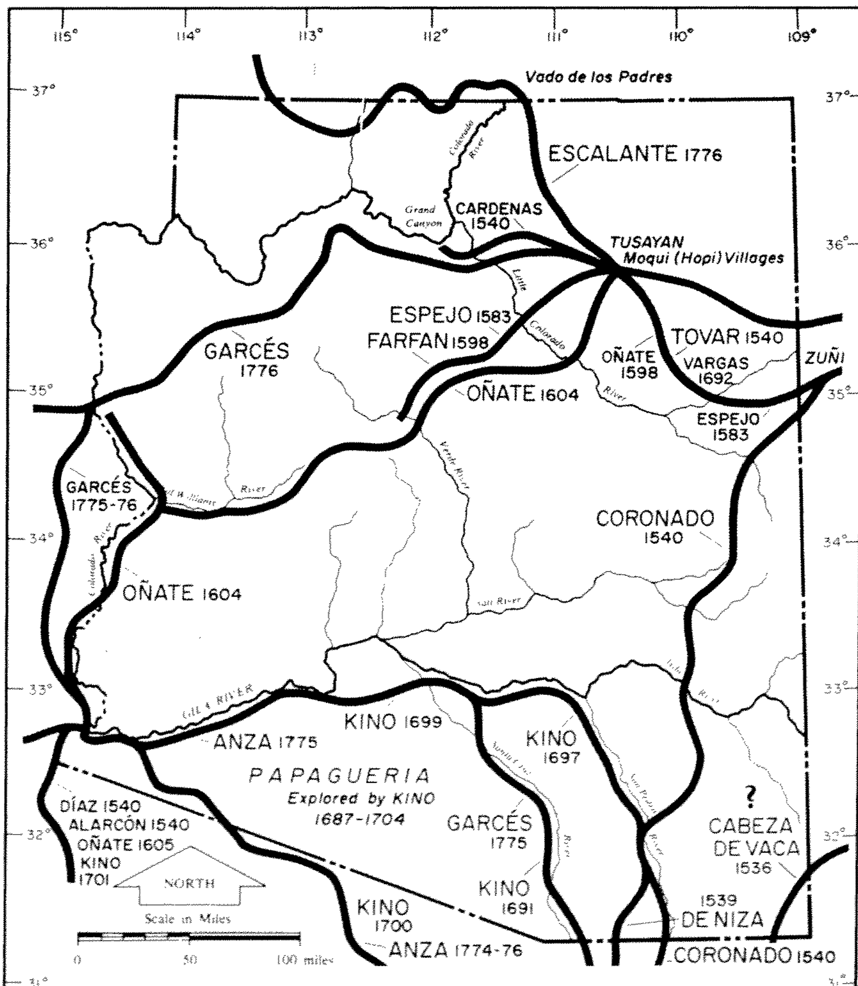
With the development of sedentary agriculture however, the scene was set for major impacts on the environment. The evidence for agriculture revolves around the three relatively well known indigenous crops: maize, squash and beans. C14 dates have been obtained for the earliest occurrences of maize and squash at the Bat Cave, Tularosa Cave and Cienega Creek sites in west central New Mexico and eastern Arizona. These plant remnants are said to be associated with Chiricahua stage artifacts and have been dated at between about 4200 and 3500 BP by C14 analysis. Beans from later San Pedro stage levels at Bat Cave have been dated as early as 3,000 BP. Maize was also recovered from these San Pedro levels. This corn was a crossbreed between early maize and a teosinte form of the plant, likely introduced from antecedents in Mexico. This new form of maize produced larger cobs and was more adapted to arid environments, which probably contributed to its spread through the southwest (Bronitsky and Merritt, 1986: 113). According to Bronitsky and Merritt (1986: 113), before the teosinte introduction and the development of a new hybrid maize, corn may only have been a minor component of an economy which relied heavily on wild plants, some of which might, like maize, have been encouraged to grow through "benign neglect", as was the case with the historic Papago people of early European times.

Slow and gradually increasing use of the new maize and other crops led to a gradual shift to a more sedentary and elaborate lifestyle. Domestic structures, such as storage pits and cooking hearths, as well as human burials, suggest a trend to sedentism. The existence of settled villages in certain parts of the area, by about 1500 years BP or 500 AD, is seen as a result of these trends (Bronitsky and Merritt, 1986: 114). These villages gradually elaborated into those of people known as the Hohokam with their well built mud and stone homes, as well as kivas, other ceremonial areas, ball courts and other architectures. These villages and settlements were associated with the production of corn, beans and squash through irrigation as well as farming based on natural sources of water. In some cases, irrigation canals, sluices, gates and other structures were built. In other cases, the crops were grown on floodplains or through diversion of floods and high waters. Little evidence of Hohokam agriculture and irrigation apparently has not been found in the upper San Pedro or current NCA in comparison with such evidence for the lower valley, towards its junction with the Gila River. Where sedentary indigenous agriculture and irrigation did develop, this began the process of land clearing, soil disturbance, stream and water diversion, salinization and other environmental effects that may have been of considerable significance locally, but only heralded the larger scale changes yet to come with the introduction of elaborate irrigated farming in European times.

The Spanish

The next phase of San Pedro Valley history is the Spanish period from about the 1530s to the 1850s (Bannon, 1974; Meyer, 1984; Walker and Baukin, 1979). For our purposes, this three-century span includes the time of Mexican independence from 1821 to 1856, when the U.S. Congress completed its acquisition of the current state of Arizona and other parts of the U.S. Southwest through the Gadsden Purchase. The Spanish discovered and invaded current Mexico in 1521. By the 1530s and 1540s, expeditions in search of gold, silver and other metals were underway in the present state of Arizona, as well as New Mexico and Texas. The best known of these expeditions was that of Coronado in the early 1840s (Figure 5).

Figure 5. Routes of Spanish explorers (Walker and Butkin, 1979).



A wave of Spanish invasion was religious in nature. The Jesuits, and later the Franciscans and other orders of the Roman Catholic Church, moved into the study area to convert the natives to Christianity. Serious attempts to establish missions were made from northern Mexico in the mid-to-late 1600s. Some of these efforts were successful, for example in the Santa Cruz Valley west of the San Pedro. These successes included well known sites such as Tubac, San Xavier de Bac and later Tucson. The military also increased its presence in southern Arizona and other parts of the current southwest to defend the Missions as well as other migrants moving into the region for trade and commerce (BLM, Presidio Santa Cruz De Terrenate, n.d.).

Efforts to establish Missions and Presidios, or military posts, in the San Pedro Watershed were largely unsuccessful, particularly in the southern or upper parts of the valley. Some success was achieved for a few years at Quibari (Quivari) and the nearby Terrenate Mission. However these posts were eventually abandoned because of the hostility of invading nomadic hunting groups such as the Apache and the withdrawal of the Sobraipuri and other previous collecting and gathering people, whose cultures are thought to resemble those of the archaeological Archaic.

The Spanish introduced many exotic plants and animals into the San Pedro area and the Southwest (Bronitsky and Merritt, 1986; Bahre, 1991; Bennet *et al.,* 1996). Expeditions such as Coronado's in the 1540s included hundreds of horses, cattle and other stock, some of which were lost. Such animals also were taken to Missions like those along the Santa Cruz, for use by the Spanish as well as natives. Wheat and European crops were introduced for similar purposes. Over the decades and the centuries, many of these animals and plants went wild or spread domestically through southwestern ecosystems. Water diversion and irrigation systems were expanded by the Spanish. The invaders also introduced new germs and diseases to the natives, causing epidemics that killed thousands over the years. The development of Missions, Presidios and silver and other mining camps brought larger populations and settlements, and accelerated ecosystem and landscape changes.

The Americans

The next phase of interest, the American, grew sharply with the 1849 California gold rush. Explorers and traders from the US had been active in Arizona decades earlier. James Battie, an American Mountain Man, explored and worked the Gila River for beaver and other furs in the 1820's, following the river to the vicinity of the Gulf of California (Bronitsky and Merritt, 1986: 273-276; Walker and Bufkin, 1979). He is known to have been active in the lower San Pedro Valley, close to its entrance to the Gila. Neither he, nor other American trappers, seem to have reached the upper San Pedro and the vicinity of the current NCA.

Traders, prospectors and other invaders from the US came in increasing numbers to Tucson area and other parts of current Arizona, New Mexico and California in the 1840s. War with Mexico let to US acquisition of much of the American Southwest in 1848 and the rest through the Gadsden purchase of 1856. Some predecessors of the California Gold seekers of 1849 passed through the upper San Pedro Valley, but travel increased greatly with the rush of prospectors and others from the east. These travelers used a number of routes through Mexico and the southwest, including one that ran more or less along the current border and up the San Pedro valley to the Gila, Tucson and beyond (Bronitsky and Merritt, 1986: 283-284).

After 1856, an array of US economic activities began to boom in the Southwest and the San Pedro valley watershed. Prospectors swept the region looking for gold, silver, lead, copper and other minerals. Some were found, often in short-lived deposits, lasting only a few years. Some rich finds were eventually made including Tombstone, Bisbee and a number of sites in the mountains on the fringe of the San Pedro Valley (Schwantes, 1992; Leaming, 1998). These sites lasted into the 20th century and spawned mills and settlements at now abandoned sites such as Fairbanks and Charleston, in the upper San Pedro, in what is now the NCA.

Other settlers moved in to ranch and raise cattle, horses and other stock for the mining settlements (Bronitsky and Merritt, 1986: 283-284). Some of these outfits were in place in the 1860's, including the Kitchen Ranch on the lower Santa Cruz, the Slaughter Ranch in the San Bernardino Valley, and the Hooker Ranch in the lower or northern San Pedro valley, closer to the Gila (Stewart, n.d.: 9-12). Other ranching operations began in the upper San Pedro in the vicinity of the NCA, for example on the Babocomari Creek, a tributary of the San Pedro just north of the present town of Sierra Vista and the large military post of Fort Huachuca. The Babocomari and other ranches developed on land grants made to settlers and ranchers from Mexico by the Mexican governments prior to the 1840s (Walker and Bufkin, 1979). These ranches were generally ill-defined outfits whose cattle ranged over many square miles.

The incursions of travelers, miners and ranchers, led to increasing conflicts with the Apache. One major result was an increasing number of US troops and military posts. These troops numbered in the tens of thousands and had to be fed and housed. This provided big opportunities for cattle and stockmen as well as irrigators and agriculturalists. The extent and intensity of ranching, grazing and other activities placed rising pressures on the desert environment. In his remarkable book, *A Legacy of Change,* which deals with the historic human impact on vegetation in the Arizona borderlands, Conrad Bahre (1991) describes the effects of grazing, mining and other activities in detail, with support from historic photographs.

Exploration and development activity took on new vigor in the 20th century. One major reason was the growth of recreation and tourism. Another was the entrance of rising numbers of retirees from other parts of the US. In addition, the Southwest and the San Pedro watershed, became increasingly important for military installations and activities. Recreation and tourism have been growing since the late 19th century through hunting and related outdoor activities. Guided hunts for lions, jaguars and other large animals rose after WWI. Aldo Leopold and his family described hunts for deer, turkey and other animals along the Gila and the Sierra Madre of northern Mexico in the 1920s and 1930s (Leopold, 1953).

Recreation and tourism boomed after WWII with the arrival of the entertainment industry. This involved the establishment of gambling casinos, large hotels and convention centres, as well as filmmaking and family automobile tourism to the deserts and the great mountains of the Southwest. These developments in turn, led to rapid increases in urbanization and rising demand for water and other resources over much of southern Arizona, including the upper San Pedro Valley.

A large and growing military base, Fort Huachuca, was originally established in about 1885 in efforts to quell the Apache who resisted both Spanish and American control for more than 200 years. Today Fort Huachuca specializes in electronic systems and houses thousands of troops with more planned for the future. Fort Huachuca borders on the rapidly growing city of Sierra Vista on the western side of the San Pedro valley. Sierra Vista was almost non-existent in 1958 and exceeds 40,000 today. Other nearby growing areas include the town of Benson which is close to the north border of the San Pedro NCA. Its damaging impacts on the floodplain, the riparian habitat and other parts of the valley stand in strong contrast to the protected areas in the NCA to the south.

Over the years large numbers of cattle and other stock have competed directly for range with antelope, deer and other animals. Ranching resulted in extremely hard times for the grizzly bear, the puma, jaguar, bob-cat and other predators for they have been seen as threats to domestic stock. Extensive campaigns to eliminate them were undertaken beginning in the 19th century. These led to government hunting, poisoning and other efforts in the 1920's and 1930's. Animals such as the wolf, grizzly and the jaguar have been completely or nearly eliminated from the area. As recently as 1996 a jaguar was photographed by hunting guides in one major mountain range east of the San Pedro watershed, the Peloncillo Mountains on the New Mexico-Arizona border just north of the Mexican line (Brown and Gonzales, 2001: 1). Whether such occasional jaguars are permanent residents or visitors to southeast Arizona from northern Mexico, is a question.

Other exploitive activities such as lumbering and clearing of vegetation were wide-ranging by the mid to late 19th century because of the need for wood for mining, railroad and other construction, as well as for use in making charcoal and other fuel for mining, industrial and domestic purposes. Extensive areas were cut-over, although in this case considerable reforestation has taken place as a result of measures such as the creation of National Forests and other protected areas to conserve trees, control run-off and protect water supply. The establishment of the San Pedro NCA itself is a recent expression of attempts to protect the environment, reduce destructive exploitation and develop more sustainably. Much has been done through the NCA to protect and restore plant and animal habitat within its borders.

What is known today as "active conservation management" is practiced in the NCA. This includes for example, allowing wild fires to burn to some extent without attempts to extinguish them. Certain indigenous animals are also being re-introduced, including the beaver. The fur trapper James Battie reported that, as a result of trapping by himself and others, this animal has been removed from the lower part of the San Pedro near its entrance to the Gila, by the late 1830's (Bronitsky and Merritt, 1986: 273). He probably was referring to the commercial extinction of the animal in the sense that it no longer paid to hunt it in terms of the costs and benefits of Battie's time. As a result of long continued trapping, drainage of wetlands, dynamiting of dams and habitat, the beaver had virtually disappeared from the lower San Pedro NCA by the early 1900s (Hanson, 2001: 123). It has been re-introduced in recent years.

Such restoration measures are controversial, even within the conservation community. For example, to allow wild fire and take the risk of the escape of a burn, could lead to damage or destruction of riparian forests and shrub communities which have increased along the river since the creation of the NCA in 1988. The re-introduction of the beaver also poses a threat to this riparian community and especially to cottonwood and sycamore because beaver tend to fell such trees in large numbers for use in building dams, houses and food.

To restore fire or beaver under such circumstances is risky. Such situations seem to call for an adaptive management approach of the type advocated by Holling and his associates (Gunderson, Holling and Light, 1995). In such an approach selected policies and practices are pursued on an experimental basis and carefully monitored and assessed for their effects before any final decisions are made. To follow such an approach in the San Pedro NCA may however, be difficult because of staff and budget shortages. Collaborative efforts involving the universities, colleges, schools and volunteers from the Friends of the NCA or other volunteer organizations would seem promising here and some of this has begun to occur.

Growing use of ground water as well as drainage and other activities, have reportedly led to reductions in the water table as well as changes in surface runoff (Anonymous, 2000). These changes have contributed to the loss of cienegas. Few of these formerly extensive wetlands now remain, one being a Research Area established by the BLM in the NCA near St David. Interest in conserving and restoring the cienegas as "natural sponges," in order to reduce the rates of run-off and other hazards such as floods, encounters challenges. A major challenge is the downcutting that has occurred in many stream valleys of the San Pedro and other parts of the Southwest, apparently mainly since the late 19th century. Prior to that time, relatively few arroyos seem to have been found in the study area. Vegetation patterns also seem to have been quite different than now, with much less mesquite or scrub desert, fewer trees along the streams including the main stem of the San Pedro, and more grassland and open country. Considerable evidence is available to suggest that such changes have largely occurred in the region since the 1880's (Bahre, 1991).

Various causes have been put forward for these changes, including overgrazing of the ranges, removal of tree cover for fuel and other purposes, climate changes, drainage, reduction in wild fires, and elimination of beaver. Another possible cause that does not appear to have received much attention is earthquakes and tectonic activity. A major quake is known to have occurred in 1887, exceeding 7.5 on the Richter scale, and apparently causing uplift and earth movement over a large area. Overall, however, it seems unlikely that any one of these changes is alone responsible for downcutting and other changes in stream patterns in the study area. More likely, the changes interact with one another in some poorly understood way.

Two fundamental points should be made before concluding this paper. The first involves the basic assumptions and strategy upon which ecosystem or landscape management of the San Pedro Riparian NCA is to be based, particularly with regard to vegetation. The current riparian forest and shrub vegetation has developed to a considerable degree since the creation of the NCA in 1988, and is different that an earlier 19th century landscape dominated by grasslands, and related plant communities along the main stream (Hanson, 2001; Bahre, 1991). As noted previously, to introduce active conservation management based on the idea of a return to that earlier landscape would mean modifying the protectionist policy that has led to the growth of the present gallery forest as well as the rich habitat for resident and migratory birds and other fauna so valued by local people and visitors today. At least one prominent conservationist in the area has raised this problem and has argued for conservation of the present landscape while cautioning about the effects of burning and beaver restoration (Hanson, 2001).

The second fundamental point is that a major if not the major threat to the health of the San Pedro Riparian NCA and surrounding areas today is urban and military development in the Sierra Vista – Fort Huachuca area along the west side of the river, as well as growing settlements in other parts of the valley. These developments will continue to consume large amounts of groundwater since precipitation and runoff in the area are insufficient to meet the demand. Continued development poses a risk to the flow of ground water to the San Pedro River and so to the maintenance of the riparian ecosystem. With leadership from the BLM, the Upper San Pedro Partnership, a committee of regional interests, has been working for a conservation and sustainable approach to this ultimate water challenge. Commitment to growth continues to be very strong however, for example, the Garrison commander at Fort Huachuca outlined plans for large scale growth at the military over a seven year period beginning in 2002 (Spinks, 2002: 1). On the other hand, the military has become sensitive to criticism of its growth and large scale impacts on water. The military is now introducing water use conservation methods on and assisting with conservation outside the base. Numerous new housing projects also are planned for Sierra Vista and surrounding lands along the eastern flank of the Huachuca Mountains and conflict over these is ongoing.

Summary and Implications for Planning

The San Pedro Riparian National Conservation Area is highly significant for national and cultural heritage and related conservation, education, research, recreation, tourism and other purposes. Some of the major reasons for this significance are:

1. The highly complex geologic history and diversity of sedimentary, metamorphic and volcanic rocks and associated land forms, notably the highly faulted and pronounced basin and range topography.

2. A series of recent sediments, terraces, playas and other landforms which provide an unusual record of geologic, climatic, vegetation, animal and other changes resulting from the advance and retreat of northern and alpine glaciers during the last several million years.

3. A complex desert flora and fauna exhibiting high diversity on at least a national scale, as well as breeding, migratory and wintering habitat vital to the survival of some 400 species of birds, numerous species of reptiles and other life. In terms of species richness of mammals, the San Pedro Riparian National Conservation Area is considered to be unsurpassed for any landscape of similar size in the U.S.

4. The San Pedro Valley is possibly the most significant archaeological area in North America, with at least four Paleo-Indian sites dating from approximately 11,000 BP in or close to the NCA. The archaeological and historic record reveals traces of many indigenous cultures and peoples up to the Spanish, Mexicans and Americans of more recent centuries. The NCA and nearby areas are very rich in cultural diversity.

5. The San Pedro Riparian National Conservation Area and surrounding country contain an unusually comprehensive historical record of the Post-Pleistocene evolution of a changing natural landscape and the complex array of effects that humans appear to have had on that landscape. Early changes include the extinction of the mammoth and other Pleistocene fauna, as well as vegetation changes through climate change, human use of fire, collecting and gathering, incipient agriculture, and the introduction of exotic plants such as maize. Later changes and effects include: accelerated erosion and gullying; changes in sedimentation and landforms through flood farming, irrigation and water

diversion; introduction of numerous European plants and animals; heavy livestock grazing and associated vegetation change; lumbering and deforestation; drainage of wetlands; gravel and other mining and habitat disturbance. Recent increases in recreation, tourism, retirement and military facilities, and urbanization, have led to habitat fragmentation and rising pressures on surface and groundwater.

6. Some attempts have been made to counteract these changes and effects, a recent example being the San Pedro Riparian National Conservation Area. The NCA was established in 1988 to protect rare riparian habitat by controlling livestock grazing, gravel mining, housing developments, and other exploitive uses of the San Pedro floodplain and adjoining terraces while principally providing for hiking, birding and other forms of low-tech recreation and tourism. A principal goal was nature conservation and some success has been achieved through protection of riparian forests and other vegetation as well as bird and other habitat. The planning implications of these changes and associated conservation efforts are very significant and include:

a) Undertaking more detailed monitoring, assessment and reporting of the effects of the NCA and disseminating the results on a widespread regional, national and international basis. The success of the NCA to date makes it a useful example for conservation programs in other riparian areas and in both dry and humid regions.

b) Reviewing and strengthening the NCA and extending the concept to other rare and threatened riparian systems in Arizona and other parts of the southwestern deserts in the U.S. and Mexico.

c) Dealing with current issues associated with active conservation planning and management, such as fire and beaver re-introduction, through an adaptive management approach and close interaction and consultation with citizens who can supplement the knowledge, values, and resources of the BLM.

d) Building natural corridors and linkages with significant surrounding habitats such as the Huachuca Mountains and continuing efforts to extend principles and programs associated with the NCA across the border into Mexico.

e) Working to have the NCA designated as a World Heritage Site because of its uniqueness and diverse geological, biological and cultural heritage.

Some moves have already been made in these directions. In 1989, a San Pedro Riparian Management Plan was introduced by BLM. The Plan involved some consultation with the public about the selection of one of four major alternatives. These alternatives were very general, ranging from relatively strict conservation management to heavy emphasis on recreation and tourism. The selected alternatives involved balancing resource protection and public use of the San Pedro NCA area. The Environmental Impact Statement (EIS) prepared for the proposed planning alternatives contains numerous comments and criticisms of the plan and the preferred alternatives, mainly from citizens.

The preferred alternative included a number of actions aimed at areas of major concern such as recreation, water, wildlife, soils, and the watershed. These actions were preparatory in nature or put in the form of guidelines or statements of principle. For example, the wildlife actions included inventory of terrestrial and aquatic plants and monitoring to determine the condition and status of wildlife and their habitat (BLM, 1989: 2). The planned actions also included: allowing commercial uses only if compatible with conservation management of the San Pedro; developing interpretative displays and facilities; restricting campfires to designated locations; and developing a limited number of campgrounds. It has not been possible to assess the implementation and effects of such actions for this study. To do so would be difficult in any event because of their general nature, which leaves considerable discretion with the management agency, BLM.

Of considerable interest in planning for the conservation and use of the San Pedro NCA from its outset in the late 1980s, has been a growing emphasis on water. In the 1989 Management Plan, actions included closing and stopping unnecessary irrigation and non-irrigation wells and using one well on a short term basis in one field for an experimental revegetation trial. These actions and others were intended to address the objectives of conserving the groundwater resource while providing necessary support for other programs (BLM,1989: 2)

Since the creation of the NCA and the beginning of planning, water conservation and use have become major, if not the major issues in the NCA and surrounding areas. In this context, it is clear that the growth of military activities, urbanization and settlement pose significant threats to availability of water for use not only by humans, but all life in the region. It has also become obvious that the future of water as a resource and as an essential element in maintaining ecosystems, is outside of the control of BLM, any other management agency, or landowners. Much of the water needed to maintain the San Pedro River and the NCA originates via surficial or ground water flows from surrounding areas. And agencies and owners of these surrounding areas are also affected by the use of water by their neighbours.

Such interrelationships led to the formation of the Upper San Pedro Partnership in the late 1990s. The Partnership was formed to facilitate and implement sound water resource management and conservation strategies in the Sierra Vista Sub-Watershed of the San Pedro River. The Partnership is a consortium of agencies that own land or control land or water use in this Sub-Watershed. It also includes agencies that can provide significant resources to help the Partnership attain its purposes. Fourteen agencies are part of the Partnership and include Cochise County, Sierra Vista and other local organizations, the Arizona Department of Water Resources and other state agencies, the federal Bureau of Land Management, Fort Huachuca, and The Nature Conservancy, an NGO. The Partnership reflects the interests of a range of organizations operating at local to national scales. The Partnership is said to involve a combined top-down-bottom-up approach, with a focus on community and citizen involvement.

The Partnership has only existed for a few years and it is early to evaluate its progress. The first priority of the Partnership is the development of what at times is called a Water Resources Plan and at other times an Upper San Pedro Conservation Plan. The Conservation Plan involves three broad strategies: reducing human and natural water consumption to the minimum necessary to meet the needs of people and nature; reclaiming used water or effluent; and improved rainfall harvesting techniques (Anonymous, 2000). An approach of growing importance to the Partnership is the use of easements to purchase water rights from heavy users, notably agriculturists. A prominent participant in the easement program is the military operation at Fort Huachuca, which has contributed in the neighbourhood of one million dollars to purchase such easements. Further research is needed to determine how well this and other initiatives of the Partnership are working.

Another potentially very significant aspect of the Partnership's approach is linking water conservation and use with wildlife conservation, principally through the work of an Open Space Sub-Committee. An Open Space program is seen as contributing both by conserving water resources and by providing essential natural links or corridors between the nearby mountains and the San Pedro River. Such linkages are seen as facilitating wildlife migration, conserving habitat and preserving the social values in the area (Anonymous, n.d.: 11). In adopting this approach, the Partnership is explicitly linking the traditional field of water resources management with the traditional field of wildlife management in the context of a broad ecosystem approach. The Partnership is also attempting to link traditional engineering approaches to water with the land use and planning approaches of the environmental planners. The "technical fix" is being extended to include spatial and regional planning. It will be especially interesting to follow the implications of this combined approach. It seems to be a major current example of a broad civic watershed approach to resource and environmental management that is needed in many other parts of North America.

Acknowledgements

I would like to thank the Social Science and Humanities Research Council of Canada (SSCHRC), and the Heritage Resources Centre, University of Waterloo, for providing funding and other support for this research. I would like to express my gratitude to the staff of the American Museum of Natural History's Southwest Research Station at Portal, Arizona, for the use of their facilities in the research and writing of this paper. I would like also to thank Shirley Nelson for assisting in the fieldwork. Chris Lemieux assisted in the preparation of this manuscript.

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Why Y2Y? Understanding the Role of Large Landscape Corridor Initiatives in Regional Conservatoin Planning, Using the Yellowstone to Yukon Conservation Initiative as a Case Study

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Abstract

Increasing realisation that protected areas are limited in their capacity to fulfil conservation goals has given rise to planning for conservation in a regional context, which encompasses protected and unprotected lands. A number of regional-scale, multi-species habitat conservation efforts have developed, one prominent example being the Yellowstone to Yukon Conservation Initiative (Y2Y) in western North America. This research examines some of the strengths and limitations of Y2Y in terms of its contribution to regional conservation planning. This was considered in light of some successes and obstacles encountered to regional approaches. The preliminary findings discussed are based on interviews conducted with a broad range of actors in conservation planning in two communities in Y2Y in Alberta-Canmore and Crowsnest Pass. The Y2Y initiative was believed to have made considerable progress in establishing the concept and introducing the notion of planning for conservation in a regional context. However, interviewee comments suggest the organisation needs to devote more effort to building public and more widespread support, maintaining a high profile, and developing a niche for the initiative, in terms of what it can offer to communities and groups involved in conservation planning.

Introduction

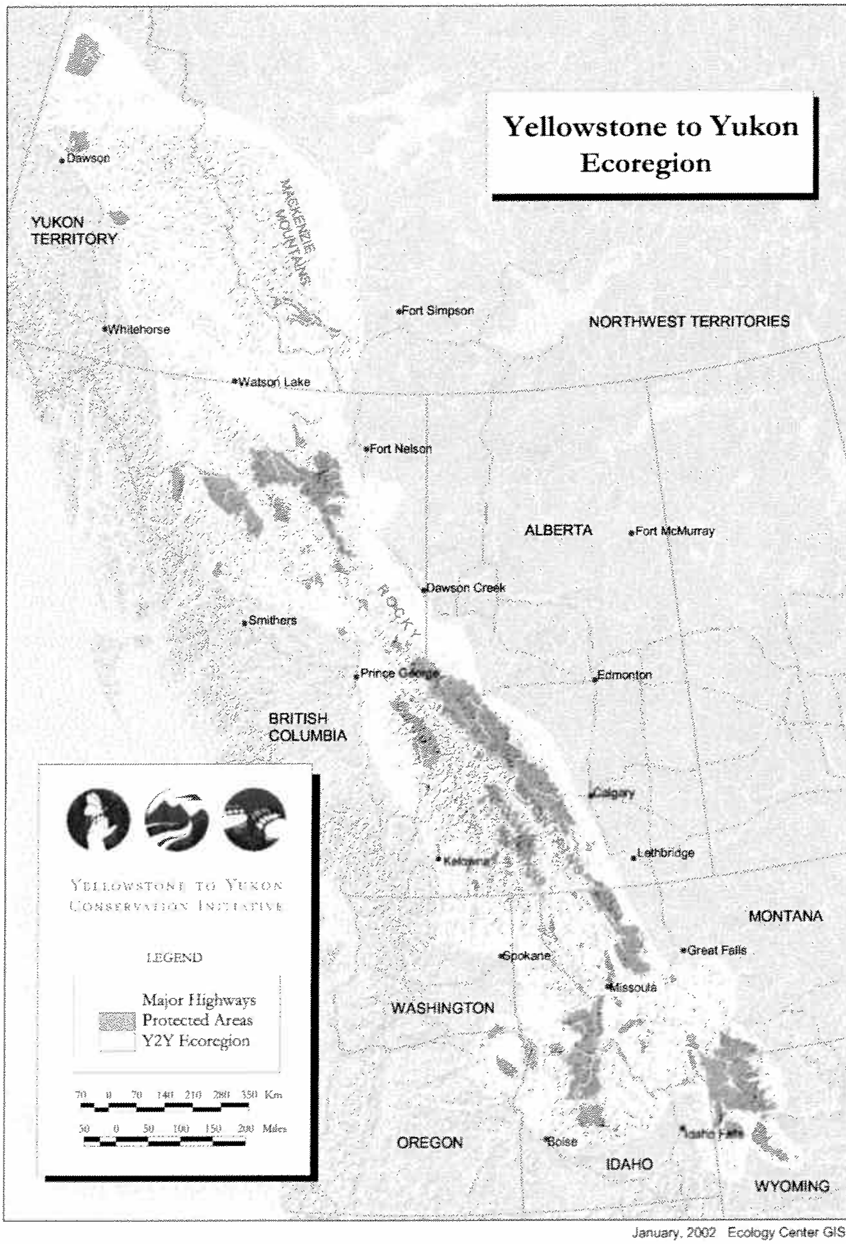
The traditional approach to nature conservation has been to preserve extensive tracts of wild lands in the form of parks and protected areas, maintained by management, legislation and regulation (McNeely, 1995). However, these areas have been proven to be limited in their capacity to fulfil conservation goals, as they are usually too small to maintain wildlife populations, are too few in number and unevenly distributed, and do not adequately represent the diversity of the world's ecosystems (Grumbine, 1990; Pressey, 1994). Furthermore, the effectiveness of existing protected areas is limited by their management and legislation in isolation from surrounding lands (Slocombe and Dearden, 2002). Such management has contributed to a lack of local support for protected areas, which are viewed as limiting human usage and development, and opportunities for economic growth (Lusigi, 1981). This local support is now understood to be critical to the long-term effectiveness of protected areas (Batisse, 1982). Designating areas of remote wilderness is also a limited means to promote an appreciation of other more common natural environments, close to home (Orr, 1993; Cronon, 1995; Miller and Hobbs, 2002). An increasing recognition of such limitations of protected areas has given rise to planning for conservation in a regional context (Parks Canada Agency, 2000; Slocombe and Dearden, 2002).

Regional approaches to conservation consider multiple perspectives, uses and boundaries, incorporating management of natural and semi-natural areas along with formally designated protected areas and their surrounding lands (Noss and Cooperrider, 1994). Regional scale planning incorporates related theory and practice of ecosystem approaches, bioregional planning, community conservation approaches and stewardship, among others. These concepts share similar characteristics which support regional planning:

- a basis on ecologically derived, rather than administrative boundaries;
- large scale, long-term perspectives;
- participatory, co-operative, adaptive and learning-based processes;
- an emphasis on integration across local to global scales and among disciplines; and,
- greater consideration of the complexity and interconnections between ecological and social systems.
  (Slocombe, 1993; Meffe and Carroll, 1997; Yaffee, 1999; Brunckhorst, 2000; Slocombe and Dearden, 2002; WWF, 2002).

Regional approaches most commonly have been based on watershed and greater ecosystem concepts, rather than bioregions (Slocombe, 1993). More recently, a number of regional-scale, multi-species habitat conservation efforts have developed (Aengst *et al.*, 1997). Examples include the Yellowstone to Yukon Conservation Initiative (Y2Y), which extends over the Rocky, Columbia, and MacKenzie Mountains north of Yellowstone (Gailus, 2001) (Figure 1); Baja to Bering Sea (B2B) a marine conservation initiative along the Pacific coast (Jessen and Lerch, 1999); and the Algonquin to Adirondack Conservation Initiative (A2A), extending from Algonquin Provincial Park in Ontario to northern New York state (http://www.atoa.org).

Figure 1. The Yellowstone to Yukon Ecoregion. (Source: Jason Meyers, Yellowstone to Yukon Conservation Initiative, 2002).



The largest and perhaps most well-known example of this type of initiative is Y2Y. The Y2Y initiative operates as a joint U.S.-Canadian network of organisations, foundations and conservation-minded individuals, working together to support and maintain this region (Y2Y, 2002). The initiative is described as a marriage between science and advocacy (Pissot, 2001). The idea was initially conceived in 1993, by a group of scientists and conservationists (Y2Y, 2002). Yellowstone to Yukon spans five U.S. states, two Canadian provinces, two Canadian territories, and the traditional territories of 31 First Nations groups, across approximately 1.2 million km^2 of mountainous terrain from west-central Wyoming to the Yukon's MacKenzie Mountains (Gailus, 2001). The Y2Y vision proposes a series of connected core areas and wildlife corridors across the region. These would be supported by land use decisions and natural resource management based on ecological goals, and human communities that recognise the interconnections between, and function in partnership with, the natural environment (Y2Y, 2002). In 1996 Y2Y was declared an operating network, and since then has expanded into an organisation with an office in Canmore, Alberta and several staff in the U.S. Currently in its sixth year of operation the network consists of over 270 groups and individuals. It has been cited by the National Round Table on Environment and Economy as an example of the "new integrated systems of land management [that] are needed" to maintain conservation values (NRTEE, 2002).

The goal of this research was to gain an understanding of what this landscape-scale conservation approach incorporates, and how it may contribute to regional conservation planning. Potential contributions can be considered in terms of fundamental requirements for regional conservation planning, defined in light of successes and obstacles encountered in practice. Lessons derived from 77 ecosystem management efforts in the U.S. identified effective public involvement as critical, along with education to reduce public opposition (Yaffee, 1996). This study identified more effective networks to facilitate shared use of knowledge as a means to address scientific uncertainty, and recommended agencies to promote interactions among disciplines, departments, and with other organisations (Yaffee, 1996). Related fundamental challenges for community-based watershed management include increasing communication and collaboration; raising awareness and understanding; developing collective will and commitment; and building capacity (Litke and Day, 1998). Clear goals and objectives are also seen as necessary for ecosystem-based management, to guide activities at every level, and to assist in reducing value conflicts (Slocombe, 1998).

As noted earlier, regional-scale planning efforts are relatively new, and much can be learned from deriving lessons from diverse examples of conservation approaches. Thus, this research attempted to assess the successes, challenges and opportunities for the Y2Y initiative in regards to regional planning for conservation.

Research objectives of this study included:

- identifying characteristics that define effective regional conservation planning;
- assessing whether or to what extent initiatives such as Y2Y address these characteristics; and,
- identifying the strengths and limitations of Y2Y in terms of its contribution to regional conservation planning.

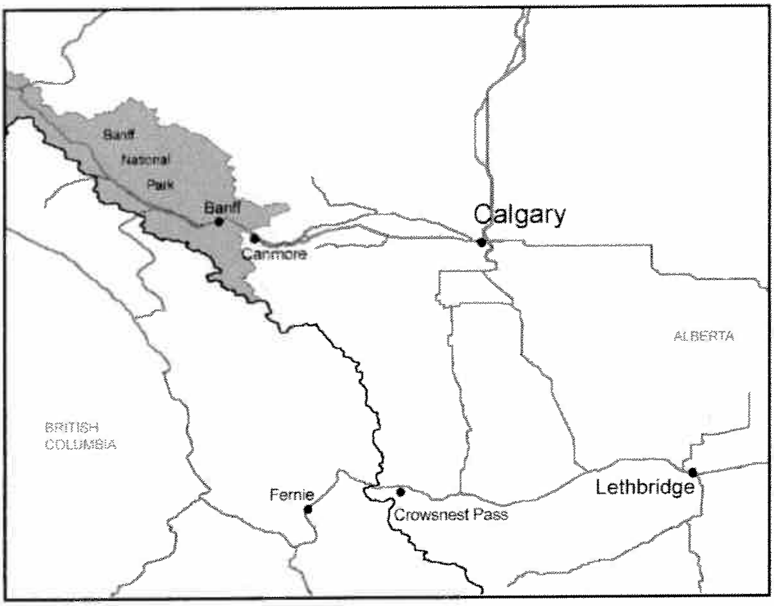
This paper focuses on some key strengths and limitations of Y2Y in relation to regional conservation planning, and provides a discussion of the formative stages of the Y2Y initiative. Its purpose is to encourage and inform further more extensive evaluations of such conservation efforts as they develop over time. While periodic review and evaluation is widely agreed to be critical to improved program performance, conservation programs suffer from a lack of in-depth, comprehensive, external, peer-reviewed evaluations (Kleiman *et al.*, 2000). Due to the recent development of these large scale conservation approaches, there is little analytical information available (Nelson and Sportza, 2000).

Methods

Because there is relatively little information that assesses landscape-scale planning approaches, this research employed an exploratory approach to develop a well-grounded view of what is occurring in the case of Y2Y (Neuman, 1997). This approach lends itself well to using qualitative data, which is more open to using a range of information and uncovering new issues (Neuman, 1997). A case study research strategy was also used to gain an understanding of the context of large scale conservation planning, rather than focussing on a specific variable (Merriam, 1991).

Methods of inquiry included a review of conservation planning literature, interviews in two communities in Alberta-Canmore and Crowsnest Pass, and a review of Y2Y documentation. Interviews and document analysis were employed as they are commonly used qualitative tools in assessments (Datta, 1997). Communities were selected as a focus for inquiry to provide a perspective on linkages between local and regional levels of conservation planning activity. Research was focussed on the communities of Canmore and Crowsnest Pass due to their critical ecological significance as "pinch points" within the Y2Y corridor, threatened by increasing development pressures (Figure 2). Canmore is an important area in the development of Y2Y, as the location of the headquarters of the Y2Y organisation, and as a rapidly growing community adjacent to Banff National Park that has undertaken a number of environmental initiatives. Crowsnest Pass is a community with a resource-based economy, located in southern Alberta near the B.C. border. It is believed to be currently facing the same development pressures as Canmore experienced about 20 years earlier.

Figure 2. Canmore and Crowsnest Pass, Alberta.



In total, 53 semi-structured interviews ranging from a half-hour to over two hours in length, were conducted with 57 individuals directly and indirectly involved in conservation planning efforts in the two communities. Interviewees were drawn from all three levels of government, wilderness-advocacy, land conservation, naturalist, and community stewardship groups, academia, local tourism, media representatives, business and economic development agencies, outdoor recreation groups, informed community members, and from the Y2Y organisation. Interviewees were identified through "snowball sampling" (Palys, 1997) – communication with respondents, who recommended additional respondents. Interviews were conducted in two time periods, the first 16 in Canmore and Calgary June 25- July 9, 2001, and the remainder of the interviews from November 18- December 21, 2001 in Crowsnest Pass, Canmore and Calgary. Questions included what interviewees understood the purpose and goals of Y2Y to be, their involvement in Y2Y, its successes and challenges, and what factors contribute to and detract from successful planning efforts.

The data presented in this paper are derived from preliminary interview results, focussing on factors that influence development of a regional-scale approach to conservation, in reference to some of the needs and challenges earlier presented. These factors primarily include the level of understanding of the concept (degree of awareness, knowledge and involvement in the initiative), as a basis for collaboration. Further discussed are means of communicating the initiative to groups and the public.

Some Preliminary Findings –Interviewee Perspectives

A dominant theme in interviews across communities and respondents was the importance of awareness of the concept, specifically awareness of the public and communities. Several respondents stated the extent of public awareness, engagement, and the visibility of the concept to be measures of success of the initiative. When asked about the successes of Y2Y, 'the establishment of the concept', 'raised profile and awareness of the idea', and 'attraction of people to vision' were talked about more than any other topic. Similarly, elements regarded as necessary for successful conservation planning for Y2Y most consistently were stated as the 'awareness and support of the public and communities', 'connections with stakeholders', and a 'high-profile of the concept'. Respondents in the Crowsnest Pass more frequently cited the 'importance of education', 'getting the message out', and 'public consultation'. Correspondingly, predominant obstacles were seen to be 'public perception', 'lack of awareness', and 'being portrayed as a radical movement.'

Acknowledging the attention that has been directed to the area and the concept, there is still considerable room to develop awareness and understanding of Y2Y. Respondents in Canmore and surrounding area emphasised the awareness of the concept as a success more so than those in Crowsnest Pass. This distinction is most likely due to the pronounced sentiment among the majority of respondents in the Crowsnest Pass area, that the general public was not aware of or well-informed about the concept of Y2Y. In Canmore, this opinion was expressed mainly by respondents operating at the local level who were not directly involved in conservation efforts-local representatives of tourism, recreational, economic development and business sectors. Among respondents in both communities knowledge of Y2Y was varied, but in many cases was limited to a general understanding of the concept, maintaining connectivity of wildlife habitat, corridors and protected areas across the landscape. Representatives of the provincial and municipal governments in the Pass did not consider themselves to have a very strong understanding of Y2Y, nor did some representatives of a land conservation group operating in the region. Government officials from all levels in the Canmore area were more informed of the concept, but their involvement in the initiative was limited to contributing through doing their job well.

A limited sphere of understanding and involvement has implications for the development of the initiative. Representatives from provincial government, municipal government, and economic development among others, noted the need to sell a balanced approach, which is broader in base, and avoids being represented as a radical movement. This is critical to overcoming one of the largest acknowledged obstacles to Y2Y, specifically its perception as an elitist environmental movement seeking to exclude people from the region. Parks Canada and the Rocky Mountain Elk Foundation, neither actively involved in Y2Y, have received complaints from the public and members regarding their support for this perceived radical effort.

Addressing these concerns involves reflecting on some of the elements necessary for successful conservation planning, which were put forward by interviewees. Along with public support and education, several respondents mentioned clarity of the purpose and goals of Y2Y. They stated that Y2Y needs to clarify what its goals are, identifying more tangible roles – both how communities and groups can take part, and what the initiative can offer those groups. A representative of a local environmental organisation in Crowsnest Pass made the point that while education is important, a lot of people do understand the issues, and there is a need for examples of success stories that can be presented to councils, and be promoted as options for the community. Convergent factors such as the introduction of conservation easement legislation into Alberta at the same time as the initiation of Y2Y, and a growing awareness of environmental concerns would suggest that people are generally more aware of conservation issues in Crowsnest Pass and elsewhere. What are needed are examples of how things can work, so that the argument may become less abstract and entrenched in values.

The Y2Y organisation is engaged in developing and publishing success stories across the Y2Y region through their website. In terms of promoting the issue to the public and at the community level, provincial and municipal government officials in Crowsnest Pass and Canmore stated the need for local champions – local individuals who are respected in the community and who can promote the concept. They provide a means to build connections between communities and the initiative, and allow for more community involvement and representation in decision-making and efforts that are undertaken. The most commonly reported source of information about the Y2Y initiative, and also one of the stated successes of the initiative was the hike that was conducted by Karsten Heuer (a former Banff Park Warden) across the Y2Y region, where presentations were made about Y2Y in communities along the way. This direct communication with communities and the publicity that surrounded it was considered to be the most effective form of outreach to date by the Y2Y organisation. This provides some direction for the orientation and delivery of future local level outreach efforts by Y2Y.

Conclusions

The predominant successes and obstacles described above relate in large part to public awareness, knowledge and communication of the initiative, similar to findings reported in Yaffee (1996) on lessons from numerous ecosystem management efforts in the U.S. Despite the successes in promotion of the Y2Y vision at a large scale to an international audience of funders and conservationists (i.e., achieving significant funding from private foundations in the U.S., and being cited by numerous high profile organisations, such as the National Round Table on Environment and Economy) there is need for further awareness-raising and promotion on-the-ground at the local community level. This is particularly true in the community of Crowsnest Pass, which has experienced less interaction and involvement in Y2Y than the community of Canmore. In Crowsnest Pass the main conversation regarding conservation planning deals with conservation easements by the Nature Conservancy of Canada (NCC) and the Southern Alberta Land Trust Society (SALTS). While SALTS has had some interaction with the Y2Y organisation, representatives of the NCC have to date had little involvement in the Y2Y initiative, and have in some cases emphasized this lack of direct connection, in response from concerns from the public. One respondent (an independent observer) in Crowsnest Pass stated that there is a growing opposition to conservation planning represented by Y2Y in this area.

The majority of respondents viewed public awareness, education and support to be critical factors to the success of the Y2Y initiative. This emphasizes the need for a broader base of participants in the organisation, and also a greater concentration on social science questions related to conservation planning. Several respondents (primarily representatives of research organisations) stated this latter consideration as important for Y2Y. An emphasis on social concerns suggests a somewhat different orientation for Y2Y than has previously been the case. In discussion with members of the Y2Y organisation, awareness was acknowledged to be important, but at the time that interviews were being conducted, effort was being put into the development of the science and conservation area design for Y2Y, and communities were stated not to be a priority. The organisation is now undertaking a communications research program to develop some baseline information on views of various constituencies, and to build organisational and individual capacities to deliver more effective messages. Y2Y has also partnered with the Sonoran Institute, an American organisation establishing roots in Canada, which is focused on community stewardship (http://www.sonoran.org/si).

The implications of Y2Y not being well-known, or even being a focus of opposition in Crowsnest Pass, are that future efforts to achieve conservation goals in this area may face some stronger opposition if relationship building does not occur. As suggested by respondents, public awareness building, education and consultation need to take place. This can be augmented through the development and promotion of success stories to be employed as models, and communication directly with communities, by local champions. The important point here is that these and related activities are time and energy intensive, and may not provide immediate desired results. This needs to be kept in mind so that those involved in the Y2Y initiative do not become discouraged by opposition to conservation efforts. The Y2Y initiative has made large inroads into establishing the concept and introducing the notion of planning for conservation across this region. However, interviewee comments suggest that the organisation needs to devote more effort to building public and more widespread support, maintaining a high profile, and developing a niche for the initiative, in terms of what it can offer to communities and groups involved in conservation planning.

Acknowledgements

Thanks to advisor Dr. Stephen Murphy at the University of Waterloo and Professor Scott Slocombe at Wilfrid Laurier University for their ongoing time, effort and financial support through this research.

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The Countryside, Parks, Tourism and Foot and Mouth Disease in the United Kingdom

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Abstract

In April 2001, from a viewpoint in the Northern Pennines of England I could see not only the beautiful rural landscape of the Lake District National Park, but also the sad and disturbing sight of seven fires burning the carcasses of farm animals to control Foot and Mouth Disease. Within weeks the countryside and many parks in much of the U.K. (United Kingdom) were transformed visually, ecologically, socially and economically. A year later, with the eradication of the disease, the countryside, with its agriculture, parks and tourism, is reviving but is unlikely to be the same as before. This paper examines the impacts of the Foot and Mouth Disease e lpidemic of 2001 on the countryside, parks and tourism of the U.K.

The Countryside

The U.K. (United Kingdom) is a small country with a large population. There are 59 million people settled at an average density of 626 people per square mile. This compares with an average density for Canada of 8 people per square mile. There are of course parts of the U.K. and Canada where the actual population density is quite similar. There are many cities, no wilderness (according to most people's standards), but 70% of the country is a rural, largely agricultural landscape, usually referred to as the "countryside." It is a treasured landscape, that for many epitomizes the U.K., and contributes to a sense of national identity (Parker, 2002). Engel went so far as to exclaim that "if you don't understand why the countryside matters so much to the British, I would respectfully contend that you understand nothing" (Engel, 2001).

Most of the countryside is private farmland. Its character reflects various geographical opportunities and constraints as well as centuries of farming practice. But, it also is influenced, and many would argue sustained, by farming subsidies from the British government and European Community amounting recently to £3 billion per year. There are currently 350,000 farmers but there were 400,000 in 1994, and the decline is continuing. It has been predicted that "up to 25% of all farms could disappear by 2005-06" (Ilberry, 2002: 146).

The countryside, especially in the northern and western parts of the U.K., although largely farmed, is important for the conservation of biodiversity and is also a major resource for recreation and tourism. Therefore, much of it has been included in protected areas.

Parks

There are at least 29 categories of protected areas in the U.K. (Bishop *et.al.*,1997). Two of the most extensive are National Parks and Areas of Outstanding Natural Beauty. The National Parks are intended to protect natural beauty and provide opportunities for recreation and tourism while allowing rural land uses such as agriculture, forestry and villages, to continue. The 11 National Parks, designated since 1951, cover 10% of England and Wales. Areas of Outstanding Natural Beauty (AONB) are intended to conserve natural beauty while allowing recreation, tourism, agriculture, forestry, other rural industry and community development compatible with this objective (Gubbay, 1986). Since 1956, 37 AONB have been designated. The land in these Parks and Areas is part public, part private, and mostly farmed. Thus, Cartwright felt justified in saying: "We have come to understand that landscape is entirely artificial. Those parts of the landscape free of garden centers and Little Chefs – the parts that seem most natural – are that way because people made them that way. There is nothing about the countryside that could be called natural, from the artfully placed copses and carefully tended stone walls to the church spires dominating the villages" (Cartwright, 2001: 10). Nevertheless this countryside has conservation values, protected in parks, but influenced by agriculture and tourism.

Tourism in the Countryside

According to The Countryside Agency (2001), "the landscapes, cultural richness and biodiversity of the English countryside are increasingly seen as a reason for overseas visitors to come to the U.K. and for British visitors to stay here on holiday." The scale of this visitation is impressive. The National Parks attract some 100 million visitors per year. The Peak District National Park covers 550 square miles and is within 100 kms of half the population of the U.K. so it alone attracts 30 million visitors per year. The 305 km Coast-to-Coast trek, on footpaths through the Lake District, Yorkshire Dales and North York Moors National Parks attracts 30,000 hikers per year (Avery, 2002). Tourism is twice as important as agriculture in the rural economy. Visitors to the English countryside spend L.12 billion/year (c.$27 billion). Tourism in the English countryside supports 380,000 jobs (Norfolk, 2001).

Foot and Mouth Disease and Its Control

The Foot and Mouth virus was first recognised in Europe in the nineteenth century. It affects cloven-hoofed animals, especially sheep and cattle. It may lie dormant for many years then erupt and spread easily and quickly, by physical contact but even through the air. The last serious outbreaks were in 1923 and 1967. The latest outbreak in the U.K. began in February 2001 in southwest England, then, as a result of animals being shipped, spread to northern England. By April 2001 there were 1603 cases. It was controlled firstly by isolating farms, killing livestock and incinerating them. Over 4 million sheep, cows and pigs were slaughtered.

Access to most of the countryside and parks, even areas well away from where Foot and Mouth Disease had been found, was prohibited. In March 2001, for example:

- all 140 Royal Society for the Protection of Birds Nature Reserves were closed;
- all ll 200 English National Nature Reserves were closed;
- 70 Nature Reserves in Scotland were closed;
- in Snowdonia National Park in Wales, all rights of way across farmland and common land were closed;
- in Exmoor National Park, in south-west England, there was no access to woodland or moorland, and all footpaths and bridleways were closed;
- in the Lake District National Park in north-west England, access to the open fells and moorland was banned;
- in Northumberland National Park in north-east England, visitors were urged to stay away, and all footpaths and bridleways were closed;
- in the Norfolk Broads in eastern England, boating was restricted and all footpaths were closed;
- in Lincolnshire alone, 4500 footpaths were closed to the public;
- most Forestry Commission woodlands, totaling 2.4 million acres, were closed;
- more than 70% of Britain's 2000 mile canal network was closed; and,
- the National Trust's 15 major estates in Northern Ireland were closed. (Anon, 2001a: 18).

By May 2001, there were about 2000 cases of Foot and Mouth Disease, but it was deemed to be under control so visits to the countryside were gradually permitted. However, on May 12 it was reported that "the drive to lift restrictions in time for last week's Spring Bank Holiday succeeded in opening only 18% of the country's 130,000 miles of footpaths" (Cook, 2001: 16).

The U.K. was not declared completely disease free until January 2002. In May 2002, it was estimated that the epidemic had cost the British taxpayer, including vet bills, cleanup and compensation paid out to farmers, over C$5 billion (Campbell, 2002).

Immediate Impacts on Tourism

Upon the outbreak of Foot and Mouth Disease and the consequent imposition of constraints on access to the countryside, recreational visits to the countryside, including non-farm areas, villages and events, by domestic and foreign tourists, declined rapidly and severely. It was estimated that the financial loss of domestic tourism, amounted to £2-3 billion. Lost foreign tourism income in 2001 was estimated at £1-2 billion. Eighty percent of accommodation providers in the countryside were affected. Two to three hundred thousand jobs in the countryside and elsewhere were affected. In March 2001, it was estimated that the Wildlife Trusts were losing L.50,000 per week because their wildlife reserves were closed.

There were also broader impacts. Foreign tourism to the U.K. as a whole declined. Other countries gained tourists. Some countries became reluctant to accept visitors from the U.K. For example, a group from the British Trust for Conservation Volunteers, intending to work in the Nature Areas at Trent University in Peterborough, Canada, were asked not to come for fear that they might bring Foot and Mouth Disease into the country and to the campus which is surrounded by farmland.

Government Responses

The government responded to the Foot and Mouth Disease crisis and its repercussions in a variety of ways, albeit, according to some, too slowly and inappropriately (Anon, 2001). A Rural Task Force was established and financial aid offered to those adversely affected by the epidemic. By May 2001, £250 million had been given by the government to help businesses affected by disease and its impacts. £2 million was provided for 78 national park and local authorities to restore access to the countryside. A Helpline/website was created to indicate opportunities to visit the countryside. Charitable foundations, such as the Royal Agricultural Benevolent Association, also relayed public donations to farmers and afflicted rural communities. By June 2001, a 5-year Strategy for Rural Tourism had been prepared by The Countryside Agency and the English Tourism Council to counteract the decline of tourism in the countryside. In February 2002, the government launched a campaign entitled "Your Countryside – Your Welcome."

Other Consequences

The epidemic has accelerated previous trends toward farm consolidation and closure. Some farmers have changed from livestock to arable farming. Less or different farming will modify the appearance and possibly the appeal of the rural landscape and the parks that protect some of it. Simon Lyster of the Wildlife Trusts worried that "the current crisis will force livestock farmers out of business or arable. It is already difficult to find graziers for our nature reserves...Without grazing, many of our most precious habitats will lose biodiversity and perhaps disappear altogether" (Lyster in Thomas, 2001: 72). *Country Life* magazine noted that "the Lake District National park will have to consider how to manage fells that have been stripped of their sheep" (Anon, 2001).

There is now a greater appreciation of the importance of countryside tourism. Accordingly, a vision is developing of the countryside as a recreation and conservation resource more than an agricultural resource. The crisis provoked a review of EU/U.K. subsidies for farming, tourism and conservation. Farmers are now being urged to manage land for tourism and conservation, not just agriculture. However, not all wish to do so. In the words of Forgrave, "No farmer wants to become a glorified park-keeper..."(2001, 2).

Conclusion

The Foot and Mouth Disease epidemic of 2001 in the United Kingdom had a major impact on agriculture, the countryside, parks, recreation, tourism and the rural economy. It increased awareness of the amenity value of the countryside and its parks and has accelerated some existing trends in farming. Yet the amenity value, biodiversity, and landscape of the parks in the countryside have depended to a large extent on the farming, which seems bound to change.

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Acknowledgements

The award of a Sabbatical Research Grant by Trent University, and the provision of research facilities by the Department of Geography, The University of Reading, U.K. are gratefully acknowledged. I suppose I should also acknowledge the Foot and Mouth Disease virus for encouraging me to think more profoundly about the countryside and write this paper. However, I would rather condemn it for restricting my access, and that of millions of others, to most of the wonderful parks in the U.K!

Natural Heritage Inventory of the Great Lakes Heritage Coast: The Georgian Bay Coast Project, Phase 1 - South-Eastern Georgian Bay Coast

Jarmo V. Jalava and Wendy Cooper
The Nature Conservancy of Canada

Abstract

This paper briefly summarises the results of Phase I of the Georgian Bay Coast Project, a project being implemented as a rapid reconnaissance life science inventory of Ontario Living Legacy (OLL) sites, intervening Crown and private lands, and selected natural areas on private lands along the eastern coast of Georgian Bay. Efforts concentrate on documenting and describing the locations and viability of species and vegetation community occurrences as well as ecosystems of high conservation importance. Field studies are being integrated with existing databases of the Ontario Natural Heritage Information Centre (NHIC), and key maps and descriptive products for public lands will be web-based, accessible, and shared with the broader conservation community and the general public interested in the natural history of the coast.

A more comprehensive ecological theme study for the entire Georgian Bay coast is planned for publication in spring 2003. This thematic study will summarise and evaluate information from background literature, as well as data gathered during the 2001 and 2002 field seasons of the Georgian Bay Coast Project.

Introduction

The Georgian Bay Coast Project (GBCP) is a two-phase project initiated by the Ministry of Natural Resources (MNR) in partnership with The Nature Conservancy of Canada (NCC) and the Ontario Region of The Nature Conservancy of Canada and Georgian Bay Land Trust (GBLT) Joint Venture. The goal of the project is to complete a life science inventory of the Great Lakes Heritage Coast region, including both public and private natural areas along the eastern coast of Georgian Bay.

Phase I consists of a natural heritage inventory of Ontario Living Legacy (OLL) sites and intervening Crown lands from Severn River north to Franklin Island. Life Science Checksheets based on detailed ground inventories were completed for OLL sites and aerial surveys were used to inform brief life science reports for the intervening Crown land areas. Aerial surveys with limited ground-truthing and draft life science checksheets for OLL sites from Franklin Island north to the French River were also compiled. In addition, life science reporting based on detailed ground inventories for selected private lands of interest to the Ontario Region NCC and GBLT Joint Venture were undertaken along the entire eastern coast of Georgian Bay.

Phase II, commencing May 2002, will complete ecological studies of the eastern coast of Georgian Bay, with surveys of remaining OLL sites and intervening Crown Lands between Franklin Island and the French River. Inventory of additional private land sites will also be undertaken. Phase II will also include site inspections of sites in the District of Muskoka as a contribution to the partnership between the GBCP and the Muskoka Wetlands Mapping Project (a collaborative project involving Ducks Unlimited, District of Muskoka and MNR). Finally, pending funding approval from Parks Canada, botanical inventories of the Georgian Bay Islands National Park will be undertaken by the GBCP field crew in 2002.

At the conclusion of Phase II, a report encompassing the findings of both Phase I and Phase II and an evaluation of the Georgian Bay Coast ecological theme area will be published. It will include a biophysical synopsis of the study area, comparative evaluations of sites on the basis of representation, species lists for the entire study area, and an assessment of site- and species-conservation priorities, and land-use and resource management considerations from a greater ecosystem perspective.

Field Results

Field Summary

The project began with a reconnaissance helicopter survey on March 26, 2001 (before the project had officially started) by MNR and NCC staff. Once the project had officially begun on May 1, 2001, the initial two weeks were spent preparing for the field season. Breeding bird surveys and vascular plant and vegetation community inventories commenced on May 23, 2001. Herpetofaunal, mammal and invertebrate observations were also recorded throughout the field season.

Vegetation Communities

A preliminary vegetation community classification was developed in May 2001 in preparation for the field season by the Georgian Bay Coast Project (GBCP) based on ecosite and vegetation type schemes in the *Forest Ecosystem Classification of Central Ontario* (Chambers *et al.*, 1997) and the *Ecological Land Classification (ELC) for Southern Ontario: A First Approximation* (Lee *et al.*, 1998), as well as supplementary lists of significant vegetation types provided by the Natural Heritage Information Centre (NHIC). This was necessary because of the absence of a comprehensive ecological land classification for the southeastern portion of the Canadian Shield in Ontario, as Chambers *et al.*, (1997) covers only terrestrial (primarily forested) community types. Vegetation communities were described during field surveys using standards developed by the NHIC and adapted by the GBCP for rapid-reconnaissance field inventory compatible with the provincial ecological land classification template. At the end of the field season, vegetation data were compiled into a master spreadsheet and classified. The preliminary classification was re-evaluated with the benefit of the >1100 new community records compiled by the GBCP in 2001, in collaboration with NHIC (Bakowsky, 2002 pers. comm.). Additional applicable vegetation classifications (e.g., Harris *et al.,* 1996; ABI, 2001; NHIC, 2002; Bakowsky, 2002) were used to refine the vegetation list. All of these classifications are currently being synchronized by the NHIC in collaboration with other Association for Biodiverisity Information (ABI) member agencies in order to ensure compatibility among jurisdictions. A working classification for GBCP compatible with the standard Ontario ELC is now in place, although element codes, conservation ranks and the vegetation typing (G-RANKS and S-RANKS) are still works-in-progress at the time of writing.

Approximately 1200 records of over 125 vegetation community types were documented and geo-referenced from the Phase I OLL and NCC/GBLT study areas. These community types include older growth forest stands and high quality (pristine) examples of common and uncommon communities such as rock barrens, bogs, fens and other wetland types. Globally and provincially rare communities such as Atlantic Coastal Plain meadow marshes and Great Lakes shoreline meadow marshes were also documented and geo-referenced (Table 1), as were a number of vegetation types not previously documented according to the standard Forest Ecosystem Classification and/or Ecological Land Classification schemes in south-central Ontario.

Table 1. Globally and provincially significant vegetation types of the southeastern Georgian Bay coast.

CODE	VEGETATION TYPE	G RANK	S RANK
P34	Acidic Treed Talus Ecosite	G4G5Q	S3S4
P32	Acidic Open Granite Talus Type	G4G5	S3S4
P64	Common Juniper Acidic Shrub Rock Barren Type	?	S2
T113A	Dry - Fresh Hemlock - Oak Mixed Forest	G?	S3-S3S4?

T122A	Dry - Fresh Oak - Red Maple Deciduous Forest Type	G?	S3S4
T134	Dry - Fresh Sugar Maple - Basswood Deciduous Forest Type	G3G4	?
W188	White Pine Mineral Coniferous Swamp	G3G4	S2
W196A	Red Maple - White Pine Mineral Mixed Swamp Type	G3G4	S2
W201	Red Maple - Conifer Organic Mixed Swamp Type	G3G4	S2
W226	Buttonbush Mineral Thicket Swamp Type	G4	S3
W226A	Buttonbush - Sweet Gale Mineral Thicket Swamp Type	G?	S2S3?
W235	Buttonbush Organic Thicket Swamp Type	G4	S3
W238	Winterberry Organic Thicket Swamp Type	G2Q	S3S4
W239	Mountain Holly Organic Thicket Swamp Type	G?	S3S4
W245	Twig-rush Graminoid Open Fen Type	G3G5	S3?
W248A	Cottongrass - Beak-rush / Yellow-eyed Grass Open Fen	G3G4?	S3-S3S4?
W253	Leatherleaf - Forb Deciduous Shrub Fen Type	G3G4	S3
W253A	Leatherleaf - Chain Fern / St. Johns-wort Shrub Fen	G3G4	S3

W262	Virginia Chain Fern Open Bog Type	G3	S3
W268A	Atlantic Coastal Plain Forb Bedrock Meadow Marsh Type	G?	S2?
W289A	Atlantic Coastal Plain Meadow Marsh Type	G2?	S3

Species Occurrences

In total, approximately 18,900 species occurrences were documented and geo-referenced at Phase I sites of the GBCP during the 2001 field season, and several hundred additional records were collected for Phase II OLL sites. Field surveys focused primarily on vascular plants, breeding birds, reptiles and amphibians. Incidental observations were also made of mammals and notable insect species.

To date, project staff have identified 782 vascular plant taxa for the study area, with some collected plant specimens still requiring verification. Only 10% (80 species) of these vascular plant species are considered introduced in Ontario.

One hundred and six species of breeding birds, 17 reptile species and 16 amphibian species were recorded at the study sites. Breeding bird data are being submitted to the Ontario Breeding Bird Atlas and reptile information will be passed on to the Georgian Bay Reptile Awareness Program.

Rare Species and Species at Risk

Of the species recorded, 42 are currently (as of April 2002) considered provincially or globally rare by NHIC and ABI (Table 2, Table 3). The data collected on these species is being supplied to the NHIC Element Occurrence Database to confirm and update existing records or provide information on previously undocumented element occurrences.

A number of the 28 rare plant species recorded from Phase I sites are Atlantic Coastal Plain species including Meadow-beauty (*Rhexia virginica*), Carey's Smartweed (*Polygonum careyi*) and Carolina Yellow-eyed Grass *(Xyris difformis)*. The remaining species include a variety of shoreline, wetland and forest species. Multiple occurrences of the reptile species at risk associated with Georgian Bay, such as Eastern Fox Snake, Eastern Massasauga and Five-lined Skink, were documented from a variety of sites. Other notable rare taxa include Pine Imperial Moth, Elfin Skimmer, Red-shouldered Hawk, Caspian Tern and several occurrences of the provincially rare-to-uncommon Prairie Warbler. In addition to the species recorded during Phase I field work, a number of species were documented from previous studies (e.g., Kamstra 1991 & 1992; Reid and Bergsma, 1994). A complete list of these studies is provided in the Georgian Bay Coast Project Phase I Summary Report.

Table 2. Globally and provincially rare vascular plants of the southeastern Georgian Bay Coast study areas.

SCIENTIFIC NAME	COMMON NAME	G RANK	S RANK	MUSKOKA DISTRICT STATUS	PARRY SOUND DISTRICT STATUS	5E7 STATUS
Carex folliculata L.	Long Sedge	G4G5	S3	U	N	
Carex novae-angliae Schwein.	New England Sedge	G5	S3	U	X	
Carex trisperma Dewey var. billingsii Knigh	Billing's Three-seeded Sedge	G5T?	S2S3	N	X	
Dryopteris x triploidea Wherry	Wood Fern	HYB	S3S4	C	X	
Echinochloa muricata (P. Beauv.) Fern.	Prickly Barnyard Grass	G5	S3?	?	N	
Galium brevipes Fern. & Wieg.	Short-stalked Bedstraw	G3G4	S2?	N		

Huperzia selago (L.) Bernhardi ex Schrank &	Fir Club-moss	G5	S3S4	RI		
Isoetes engelmannii	Engelmann's Quillwort	G4	S1	R		
Isoetes x eatonii Dodge	Eaton's Quillwort	HYB	S1	R	N	
Juncus acuminatus	Sharp-fruited Rush	G5	S3	R	N	
Juncus militaris Bigelow	Bayonet Rush	G4	S3S4	U		R
Linum medium (Planchon) Britton *var. medium*	Stiff Yellow Flax	G5T?	S3	U		
Najas gracillima (A. Braun ex Engelm.) *Magn*	Thread-like Najas	G5?	S2	R		
Panicum rigidulum Bosc ex Nees *var. rigidul*	Ridged Panic Grass	G5T?	S2S3	U	R	

Panicum spretum J.A. Schultes	Eaton's Panic Grass	G5	S2	U		
Platanthera blephariglottis (Willd.) Lindle	White-fringe-d Orchid	G4G5-T?	S3S4	C		
Polygonum arifolium L.	Halberd-lea-ved Tearthumb	G5	S3	R	N	
Polygonum careyi Olney	Carey's Knotweed	G4	S3S4	C		
Pterospora andromedea Nutt.	Pine-drops	G5	S2	R		
Rhexia virginica L.	Common Meadow-b-eauty	G5	S3S4	C		
Sagittaria cristata Engelm.	Crested Sagittaria	G4?	S2S3	U		
Saururus cernuus L.	Lizard's-tail	G5	S3	R		
Schoenoplect-us smithii (A. Gray) Sojak	Smith's Club-rush	G5?	S3	R		
Sporobolus asper (Michx.) Kunth	Rough Dropseed	G5	S1S2	R		
Triadenum virginicum (L.) Raf.	Marsh St. John's-wort	G5	S3	C		

Utricularia geminiscapa Benj.	Hidden-fruit-ed Bladderwort	G4G5	S3	R		
Viola x primulifolia L. (*V. lanceolata X V. macloskeyi)*		HYB	S1	R		
Xyris difformis Chapman var. difformis	Carolina Yellow-eyed Grass	G5T5	S3?	C		

Table 3. Globally and/or provincially rare fauna of the southeastern Georgian Bay Coast study areas.

SCIENTIFIC NAME	COMMON NAME	G RANK	S RANK	COSEWIC	MNR
Cordulegaster maculata	Twin-spotted Spiketail	G5	S3		
Eacles imperialis pini	Pine Imperial Moth	G5T3	S3?		
Nannothemis bella	Elfin Skimmer	G4	S3		
Nehalennia gracilis	Sphagnum Sprite	G5	S3		
Buteo lineatus	Red-should-ered Hawk	G5	S4B,SZN	SC	VUL
Larus marinus	Great Black-backed Gull	G5	S2B, SZN		
Sterna caspia	Caspian Tern	G5	S3B, SZN	NAR	
Dendroica discolor	Prairie Warbler	G5	S3S4B, SZN	NAR	NIAC

Clemmys guttata	Spotted Turtle	G5	S3	SC	VUL
Emydoidea blandingii	Blanding's Turtle	G4	S3?		
Eumeces fasciatus	Five-lined Skink	G5	S3	SC	VUL
Elaphe gloydi	Eastern Fox Snake	G3	S3	THR	THR
Heterodon platirhinos	Eastern Hognose Snake	G5	S3	SC	VUL
Sistrurus catenatus catenatus	Eastern Massasauga	G3G4T3-T4	S3	THR	THR

More than 200 locally significant species were also documented at the study areas. Species are considered locally significant if they are rare (R) or new (N) for the District of Parry Sound or the District of Muskoka according to a preliminary checklist for these municipalities (Oldham, 2001) and/or rare (R) or new (N) for Ecodistrict 5E-7 (Crins, 1997). Of the previously undocumented species for the districts of Parry Sound and/or Muskoka, five are currently considered provincially rare.

Applications of the Georgian Bay Coast Project

The applications of the Georgian Bay Coast Project extend beyond the completion of its stated deliverables. The eastern Georgian Bay coast is likely to be nominated as a World Biosphere Reserve and this project will help in providing some of the information needed to support that nomination. In addition, the data obtained from this project will provide valuable information to assist in updating the ranges and statuses of common and rare species along the eastern coast of Georgian Bay, most significantly the northern portion of the coast where little natural heritage information has been collected in the past.

Beyond these general applications of good resource data, this project also contributes to improved public communication along the coast through direct contact, presentations and media coverage. In addition, the project is involved in extensive partnership building among groups such as the Ministry of Natural Resources, national, provincial and local land trusts, cottager associations, municipalities and other interest groups in the area.

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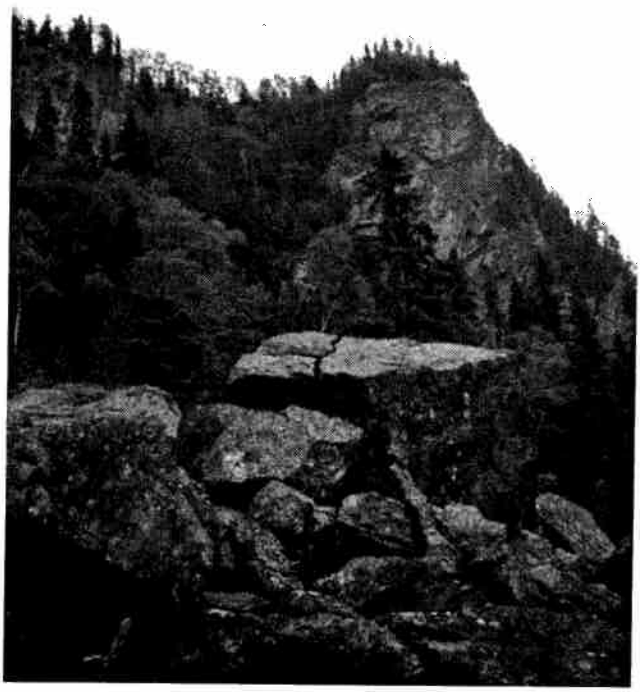
Business and the Environment



Massive boulder talus subtends dramatic cliff faces at Old Woman Bay, Lake Superior Provincial Park (B.Boles, OMNR Archive Photo)

Business Statistics for the Ornamental Horticultural Industry in Ontario

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Abstract

A system to collect and publish industry statistics for (ornamental) horticulture in Ontario has been developed and tested over the past three years. Information was gathered from nearly 700 individual business operators in more than a dozen business types, with an interim report published in Landscape Trades magazine in April, 2001 and the first of several articles in June, 2002. A projected estimation from this information identified an evolving horticultural industry projected to be valued at $4.4 billion annually (Nentwig, 2001), with a potential gross business estimated to be as high as $8.7 billion annually (Nentwig, 2002), if vertical markets such as parks, golf courses, florists, retail chain store gardening sales, and municipal horticultural operations were considered. This paper presents results of the surveys, and discusses the need for further interest and involvement in the gathering of essential statistics from sectors of horticultural activity previously unexplored.

Surveying the Industry

Statistics Canada and the Ontario Ministry of Food (formerly OMAFRA) report on the production of horticultural crops, separating ornamental from food crops (OMAF). The figures they produce represent the farm-gate value of horticulture in Ontario, considered the wholesale segment for purposes of this study, and was valued at approximately $940 million in 2000[1]. The research study, begun in 1998, was interested in the value-added aspects of the horticulture industry-landscape related businesses-which does not focus on the production of plants in nurseries and greenhouses.

Initial attempts to survey business operators in the horticulture industry were planned as a self-administered questionnaire, and over 12,000 of these were mailed to business operators, with Landscape Ontario's assistance, during the spring and

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1. Combined nursery and greenhouse (non-food) production, information from OMAF web site, May 2002.

summer of 2000. Responses were a dismal two to three percent-not nearly enough to establish any statistical information. The decisions to reformat the questionnaire, and to meet business operators face-to-face, resulted in structured interviews, conducted at Landscape Ontario's Congress in January of 2001 and 2002, and at their Garden Expo trade show in October of 2001. The Farm Safety Association also assisted in the two latter surveys by providing funding, and additional information regarding their impacts in these same business sectors was requested during the interviews.

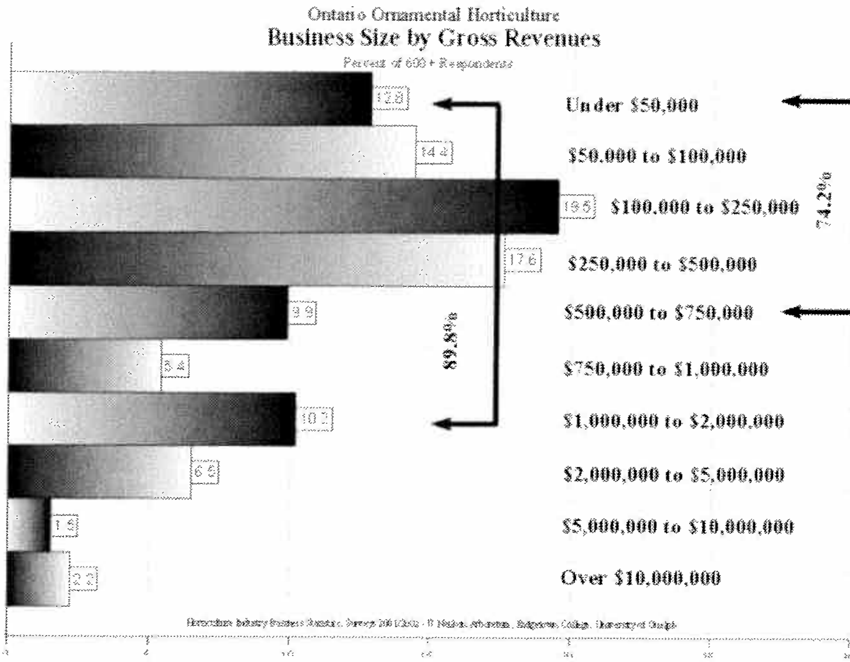
The two-to three-minute interviews netted almost 700 responses, covering mainly landscape, garden center, greenhouse and nursery operations. Many more business types were noted as component parts of these operations, some 70% having more than one component. There were 15% of the surveyed business operations concentrating in production (greenhouse or nursery) or in other pursuits (i.e., 50% of gross revenues or more in those sectors), and that were excluded from most calculations. The remaining surveys represented between 5-7% of the estimated eight to twelve thousand business operations in Ontario (see Nentwig, 2002).

Revenues

Of the nearly 500 business operators surveyed with revenues mainly from non-production operations, a predominance of small business was immediately evident, with 90% under $2 million in gross annual revenues (Figure 1).

These figures (a total of $440 million for the survey group) were projected using general industry estimates of eight to twelve thousand businesses, and showed a gross revenue for Ontario as high as $8.7 billion annually. This number was not considered an accurate reflection of actual business operations, since many areas such as golf courses, municipal (and other parks) horticultural operations, independent florist shops, and the large chain store garden centers, were not included. At the same time, it was not known if the estimated total number of business operations actually comprised larger or smaller entities than the average $725 K gross revenues. All in all, this information was the first available in three decades of the industry's rapid growth in popularity, and showed some valid trends and approximations.

Figure 1. Breakdown of business revenues of survey respondents.



Revenues were derived from many combinations of sectors, and a comparison of business sector proportions was produced from compiled revenues from all sources (Table 1).

Table 1. Sectoral breakdown of horticultural revenues of survey respondents.

Retail Garden Center	31.4%	Snow Removal	3.5%
Landscape Construction	27.2%	Design/Consult	3.0%
Grounds Management	9.2%	Ponds/Water Features	1.7%
Grower [1]	8.1%	Irrigation/Lighting	1.3%
Lawn Care	5.4%	Flower Shop [1]	0.6%
Greenhouse [1]	4.1%	Miscellaneous [2]	5.7%

1. Growers, Greenhouses and Flower Shops all exist with Retail Garden Centers.
2. Includes: lawn equipment, hardware, mail order plant sales, tree services, holidayscaping, container gardening, home and garden wares, garden furniture, excavating/grading, and others.

Personnel

A simple regionalization of business operations was developed through analysis of the first digit of the postal code for each business operation (only the first three digits were requested, to ensure anonymity). This information could not be considered representative of the industry, since respondents were from an unstructured sample within an unknown population. The results showed regional locations of respondents for the first letter of the postal code only. Revenue proportions for each area followed the location index proportions almost exactly (Table 2).

Table 2. Regionalization of business operations of survey respondents.

Eastern Ontario	"K"	13.3%
Central Ontario	"L"	38.8%
Toronto Area (except Toronto)	"M"	8.3%
Southwest Ontario	"N"	34.4%
Northern Ontario	"P"	5.3%

The Retail Garden Center (31.2%) and Landscape Construction sectors (19.0%) held half the personnel; 25% more were found in three sectors: Growers, Grounds Management, and Lawn Care; almost 20% of personnel was Miscellaneous. Over 25% were full time year round, nearly 50% full time year seasonal, and the rest part time. Just under half were unskilled labour, nearly 30% skilled, and 17% managerial. Only 6% were supervisory, a middle management role often missing from small business operation types of this industry.

A projection of between eighty-five and one hundred thousand employees in the industry, was produced from a seasonality report showing over 50,000 (full time) workers in 1996 Statistics Canada census data (McEwan and Duffy, 1999), and an estimated average of 5% to 10% employee growth[2]. Nearly 7,600 employees were reported in the surveys, almost half in business operations of five or less employees, and close to 70% with 10 or fewer. The average size of operation held 10.3 employees, however the median (half the businesses were fewer, half were greater) was five-again, indicative of small business.

Sector Groupings

Analysis of the data using groups of sectors, comparative to previous study work (see McEwan, 1999), left out Design/Consultation, Miscellaneous, Product Manufacturing and Distribution, and Grower operations. Over 80% of revenues came

2. Personnel growth estimated at 5% to 10%, while business revenues increased 15% to 20%, depending on sources if information.

from the specific sectors that formed these groupings in each case, however, Retail and Construction were both very high in the main sector (the first one listed below-78% and 72%), while Maintenance was split between Grounds and Lawn Care (35% and 45%). The three groupings (Retail Sales, Maintenance and Construction) covered 72% of gross revenues (33%, 13%, 26% respectively) and were formed from the following sectors:

Retail Sales:	Retail Garden Center, Flower Shop, Mail Order Plant Sales
Maintenance:	Grounds Management, Lawn Care, Snow Removal
Construction:	Landscape Construction, Ponds/Water Features, Irrigation Lighting

The number of businesses reporting involvement in the various sectors also followed the expected norms for Retail and Construction (99% and 92% in the main sector), while Maintenance reported over half involved in each of Grounds and Lawn Care. A surprising third of Maintenance operations are also involved in Landscape Construction and Snow Removal, and the Construction grouping was most diversified with over 20% in Design and Grounds, and between 11% and 15% in Lawn Care, Retail Garden Center, and Snow Removal. These involvements show business numbers, not revenues, and are not intended to be added together. It is interesting to note that Maintenance grouping sectors comprised 47% of involvements in the Construction grouping, and Construction grouping involvements appeared in 32% of the Maintenance grouping. Very little information that demonstrated a 'model' business operation for the industry was found.

The three groupings differed in business size by personnel, with five or fewer employees in nearly 40% of Retail operations, over 60% in Maintenance, and 46% in Construction, and with 65%, 83%, and 70% with 10 or less personnel, respectively. 'Employees' included owners/operators and managers, as explained during survey interviews. Previous study work (McEwan and Duffy, 1999) indicated that 80% of workers would likely fall into these three sector groupings: this study found 74% of personnel in these areas. However, some were left out simply due to the exclusion of personnel in pertinent sectors not focussed within one of the three groupings.

Industry Growth

Approximately 30% of surveys provided information on business increase/decrease for the 1999/2000 seasons, the remainder reported for 2000/2001. Over 75% of businesses indicated an increase in revenues from 1999, about 70% an increase from 2000. Increases were expected by over 75% for both 1999 and 2000. Decreases from 1999 were reported by 8% and from 2000 by 11%, while decreases in revenues for 2001 were expected by 4% and for 2002 by 3%. Net increases in revenues for the three groupings for both seasons ranged from 11% to 23% (Table 3).

Table 3. Reported trends in industry growth.

	Reported Increase/ Decrease		Expected Increase/ Decrease	
	from 1999	from 2000	for 2001	for 2002
Overall Survey	**15%**	**14 to 17%**	**10%**	**12 to 15%**
Retail Sales	14%	15 to 23%	12%	6 to 16%
Maintenance	12%	11 to 18%	9%	13 to 17%
Construction	14%	+/-16%	7%	12 to 17%

An estimation of sector increase/decrease for each grouping was tried, but resulted in little valuable information. The figures produced reported on averaged sector details for individual business operations, and when totalled were no longer relevant.

Missing Sectors

All of the above statistics related to only some of the overall horticultural activity in Ontario. Retail sales through chain and hardware store garden centers, municipal park maintenance and plantings, independent florist operations, and the golfing industry, have not been addressed at all. From the Congress 2001 survey reports (Nentwig, 2001) an estimate of $4.4 billion of value-added activity could be projected, and an 'educated guess' of $6.5 billion has been used (by the author) to include the missing sector activities. The next phase of this research is to establish connections to these sector areas, and to develop manners of determining their horticultural value. It will be important to also separate the production activities from value-added aspects of installation and management or maintenance. The compiling of these statistics will be helpful in determining the direction of future regulations and certifications for the industry, and assist in the formulation of business plans for those presently in the business.

Related information from Statistics Canada, and as reported by OMAF, do not cover the specific areas that this research tries to define. There are some U.S. statistics that cover retail (homeowner) horticultural activities[3] (NGA, 2000) and the 'green industry' in Ohio[4] which have been compared to and help define a general sense of the Ontario figures. However, definitive statistics for our horticulture industry still need to be generated. A method of collection and dissemination has

3. Retail sales up in 1999 by 11%; average household spending up in 1999 by 17% (NGA 2000).

4.Greengoods industry in Ohio in 1996 (latest stats available): $1.96 billion overall; 23% increase from 1992 http://www.hcs.ohio-state.edu/greengoods/greengoods.html.

been developed, without the sectors mentioned above, and should be expanded to include all aspects. Future research will endeavour to find better means of procuring and comparing statistical information, and broadcast the results for the benefit of both the industry and the public.

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Algonquin Provincial Park
Visitor Expenditures and Impacts

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Abstract

The Federal Provincial Parks Council (now known as the Canadian Parks Council) called for the development of a common framework to measure the economic value of protected areas. The Provincial Economic Impact Model (PEIM) is a standardized tool to estimate the economic impacts of parks in Canada, as part of the common framework. Visitor spending data and park budget data are input into the PEIM to generate estimated impacts, measured by labour income, gross domestic product, and employment.

Five distinct visitor types in Algonquin Provincial Park were examined (i.e., day visitors, car campers, interior visitors, lodge visitors, cottage leaseholders). Visitor information was collected through detailed visitor surveys in 1999 and 2000, and visitor profiles were developed. Average amount spent per person-night for each visitor type was multiplied by yearly park visitor numbers to estimate total annual spending for each visitor type. Using the PEIM, annual spending for these five visitor types was estimated at approximately $20 million. This paper contains a modest selection of study results. This is the first time precise calculations have been done for Algonquin Provincial Park.

Introduction

Competition for limited government funds, agency restructuring, desire for fiscal accountability, and increased park visitation have contributed to an atmosphere which is supportive of park agency efforts to better understand the park and its visitors from an economic perspective. Knowledge of the economic impacts of parks is relevant to governments when considering conservation policy and allocating funds (Pearson, Russell and Woodford, 1999). As such, a growing interest exists in developing widely accepted standards for assessing parks' contributions to the economy, including economic benefits associated with visitor spending generated by tourism activities within the park and in the surrounding areas.

Measuring Benefits

Measures of park economic benefits can be used for planning, policy analysis, budget justifications and marketing. There are many different ways to assess the value of benefits associated with parks and protected areas (The Outspan Group, 2000b; World Commission on Protected Areas, 1998; Coopers and Lybrand Consulting, 1996; Dixon and Sherman, 1990). Some benefits are more difficult to quantify than are others. For example, assigning value to benefits associated with species diversity or ecosystem protection is more nebulous than quantifying the value of tourism spending. Although it is common for studies to focus on calculating benefits that are more straightforward to measure, the value associated with less tangible benefits should not be overlooked.

Three categories of benefits are recognized in the common framework adopted by the Federal Provincial Parks Council (The Outspan Group, 2000a). Personal benefits are received by individuals. In the context of parks, they may include benefits received by those who visit the park as well as those who enjoy the resource indirectly (e.g., through books or movies). Business and commercial benefits are the benefits received by businesses and the surrounding community from spending that is caused by establishment, development or existence of a park (Department of Canadian Heritage, 1999). Societal benefits are benefits derived from public goods where the benefits accrue to members of society (e.g., ecological functions of parks such as oxygen production). This study focussed on business and commercial benefits.

The area in which benefits are being assessed is defined through an account register. It sets the boundaries for the analysis. Benefits to a local area will be different than those that accrue to a regional or provincial area (Department of Canadian Heritage, 1999). Analysis for this study was set at a provincial scale.

Provincial Economic Impact Model (PEIM)

Developed in partnership by the Department of Canadian Heritage and the Canadian Tourism Commission, the Provincial Economic Impact Model (PEIM) is a user-friendly computer application for estimating the economic impacts of expenditures at the provincial level on heritage activities such as the development and operation of natural areas, protected areas, parks and historic sites, and the tourism spending associated with these events. As part of the efforts to develop a common framework to measure the economic value of protected areas, the Federal Provincial Parks Council (now known as the Canadian Parks Council) has proposed the PEIM be adopted as a standardized tool for assessing economic impacts of provincial parks in Canada. The PEIM assesses business and commercial benefits at a provincial level.

The main inputs required for the PEIM are park budget data (e.g., infrastructure expenditures, operating and maintenance expenditures, and wages and salaries) and visitor spending data. Impacts of visitor spending are examined in this paper. There are three possible approaches to using the model based on time, budget and data availability.

The degree of detail required increases with each approach. The first approach requires total expenditures by all visitors (spending categories are not required). Information on visitor origin (i.e., location of permanent residence) and visitor motivation (i.e., level of influence the park had in determining their choice of this area as a stop or destination on their trip) is not required. Crude estimates are generated through this approach.[1] The second approach requires information on visitor origin and spending categories (e.g., transportation, accommodation). This approach may be suitable when typical survey information is available. Approximate estimates are generated through this approach. In addition to the information required for the second approach, visitor motivation is required for the third approach. This approach takes into account the percentage of visitor spending that can be attributable to the park according to the visitor origin, and level of influence the park had upon the decision for the trip. This approach generates the most credible estimates.

The PEIM generates estimated impacts for labour income, gross domestic product (GDP) and employment. These measures are frequently used to describe economic impacts. This study examined the application of the PEIM using the third approach (i.e., information on visitor origin and visitor motivation are required) with data obtained from Algonquin Provincial Park visitors.

Study Area

Algonquin Provincial Park (Figure 1) is the oldest and one of the best-known parks in Ontario. It covers an area of 7,725 km. A provincial highway travels for 56 km through the narrow south section of the park. The park has 12 campgrounds accessible by car (8 which are located along the southern highway corridor) with over 1200 campsites. As well, there are 29 interior access points which provide entry into 1500 km canoe routes, 170 km of backpacking trails, and over 1500 interior campsites. Of the total recorded visitors to Ontario provincial parks in 2001 (i.e.,

[1] *It is unlikely that 100% of all visitors' expenditures are attributable to the existence of the park. It is possible to use only the expenditures that took place on the day of the park visit, however this does not capture visitors who came from far away and spent significant amounts of money on the way. It also includes spending by visitors whose main motivation was not the park. These concerns can be alleviated by collecting information on visitor motivation.*

visitor statistics are not recorded for all the provincial parks), visitors to Algonquin accounted for roughly 9% (Ministry of Natural Resources, 2002).

Figure 1. Location of Algonquin Provincial Park.

Methods

Expenditure data for five distinct visitor types to Algonquin Provincial Park were collected through visitor surveys in 1999 and 2000. Surveys were distributed at park entrances, camping registration offices, and the park visitor centre. Surveys were returned either to drop boxes inside the park or via regular mail to the University of Waterloo. A total of 1131 valid surveys were analyzed to produce visitor characteristics and expenditure information for day visitors (n=289), car campers (n=437), interior visitors (n=221), lodge visitors (n=62), and cottage leaseholders (n=122). This is the first time information has ever been collected on lodge visitors and cottage leaseholders. Tour bus visitors and summer youth camps were not included in this study. For each visitor type, the average amount spent per person-night was multiplied by yearly park visitor numbers to generate estimates of total annual spending.

Results and Discussion

Profiles were created for each visitor type. Demographic variables examined include group composition, average length of stay, average income, level of education, trip motivation, park use and activities pursued. Comprehensive spending data were also collected. Demographic results may be considered in conjunction with expenditure results to enhance insights. However, expenditure results are the focus of the ensuing discussion.

Spending by Visitor Type

Different units of measurement can be used to report visitor spending. Day visitors, car campers, interior visitors and lodge visitors who completed the survey reported group expenditures for one trip. From this information, total average amount spent per group per trip is easily calculated. Total average expenditures per person-night were also examined. Person-nights are calculated by multiplying group size by length of stay (e.g., if 2 people stay 2 nights in the park, this counts as 4 person-nights). These results are summarized in Table 1. Cottage leaseholders reported expenditures over a 12-month period, rather than for one trip. Results for cottage leaseholders are discussed separately.

Table 1. Average expenditures by visitor type.

Visitor Type	Total Average Amount Spent per Group per Trip ($)	Total Average Amount Spent per Person per Night ($)
Day Visitors	710	150
Car Campers	540	37
Interior Visitors	450	38
Lodge Visitors	1,600	230

Based on the results presented in Table 1, on average lodge visitors spent the most ($1,600 per group per trip, or $230 per person-night). The second highest average expenditure was by day visitors ($710 per group per trip, or $150 per person-day). Although car campers reported spending almost $100 more per group per trip than interior visitors ($540 and $450 respectively), the average amounts spent per person-night are very similar ($37 and $38 respectively). This is because the influence of group size and length of stay are accounted for in the latter unit of measurement (amount spent per person-night). Group size and length of stay are not reflected in expenditures reported per group per trip. Lodge visitors spend approximately 6 times more than campers spend (car and interior) and day visitors spend approximately 4 times more than campers spend.

Uncommon to most provincial parks, cottage leaseholders were included as a visitor type in this study. There are approximately 305 cottage leaseholders in Algonquin Provincial Park. Annually, they spend very large sums of money on and at their cottages. The average total spent by cottage visitors affiliated with one cottage lease during one year was $10,700. This total included three types of expenses unique to cottagers (i.e., an average of $2,000 spent on leases and bills, an average of $3,500 spent on large renovations and an average of $320 spent on furniture during one year). When these expenses were removed from total annual expenditures (for consistency of expenditures measured among all five visitor types), the average yearly amount spent by visitors on one cottage lease decreased to $4,800. Included in this total was an average of $450 spent on hardware and small repairs.

Total annual amount spent by each visitor type was required for the PEIM. Prior to visitor spending data being input into the PEIM, it was necessary to make adjustments for trip motivation and camping fees. Level of influence was factored into calculations, and park fees for interior visitors and car camping were removed. These adjustments were incorporated into the results discussed throughout the remainder of the paper.

Annual spending for the five visitor types studied was estimated at approximately $20 million. Day visitors contributed most to the total spending (38%) with an estimated $7.7 million spent. Next closest were car campers at 24%, whose spending totalled $4.8 million. Similarly, interior visitors spent an estimated $4.1 million, or 20% of the combined total. Despite having the highest average per person-night expenditures, lodge visitors only contributed to 14% of total annual spending ($2.8 million) due to restricted visitor numbers. Although the average yearly amount spent by cottage leaseholder groups was quite large, the overall contribution to combined annual visitor spending was under 4% ($730,000) due to the much smaller cottager numbers.

Spending by Visitor Origins

In addition to examining spending patters by visitor type, spending was also examined by visitor origin. Recall that for two approaches, the PEIM requires knowledge of visitor origin. Categories of visitor origin were defined according to location of permanent residence:

- Local – within 80km of any park entrance;
- Rest of province – in Ontario beyond an 80km radius of any park entrance;
- Rest of Canada – outside Ontario but in Canada; and,
- International. – outside Canada.

The average amount spent per person-night for each visitor type based on the visitor origin is summarized in Table 2 (recall that adjustments were made to the visitor spending data for trip motivation and park fees prior to it being entered into the PEIM). Perhaps the most dramatic finding shown in Table 2 is the vast difference in day visitor expenditures according to their visitor origin. Average amount spent increases with distance. Local day visitors spent approximately $15 per day, compared to $93 for day visitors from the rest of Ontario, $217 for day visitors from the rest of Canada, and $238 for day visitor to Algonquin whose permanent residence is located outside Canada.

Table 2. Average amount spent per person-night by visitor origin and type.

Visitor Type	Local Area	Rest of Ontario	Rest of Canada	International
Day Visitors ($)	15	93	217	238
Car Campers	14	21	51	87
Interior Visitors	30	28	43	28
Lodge Visitors	192	197	237	223
Cottage Visitors	23	24	25	24

Park managers and staff may wish to augment the attention paid to day visitors, based on the favourable economic impacts they can generate. In Algonquin and elsewhere, collection of day visitor information has not been as systematic or as frequent as the collection of data for car campers and interior visitors. According to the results summarized in Table 2, local day visitors spend very little while visiting the park. Therefore, it is likely that impacts generated by local day visitors will be small. However, day visitors from the rest of Canada and international locations spend large amounts of money, comparable to the large amounts spent by lodge visitors (the latter visitor type is not common to most parks in Canada). Especially when the economic impacts of visitor spending based on visitor origin are considered (see the discussion regarding Table 3), this visitor type warrants further consideration in Algonquin, and possibly in other parks too.

Average expenditures for car campers followed a similar but less pronounced pattern as the one observed for day visitors. Average expenditures for car campers started at $14 spent by local visitors and increased to $87 spent by international visitors. The average amount spent for lodge visitors was consistently large (between $190 and $240), regardless of visitor origin. The amount spent by cottagers may appear rather small, especially in relation to the thousands of dollars spent by visitors on one cottage lease per year. However, the units of measurement in Table 2 are person-nights. Because the number of nights spent by visitors at the cottage throughout the year was quite large, the average amount spent per person-night was considerably reduced.

Estimating Provincial Economic Impact

After tabulating basic visitor expenditures and preparing the expendi
entry into the PEIM, provincial economic impacts of spending were
Results according to visitor origin are shown in Table 3. According
measures presented, spending by visitors from the rest of Ontario has
impact on labour income ($6.8 million), gross domestic product ($10
employment (250 full-time equivalent jobs). Certainly the majority of
to Ontario provincial parks are residents of Ontario. Spending by visi
rest of Canada and from other countries contributes $48,000 and $1.8 m
tively (almost approximately $1.9 million). The smaller economic impa
by visitors from these two origins may appear less significant.

Table 3. Estimated total provincial economic impact by visitor origi

Visitor Origin	Labour Income	Gross Domestic Product (GDP)	Emplo (F
Local	$18,000	$28,000	0
Rest of Ontario	$6,800,000	$10,000,000	25
Rest of Canada	$32,000	$48,000	1
International	$1,300,000	$1,800,000	4
Total	$8,100,000	$11,000,000	3

However, it is useful to refer to the account register, or area in which
being assessed; the PEIM assesses benefits at a provincial scale.
framework being developed, a distinction is made between econom
economic impacts. Benefits arise when monies spent reflect an i
nomic activity within the defined area (i.e., the province) that
occurred without the park (Department of Canadian Heritage, 19
perspective, spending by local and Ontario visitors is not consid
money added to the provincial economy. It is likely that most of th
have likely been spent in the province anyway.

The impact of spending by visitors from outside Ontario is counte
tion to the provincial GDP generated by visitation to Algonquin
origin is taken into consideration, Algonquin Provincial Park visit
tributes almost $1.9 million in net economic benefits to the provin

As explained, expenditures by local and Ontario residents do not constitute a net addition to the economy. However, had the analysis been performed using a local or sub-regional model, as is done by the United States National Park Service with the Money Generation Model 2 (Stynes and Propst, 2002), then much of the money spent by Ontario visitors could be counted as economic benefits. One limitation of the PEIM is that results are not considered from the local or sub-regional scale, which local stakeholders are often more interested in than results for the province as a whole.

Conclusions

Measures of park economic benefits can be used for planning, policy analysis, budget justifications and marketing. Tourism spending is one type of traditional economic impact measurement, and was a primary focus of this study. Park visitor spending can be reported using different units of measurement, and in conjunction with other types of visitor data. Basic statistics on visitor spending can reveal patterns associated with different visitor types.

When calculating estimates of visitor spending, it is important to clearly identify the area of analysis, and to refer back to this area when interpreting the business and commercial benefits that accrue to the provincial economy as a result of the spending. Based on spending by visitors who come from outside Ontario, Algonquin Provincial Park contributes a net addition of $1.9 million to the provincial gross domestic product. Results of this study suggest that perhaps increased attention should be directed towards capturing a better understanding of day visitors. This is the first time precise calculations have been done for Algonquin Provincial Park.

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User Fees at Bunaken Marine Park, Indonesia: Lessons in Developing Tourism-Related Financing Mechanisms for Marine Protected Areas

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Abstract

Marine protected areas (MPAs) around the world lack adequate funding to fulfill their basic mandate, biodiversity conservation, as well as additional goals such as fisheries management and the provision of tourism settings. Tourism's ability to bring additional funding to MPAs through fee and related revenue generation mechanisms may be part of the solution to the funding challenges experienced by MPAs...however fulfilling this promise it not an easy process.

This paper briefly summarizes what individual countries and marine protected areas are doing to generate revenue through tourism's presence in MPAs. A comparison of entrance fees, and related tourism revenue generation tools is highlighted; data from more than 40 countries is presented.

A special emphasis on the challenges associated with establishing and increasing fee systems in MPAs will be examined through a case study of Bunaken Marine Park in Indonesia. The role of stakeholders, participatory processes and the development of revenue management mechanisms such as a conservation trust fund are described.

Introduction

The chief mandate of marine protected areas (MPAs), protected areas located in or adjacent to coastal waters, is conservation of marine and coastal biodiversity; their ability to achieve this goal, especially in developing countries, is severally curtailed by a lack of funding. A report by the World Wildlife Fund (2000) supports this stating that most MPAs are "under-resourced and poorly managed, offering little in the way of real protection. Global estimates suggest that as many as 70-80% of the MPAs that have been established worldwide are protected in name only and are not actively managed at all." Many believe that tourism could be one of the answers to the funding problems of certain marine protected areas, but little data has been collected to support or disprove this.

Marine protected areas are one of the leading destinations for both local and international tourists; significant impacts arise from this visitation. Negative socio-cultural and environmental impacts have been well studied, however less research has been devoted to understanding the potential positive benefits of tourism's presence in MPAs.

Some tools for generating revenue in MPAs have been identified (e.g., user fees, souvenir sales), but insufficient data has been documented on the success of these tools and the challenges associated with their implementation (Anon., 2001; Eagles, 2000; Lindberg and Halpenny, 2001; van Sickle and Eagles, 1998; WCPA, 2000). Recently, myself and Dr. Kreg Lindberg of Colorado State University completed research which has been used to develop a publicly accessible database that details the success and failures of tourism-related revenue generation efforts for MPAs in over 40 countries. Documents associated with this study are available at http://www.ecotourism.org/retiesselfr.html. The study documented fees charged at individual parks and within national park systems as well as how the fee was administered and collected. Park managers were also asked to describe how the fee revenue was managed (i.e., did it go to a central treasury or was it earmarked for the park or an independent conservation trust), what kind of advanced notification of the fee implementation or increase was given to citizens and tour operators, was there any opposition to the fee and why, and whether the fee reduced visitation to the park or business for local tour operators.

General Findings and Conclusions

There was great variation in the fees charged by MPAs. World renowned sites such as the Galapagos (U.S. $100/visit) and Tubbatah in the Philippines ($50/visit) charged the highest fees. The most common fees were U.S. $1 to $5 per day or $10 to $30 per year. It was also common to have a combination of fees charged, for example an entry fee to the park as well as a fee to dive or to moor a vessel. Sources of fee revenues included entrance fees, admission to enter an exhibit or building (e.g., a slide show or aquarium), rental fees (e.g., snorkel equipment), user fees (e.g., camp grounds), concession fees (e.g., stores and pontoon sites), licenses and permits (e.g., fishing and mooring), and special services (e.g., guided tours).

In general the fees set by MPAs were rarely based on systematic research such as evaluation of fees charged elsewhere, financial needs of the marine park, or willingness-to-pay surveys of visitors. Rather they were commonly based on anecdotal knowledge or the selection of an arbitrary amount.

Collection of fees generally took two forms. The first was payment at an official entrance to the park or at a popular snorkel or camping site within the park, with the distribution of a paper ticket or dive tag to be worn on a diver's buoyancy control vest. Alternatively fees were paid in advance to a tour operator, travel agent or dive guide; these companies pre-purchased tickets in bulk from the management agency. Payment mechanisms were dependent on several considerations including the safety of park staff (i.e., the dangers associated with handing large sums of income on islands in the park far from police or enforcement protection), the type of fee charged (e.g., daily vs. annual), the pattern of visitor activity (did visitors congregate at a few locations or enter at one point or was visitor activity dispersed), and the ability to enforce payments.

Fees generally varied with activity and the nationality of the visitor. In most developing country parks local or national visitors were charged less than international visitors. Snorkelers sometimes paid less than divers. Adding to the challenge of revenue collection and customer satisfaction was the impact of different parks being managed by different management agencies within the same region – each park would have different pricing policies. Visitors would have to pay several times and in different ways to different agencies. An effort to consolidate, or at least simplify payment mechanisms for park visitors, was being discussed in a couple of countries that were surveyed.

Management of fee revenues generally took two forms. Traditionally the fees would go to a central treasury. In theory these revenues would be returned to the park system, but this is not always the case. More commonly many MPAs have specific conservation trusts set up to manage the revenue accumulated through park fees (e.g., Belize's Protected Area Conservation Trust, see Halpenny, 2002). These trust funds are often managed by local stakeholders including the tourism industry, community members, government agencies, park managers and scientists, etc. The funds direct money to the management of the park based on priorities set by the stakeholders.

Based on anecdotal information from park managers, few fee increases have resulted in significant changes in park visitation. Exceptions were reported from the Seychelles and Egypt where close substitute sites were available to visitors and operators – offering them a free alternative with similar traits to the marine park site. In some cases park managers reported an increase in visitation (Bonaire Marine Park and Bunaken National Park) as visitors equated fee payment with well managed coastal environments and coral reefs. In general (as with terrestrial sites) the willingness of visitors to pay for the marine experience (i.e., diving, snorkeling) generally exceeds the fees that are currently being charged.

However implementation of fees should be made with caution as increases can affect local tour and dive operators. For example, while a doubling of fees for a marine park might result in a 20 % decrease in visitation to the park it may also yield an increase in overall revenue for the park. However operators who are impacted by a 20% visitation decrease might suffer significantly depending on the source of their business. In addition local residents may be more sensitive to price change than foreign tourists; this could be linked to local peoples' lower incomes, and their greater awareness of alternative sites. Implementation of fees in increments with monitoring of impacts is recommended.

Opposition to fees generally originated from local residents and tour operators. Park managers report the main reason for the opposition from tour operators was a lack of advanced notice of the fee, and their inability to factor the fee increase into their package pricing. A 12-18 month advanced notification is recommended by this study. In general tour operators were supportive of fee increases if the revenue was retained locally for the management of the park. Education and the distribution of information on the reason for the fee introduction or increase was cited as the most powerful tool for gaining fee acceptance.

A specific case study from Bunaken Marine Park will help to illustrate some of the lessons identified in the study of MPAs and fees.

Bunaken National Park, Indonesia: Case Study

Bunaken National Park, established in 1991 on the northern tip of the Indonesian Province of Sulawesi, has rich biodiversity, including extensive mangrove forests and coral reefs. For years it suffered from a lack of funding resulting in weak management and enforcement of protection laws; dynamite and cyanide fishing threatened reefs and illegal forestry endangered mangroves. Several groups have worked together to establish a fee for visitors to the park. Local dive operators were very supportive of the initiative; they were involved from the inception of the project, working with park managers, international conservation agencies and Indonesian based NGOs.

There are three general groups of visitors-divers, backpackers and local day-visitors. A willingness to pay survey determined that visitors would pay an entrance fee of at least $12.50. However the sample for the survey was made up largely of backpackers, a more budget conscious group. It is speculated, that if the survey sample had focused more on the 10,000 dive tourists who visit each year, the result would have been higher, perhaps $20.

For a majority of respondents to the willingness to pay survey their chief concern was the management of the collected fee. Visitors wanted to see the revenue go toward conservation programs in the park, rather than into the coffers of the government or the pockets of local officials. To address this issue a pilot project was proposed for Bunaken, and the government was lobbied for the creation of a more decentralized approach to fees management. The "dive industry was a key ally in lobbying the government to pass the law" that would change how the fee revenue would be distributed. The Bunaken National Park Management Advisory Board (a multi-stakeholder board consisting of representatives from the dive industry, environmental NGOs, academia, villagers from within the park, and government officials) was created, and receives 80% of the fee revenue, while 20% is split between national, provincial, and two district governments.

The fee was developed and initiated over a 10-month period, and came into effect in March 2001. Indonesian visitors pay a fee of Rp. 2,500 (U.S. $0.30) and foreign visitors (divers, snorkelers, backpackers) pay Rp. 75,000 (U.S. $8). Residents within the park are exempted. The managers and Board chose to introduce a relatively low fee for the first year for several reasons: (a) to minimize industry and especially backpacker opposition; (b) to prevent government officials from "eyeing" the funds collected as a treasure trove to delve into; and, (c) to "prove" to tourists that their fees are really doing something before asking a larger fee – by starting small, they could avoid overly high expectations from tourists. The managers and Board estimate that it will require approximately $250,000 per year at a minimum to manage the park; given current estimates of approximately 10,000 visitors this would mean an eventual fee increase to $25/year. The system is based on Bonaire Marine Park's model, in that when a visitor pays his or her fee at one of two entrance gates within the park, or from a dive operator or travel agent (who buys passes in bulk from the Bunaken National Park Management Advisory Board) they receive a waterproof entrance tag which must be worn. As in Bonaire,= the tag has become a collector's item. Indonesian day visitors receive paper tickets, as with other national parks.

The implementation of the fees has gone very well. Diver and dive operators are very supportive. Some opposition has been expressed by travel agents who sell a small number of tours to the park. Their chief concern was that they were not consulted from the beginning and they were not informed about the fee before their rate lists were published for 2001, thus they could not adjust their prices accordingly. Travel agents are now actively involved in the process, helping the Board to make decisions about how to spend the revenue. The other group that remains in opposition is price conscious backpackers. Despite an active campaign to inform travelers regarding the need for the fee and how it will be used for conservation within the park, backpackers remain unsupportive of the fee.

Another group whose involvement is increasingly sought is local villagers. Once the fee program was launched they became more and more concerned about where all the money was going. An extensive "socialization" campaign was implemented to let locals know just how the revenue was being used. Other educational campaigns include: the development of a FAQ (frequently asked questions sheet)about the entrance fee and where the fees are going; press releases and packages to numerous local newspapers, travel guides (e.g., Lonely Planet), and Asian based diver and travel magazines, an announcement was sent out to all the wholesale dive operators worldwide who take tours to Bunaken; and, large neon signs were placed in the arrival halls of the airport (M. Erdmann, Almonte, 2001, personal communication; Lindberg and Halpenny, 2001).

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Ecotourism, Protected Areas and Community Development Associated with Two Chinese Parks

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Abstract

The connections between people, parks and tourism have received significant attention in recent years, recognizing the potential for mutually beneficial relationships. Ecotourism has been promoted and widely adopted as a strategy for funding conservation initiatives, while at the same time contributing to the socio-economic development of host communities and providing for quality nature/recreation experiences. Parks are among the most common ecotourism destinations. This study assesses the current status of ecotourism at two protected areas in Hainan, China, where it is being promoted as a strategy for balancing regional economic growth and conservation objectives. Through an evaluation of the existing tourism-park-community relationships, opportunities and constraints are identified. In light of the study findings and the salient literature, planning direction is offered with the intention of enhancing the capacity of ecotourism to generate benefits for both communities and the parks, and thus contribute to the sustainable development of the region more generally.

Introduction

The relationships between tourism, parks and people have received significant attention in recent years, from academics, as well as both government and non-government conservation and development agencies (Cresswell and MacLaren, 2000; Brandon, 1996). A variety of socio-economic reasons are responsible for this interest. Consider the following three trends.

Facing increasing habitat disappearance and biodiversity decline, most nations have made efforts to protect some portion of their remaining natural spaces (Woodley, 1999). However, competition for often scarce resources is making it increasingly difficult for governments to rationalize the allocation of large areas of land for protection. Conservation agencies, especially in developing countries, are also commonly faced with limited budgets (Loon and Polakow, 2001; Norris, 1992). The result has been that protected area systems are under pressure to find innovative ways to generate funds for conservation (Boyd, 2000), and to demonstrate financial viability in the face of rising opportunity costs.

Secondly, ecotourists are motivated by a desire to observe and learn about tropical forests, birds, mammals, etc., preferably in an undisturbed wilderness setting (Eagles, 1992). Such settings are often to be found in parks. Growing demand for nature-based travel experiences has made parks some of the most popular (eco)tourism destinations (Boyd, 2000; Ceballos-Lascurain, 1996). Many international tourists are attracted particularly to the 'natural wealth' of the developing countries (Hummel, 1994).

Thirdly, the protection of biodiversity and provision of public use have long been objectives of national parks (Hvenegaard and Dearden, 1998). However, in recent years, recognizing that park creation can cause abrupt change for resource-based economies (Place, 1991), mandates have also shown increasing support for linking park management and conservation strategies with the needs of surrounding local communities (MacDonald and Aumonier, 1998; Boo, 1990). These considerations are particularly acute in developing countries.

It is not surprising then, that many have noted that opportunities exist for linking ecotourism, parks and communities for mutual benefit, especially in a developing world context. Some have assigned ecotourism great potential, suggesting it has the capacity to provide high quality tourism experiences, while generating funds and support for conservation, and stimulating local socio-economic benefits (Weaver, 1998; Wells, 1997; Nenon and Durst, 1993).

While there is evidence that ecotourism's espoused benefits can be realized (Eagles, McCool and Haynes, 2002; Mitchell and Reid, 2001; Hatton, 1999), there are equally as many cases where ecotourism has fallen short of its proposed objectives (Nepal, 2000; Walpole and Goodwin, 2000; Ross and Wall, 1999b). Indeed, ecotourism's impact has been highly variable. Nevertheless, developing countries continue to turn to ecotourism as a means of generating broad-based benefits. Given this, one must ask if ecotourism is contributing to sustainable development – are its espoused benefits being realized? Ross and Wall (1999) have criticized the lack of practical assessments of ecotourism's status in specific areas. This study is an exploration of the delicate relationships that exist between (eco)tourism, parks and people.

Study Objectives

This study sought to assess the current status of ecotourism at two protected area destinations where it is being promoted as a sustainable regional development strategy. The existing tourism-park-community relationships are evaluated at

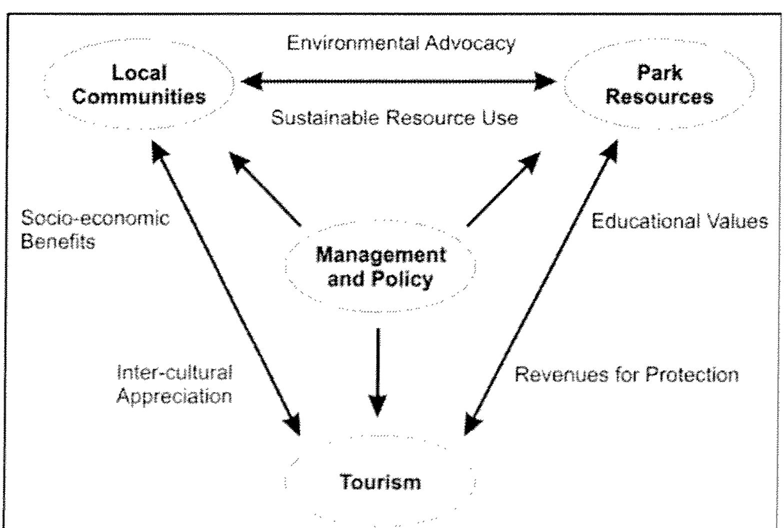
Jianfengling and Diaoluoshan National Forest Parks (JNFP and DNFP), in Hainan Province, China. Hainan, although endowed with a wealth of natural resources, is one of China's most economically backward provinces. Ecotourism has been identified as an important provincial strategy for balancing economic growth and conservation. The study is intended to enhance the capacity of ecotourism to generate benefits for both the local communities and parks, and thus contribute to the sustainable development of the region more generally.

Methodology

In order to be able to comment on the tourism-park-community relationships, input from the various stakeholders at each site – park managers, community residents, hotel managers and tourists – was required. Interviews, observations and secondary sources were employed to gather information on park management and facilities, community perceptions of the park and tourism, and levels of tourism spending. Triangulation was used wherever possible to confirm findings and limit personal and methodological biases.

An evaluative framework developed by Ross and Wall (1999a) was adopted to help guide each case study evaluation (Figure 1). The framework conceptualizes ecotourism in terms of synergistic links, and uses a variety of indicators to determine if existing relationships are operating in a manner that allows each to make positive contributions to the other.

Figure 1. A Framework for Conceptualizing and Evaluating Ecotourism (Source: Ross and Wall, 1999).



Results

Ecotourism, strictly defined, and as assessed under the adopted framework, does not currently exist at either park. The case studies revealed that most community members have a good understanding of why the parks were created and that forest protection is important because of its influence on climate, ecology and water resources. The majority of respondents in each case think that the parks are a good thing overall, and would welcome more tourism. In each community, there is the perception among some, that the park has had a positive influence on the local economy. However, it is also noteworthy that in each case at least one-quarter of residents surveyed indicated that the park has had no and/or only negative effects (mainly in terms of lost jobs and land) on their lives. In reality, community socio-economic benefits have been very limited. Similarly, (eco)tourism has not generated revenues for conservation at either park. Nevertheless, the overwhelming pattern in interview responses was optimism, with most officials and residents seeming confident that tourism growth will generate benefits for their community. A limited number of residents qualified their optimism with concerns over environmental damage or community safety. The few who were more pessimistic generally held the belief that only government officials will benefit from future tourism growth.

The case studies have also identified a number of important factors – weaknesses in the tourism-park-community relationships – that stand to limit ecotourism's ability to generate benefits. Few tourists currently stop in either community en route to the park, and there are relatively few spending opportunities, for either tourists or locals, suggesting a significant potential for economic leakage. Community residents are not actively involved in park planning processes at either location. Relatively little is known about the tourists that visit JNFP and DNFP, and in both cases it was evident that staff have little expertise in park or tourism management. Sound planning and management strategies may help to overcome some of these issues and, when coupled with fairly widespread community support and recent funding increases, suggest that there is significant potential at both destinations for ecotourism to develop in a manner that will provide benefits on a broad scale.

Discussion: Planning Implications

Ecotourism development is in its infancy at both sites, and cannot be expected to be operating without flaws. The comments offered here draw on the salient ecotourism literature, and are intended to provide planning direction that will help decision-makers find a path of development that promotes synergistic relationships.

Relationships Between the Local Communities and Parks

Park establishment can alter the local economic base and often results in reduced access to resources for local people (Lindberg, *et al.*, 1996). This has been the case at both JNFP and DNFP. Where residents face pressures due to resource use restrictions, compensation should be provided (Sherman and Dixon, 1991). This is especially important recognizing that many of the threats protected areas face arise from the needs of local communities to use resources for survival (Norris, 1992). Dependence on natural resources is high in both the Jianfengling and Diaoluoshan regions, and illegal resource harvesting has occurred at both parks as a result. Some residents have lost jobs or land, and noted that it is now harder to make a living. Although some compensation has apparently been provided to residents in the form of new homes, seeds and lump sum payments, interviews revealed differing interpretations of what has been provided and whether or not it was adequate. Park officials are also hoping that compensation will come in the form of increased employment opportunities from the development of ecotourism. For now, such opportunities have yet to materialize, and other strategies are needed. Earmarking a portion of park budgets/revenues to go toward community development projects and providing alternative resource supplies for agriculture, plantations, etc., outside of the parks would be two potentially valuable strategies. The creation of a multi-use buffer zone at JNFP is a positive step in this direction.

Although each park has made an effort to educate community members about the reasons behind park establishment and the importance of protecting the forest, residents have not had the opportunity to participate actively in planning processes. This problem is not unique to JNFP and DNFP. Communities adjacent to parks have frequently been overlooked (Ceballos-Lascurain, 1996). This is significant, recognizing that the generation of benefits and positive attitudes toward tourism is to a large degree dependent on local people's ability to participate effectively in decision-making (Lindberg *et al.*, 1996). Failure to involve local people can lead to poorly integrated conservation-development projects that damage the resources and reduce tourism's potential to generate benefits (Cresswell and MacLaren, 2000). At DNFP and JNFP opportunities to participate could be provided using public forums and/or committees comprised of local residents to allow residents to voice their concerns. If community members have a vested interest in such processes they are more likely to become advocates for the park and support the development of ecotourism. Although participation can be a time consuming and difficult process, the risks associated with not providing such opportunities would seem to outweigh any potential costs.

Relationships Between the Local Communities and Tourism

There have been relatively few socio-economic benefits to date at either site. Some perceive improvements in water resources, climate, roads, incomes and the local economy. This is important recognizing that attitudes toward tourism are largely based on perceived costs and benefits (Lindberg *et al.*, 1996). Although road improvements were observed, climate and water resource effects are difficult to confirm and, in reality, tourism-related employment and income have been limited. Aside from work in the hotels, travel companies, or as a guide, and occasional small shop sales to tourists (water, fruit, snacks, etc.), employment and income from tourism have yet to materialize on a significant scale at either site. Should ecotourism grow and employment opportunities expand, it will be important that local residents have the requisite skills to be able to fill positions. Management will want to consider developing training programs for local people before importing workers who may already possess the necessary skills, but will add to the loss of economic benefits from the local community (Sherman and Dixon, 1991). In the future, ear-marking a portion of park budgets/revenues for small loans for local people wishing to start a tourism venture may also help generate and retain community benefits (Lindberg, 1991).

Given the prospect for future foreign investment at both parks, managers will want to ensure that they retain some control over the development of the industry. Foreign investment increases the potential for economic leakage and can, somewhat paradoxically, limit opportunities for locals to get involved in tourism if outside investment outpaces local capacities to accumulate capital or acquire training (Place, 1991). Local control will allow the flexibility to impose conditions on projects that will maximize community benefits (Loon and Palakow, 2001). The use of locally produced goods and services, and the employment of community members whenever possible are absolutely critical to generating and retaining socio-economic benefits in the community.

Although the lack of benefits can be attributed, in part, to the relatively low levels of visitation at each park, it is also due to the location of tourism activity (at the park hotels, which lie some distance from the communities) and the absence of spending opportunities for tourists in the communities/towns. The capacity of ecotourism to generate benefits in the future will, to a significant degree, depend upon the ability of managers to encourage tourists to spend larger sums of money, in the desired locations (i.e., in both the parks and the communities). Providing tourists with opportunities to spend money locally, through the development of tourism facilities and services in appropriate locations – interpretative media, food concessions, souvenirs, etc. – can help in this respect and also encourage tourists to return in the future (Lindberg, 1991).

Spending opportunities are not only important for tourists, but also for local people. In small, rural economies like those at JNFP and DNFP, aside from food and basic supplies there are few goods or services available. This results in local people travelling to larger centres to purchase major appliances, electronics and other 'big ticket' items. If (eco)tourism grows, much of the money that will be spent on accommodations, food, etc., will ultimately leave the community in the absence of locally available goods and services. Although tourists' direct expenditures are important, it is also important that a portion of those expenditures be kept in the community through local secondary (indirect) and tertiary (induced) spending.

Relationships Between Tourism and the Parks

Protected area use fees, especially in developing countries are often nominal (Wall, 1994) or missing altogether (Lindberg, 1991). At JNFP and DNFP no use fees have ever been charged, and park operated hotels and travel companies have generated little, if any profit. As a result, (eco)tourism has yet to raise funds for management or conservation activities. Although levels of visitation have been relatively low, even a small fee could have raised substantial funds. It is quite possible that tourists would be willing to pay more than the 50 RMB ($9.60 CDN) or 20 RMB ($3.85 CDN) that managers at DNFP and JNFP respectively are considering implementing in 2002. Nature-oriented tourists have also been shown to be willing to make donations towards conservation programs (Hvenegaard *et al.*, 1998). A survey of park tourists, asking what they would be willing to pay to enter the park could help to determine appropriate use fees and donation mechanisms. The same survey could be designed to collect information on tourist demographics, spending patterns and satisfaction levels – critical management information that is missing at each park.

Higher use fees than those currently being considered could potentially be charged if high quality experiences were provided at the parks. Each offers spectacular tropical scenery, but accommodations are basic and educational opportunities few. Although ecotourists may be content with such accommodations they do demand high quality experiences (Eagles, 1992). Neither JNFP nor DNFP currently offer such an experience given the lack of educational opportunities. On a positive note, both parks have provided some training for a small number of Chinese-speaking guides, and a new visitors centre has recently opened at JNFP. With recent funding increases it may also be possible to begin to develop and implement nature interpretation plans.

Many of the tourism-park-community relationship weaknesses identified in this thesis have been aggravated, if not caused, by funding shortages and limited, or inappropriate, staff education. Careful planning and management are required if ecotourism is to develop successfully (Boo, 1991). This in turn, requires a properly trained, interdisciplinary staff (Boyd, 2000) and the presence of sufficient funds. Each park is scheduled to receive substantial funding increases from the government over the next ten years, suggesting the potential for enhanced management effectiveness. One official at DNFP also indicated that they are trying to establish a special university training program to prepare students to fill key management positions. The effectiveness with which funding increases, training initiatives and management strategies can be used to strengthen the tourism-park-community relationships will be critical to the successful development of ecotourism at both sites and, more generally, to the sustainable development of Hainan.

Implications for Parks in the Developed World

Although the scope of this paper does not permit a detailed exploration of the study's implications for protected areas in the developed world, the findings arguably have much broader application than for Hainan, China alone. Park managers in Canada face similarly sensitive tourism-park-community issues when dealing with First Nations groups and small, resource-based communities. The connections between parks and their potential for (eco)tourism have also received increasing attention in recent years, as parks in Canada are under pressure to generate revenues and justify their existence. Finally, park management is, to a large extent, about balance – between resource use, enjoyment (recreation) and conservation. In this sense, the approach used in this study of evaluating protected area sites in terms of the relationships between resources and people has broad applicability. Evaluations can afford protected area managers everywhere, the opportunity to identify weaknesses and, in response, develop or refine planning and management strategies that strive to nurture synergistic people-park relationships.

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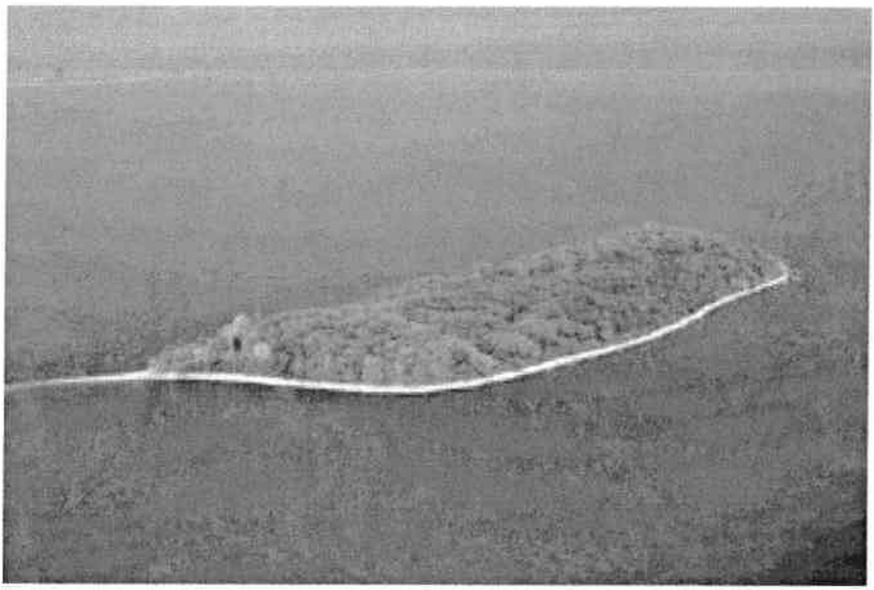
Environmental Analysis and Planning



Middle Island, the southernmost land mass in Canada, Pt. Pelee National Park (Anon. NCC Archive Photo)

A Volumetric Analysis of Coastal Dune Blowout Morphology Change, Pinery Provincial Park

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Abstract

A coastal dune trough blowout was studied in Pinery Provincial Park between 1999-2001. The park and the dunes are located on Lake Huron's western shoreline, where the sediment budget is rapidly increasing due to recent drops in Great Lake water levels allowing for a greater amount of exposed sand. This increased sediment supply may provide a catalyst for increased foredune development and increased volumes of sand transported through the blowout. Primarily, three research objectives were pursued throughout this study. Field research objectives included erosion pin measurement to monitor and verify morphological change through the throat of the blowout and aeolian sediment trap volume measurements to establish transport into and out of the blowout. Three-dimensional maps were utilized to calculate volumetric change between different study seasons. The greatest morphological change noted through these research objectives was rapid sediment deposition on the lakeward side of the foredune.

Introduction

Coastal dunes are found above high water marks of sandy beaches and can occur on ocean, estuary and lake shorelines (Carter *et al.*, 1990). Dune formation is a function of sediment grain characteristics and supply, the beach profile, and the wind regime. Several areas of dunes can be found around Great Lakes shorelines. Davidson (1991) identified 20 different sand dune locations along Ontario's shorelines, all of which are in different stages of maturity and erosion, due primarily to human influences.

The study site, within Pinery Provincial Park, is located on Lake Huron's eastern shore (Figure 1). Lake Huron water levels fluctuate over different temporal scales. Water levels have been declining over the past three years due to a combination of lower precipitation, higher air temperatures, and increased evapotranspiration in the Great Lakes basin (GLERL, 2000). The decreased lake level has allowed an opportunity to make a comparative analysis between data collected in 1995 (Byrne, 1997), when Lake Huron was at a relative high level, and during 1999 and 2000 when the Lake Huron was at a relative low. The more recent study occurs during a period of low lake levels, therefore having a much larger beach surface area, and ultimately a much larger sediment supply available to enter the dune system.

Figure 1. Location of Pinery Provincial Park.

Byrne (1997) studied the seasonal variations of sediment transport through a blow-out in a secondary dune ridge. Blowouts are saucer-, cup-, or trough-shaped depressions or hollows formed by wind erosion on a pre-existing sand deposit (Hesp and Hyde, 1996).

Pinery Provincial Park dunes are part of a nature reserve section of the park (OMNR, 1986). The dunes are subject to intense recreational traffic which cause many erosional features, usually initiated by human trampling (Bowles, 1980). The park management plan has changed such that most of the park is now protected zones, in which park users are banned from moving freely off park road and trail networks. Part of the park's mandate is to conduct dune preservation research and use this research to make informed management decisions to protect the dunes and the overlying Oak-Savannah ecosystem. The research conducted on sediment transport, and transport during different time periods, will help managers to plan dune stabilization strategies.

Study Site

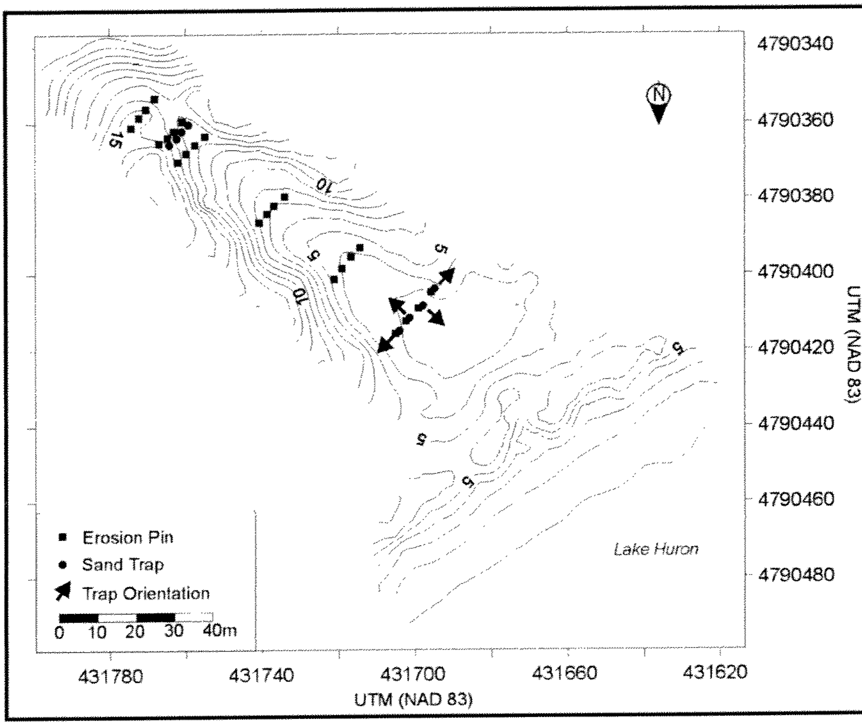
The field studies were conducted on the sand dunes along Lake Huron behind the foredune ridge. The study site is a small trough blowout located in the wilderness area of Pinery Provincial Park (Byrne, 1997). The 250 m long 90 - 75 m wide dune is a complex, digitate dune (Pye and Tsoar, 1990). The axis of the blowout (northwest to southeast) is normal to the foredune ridge and shoreline of Lake Huron. Winds are strongest form the north, west and south, while easterly winds are relatively weak. Park climate is characterized by warm summers and cold winters, with rapid changes in conditions with the passing of mid-latitude depressions. Precipitation is spread evenly throughout the year with slight peaks in February and March (Fisher *et al.*, 1987; Byrne, 1997). Snowfall usually begins in late November and ends at the beginning of April. The mean frost-free period is 150-160 days, with a 205 day growing season (Fisher *et al.,* 1987). The dominant vegetation in the foredune and along the crest of the trough blowout is *Ammophila breviligulata*, with occasional clumps of *Calamovilfa longifolia*. Both plants are perennial dune forming grasses, and are effective in trapping sand, and both possess pronounced abilities to elongate upwards in response to sand accumulation (Maun, 1984, 1985).

Methods

To quantify a relative amount of sediment movement through the trough blowout, measurements of sand flux were obtained using vertical cylindrical traps developed by Leatherman (1978) and enlarged by Rosen (1979). The traps were placed in two arrays of four traps; traps one through four were lined up in the lower opening of the blowout and traps five through eight were lined up in the throat at the crest of the blowout as seen in Figure 2. The open direction of the traps, which were lined up in four cardinal directions relative to the blowout's orientation, are as follows; southwest (1,5), northwest (2,6), northeast (3,7), and southeast (4,8). This arrangement was used to replicate Byrne's (1997) study. Sand traps were emptied approximately every ten days, three times per month. High lake level data were collected from August 1994 through August 1995. Low lake level data were collected June 1999 through August 2000.

Erosion pin data were collected to identify areas of erosion and deposition within the trough blowout. The erosion pins were 5mm round steel rods, approximately 2m in length. During each site visit, every pin was measured from the top of the pin to the sand surface (Byrne 1997; Jungerius and van der Meulen, 1989). The low lake level period study used the initial three arrays, but three more arrays were added early in the second study towards the upper portion and leeward side of the crest of the blowout. The first, or lowermost, array of pins were located approximately 15cm away from sand traps one through four. The second through fourth array of pins was located approximately 25 m up the blowout. Pins were spaced evenly across the width of the blowout within each array. The fifth pin array was in line with sand traps five through eight. The sixth array of pins was located just landwards of the crest of the blowout.

Figure 2. This topographic map shows the location of sand traps and erosion pins within the trough blowout. Traps 1- 4 are are located at the mouth of the blowout (middle of the map), and traps 5 - 8 are located at the crest (bottom right corner). Erosion pins 1 - 4 are adjacent to the lower traps (1 - 4) and are numbered sequentially landward through the blowout.

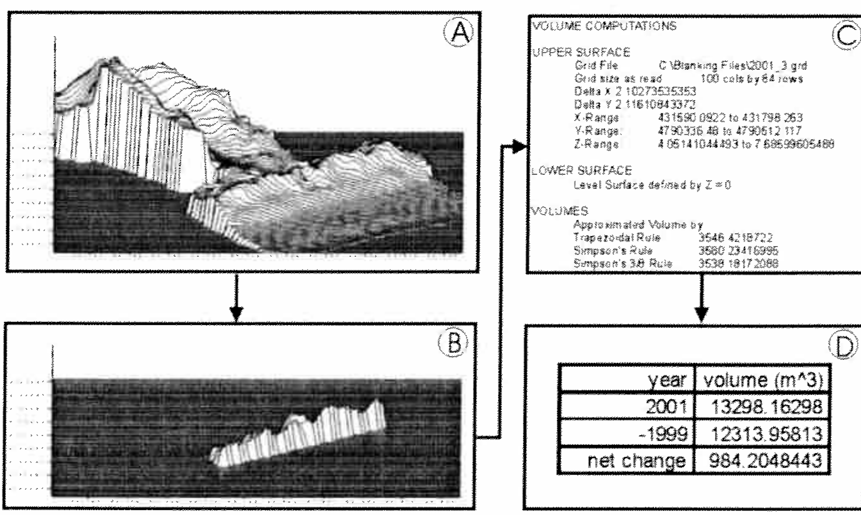


The site was mapped using a Leica Model T1600 Total Station in summer 1999 and a Leica Model SR530 Dual Frequency Geodetic Real-time receiver GPS Station during summer 2000. The data sets were formatted to UTM coordinates and verified for accuracy between data sets by comparing two control points and a back sight. The x,y,z, coordinates were entered into Surfer mapping software. Surfer interpolated (using Kriging gridding) all points between the collected coordinates to create a smooth surface for creating contour and wireframe maps. The end result of the interpolation process created a grid file. This grid file designated every data point to have an x, y, and z (or latitude, longitude, and elevation) coordinate. Using grid files, the three-dimensional maps were created.

To ensure that similar boundaries are used on both the 1999 and 2000 maps, blanking files were created. Blanking files are user chosen areas within a grid file. The user creates a polygon shape based on chosen grid points, and then the user can choose to include everything within, or outside, of that grid box. All other values become zero. For this study, blanking files were designated based on personal observations of areas of erosion and deposition, and were delineated at breaks of slope in the sand dunes.

From the beach moving landward, the study site was broken into 11 sections, or blanked files in which areas outside of the blanked region were assigned a zero value, for volumetric analysis. Volumes were calculated for each of the 11 sections for both the 1999 map and the 2000 map. The volume from the 1999 section was then subtracted from the volume of the exact same section of the 2000 mapping data. Positive values from subtracting the two maps indicates an overall increase in sediment in the section, or an area of deposition. Negative values indicate overall erosion in the area (Figure 3).

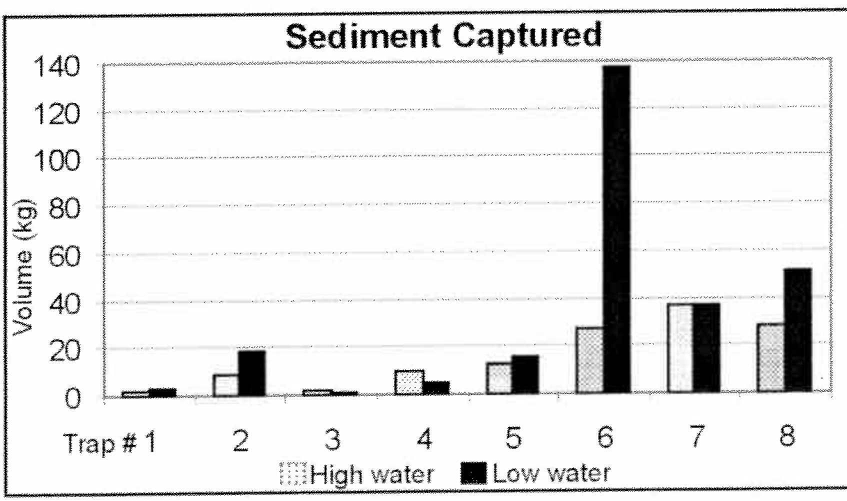
Figure 3. This is an example of the process for calculating volume change between data sets. The first step is to create a three-dimensional grid based on surveyed points (diagram A). A volume is calculated for identically defined areas on both maps (diagram B). All areas outside the region are assigned a value of 0. Diagram C displays a portion of the output file created by Surfer that includes volume calculations for the designated area. The final step is to the subtract 1999 map volume from the corresponding 2001 map volume (diagram D). Positive values indicate net deposition, negative values indicate net erosion.



Results

The upper four sediment traps (5-8) captured significantly more sand than the lower traps (1-4) as seen in Figure 4 during both the low and high water period studies (Byrne, 1997; Byrne and Bitton, 2002). Trap 2, the lakeward facing lower trap, captured the most sediment (16.2 kgs) of the lower traps indicating a definite net migration of sediment landward from the beach. Similarly, trap 6, the lakeward facing upper trap, captured the most sediment (137.3 kgs) moving landward in the upper array. This indicates a net landward migration of the dune blowout. The large amount of sediment moving in the upper compared to the lower traps indicates that most of the erosional activity is occurring through the blowout. As well, due to the increased sediment moving through the blowout during low lake levels, we can infer that the increased sediment budget (increased beach surface area) has allowed more sand to be readily available for transport through the dune system.

Figure 4. Sand transport variations between the high water period (1994/95) and the low water period (1999/2000) for all eight sediment traps. Low water period has substantially more sediment captured. This is especially marked in the upper traps (5 - 8).



The erosion pin record indicates a net erosion through the throat of the blowout. The first two groups of pins indicate the least amount of erosion through the two study periods, although it is a very small decrease in elevation (~less than 5 cm). The third pin row exhibits increasing erosion, especially along the north eastern side of the blowout throat. The fourth row of pins show the most erosion (~40 cm average), with the greatest decrease in elevation at all four pins in the row. The next two rows of pins, situated at the crest and brink of the blowout throat display areas of great erosion along the southwestern edge (30 cm decrease in elevation), and the initiation of dune building toward the northeast (10 – 20 cm deposition). From the erosion pin data we can conclude that the most erosion is occurring through the throat of the blowout, especially further up-slope from the base of the blowout, and that deposition is beginning landward of the crest in the northeast direction.

Volumes for each of the 11 subsections were calculated by averaging the volumes from the Surfer output file. The Surfer output file contained volumes based on 3 surface fitting interpolation methods: Trapezoidal Rule, Simpson's Rule, and Simpson's 3/8 Rule. All three rules approximate definite integrals to create an upper dimension for calculating volumes. Trapezoidal rule calculates using a straight line within each subinterval, while Simpson's and Simpson's 3/8 rules calculates to a quadratic and a fifth power respectively. These averaged volumes were next used to subtract the 1999 volume calculation from the 2000 calculation (Figure 5). These results give an absolute value of volume change (Table 1). Table 1 also lists a volume relative to the total volume of sand for that subsection, giving a relative amount of volume change.

Figure 5. The sections were divided based on breaks of slope within the study area. Negative volume change values indicate areas of erosion; positive indicate deposition. (See Table 1 for values). Each section represents the volume change relative to the total volume of that area; increased concentration of dots indicates erosion, darker shading indicates increased deposition.

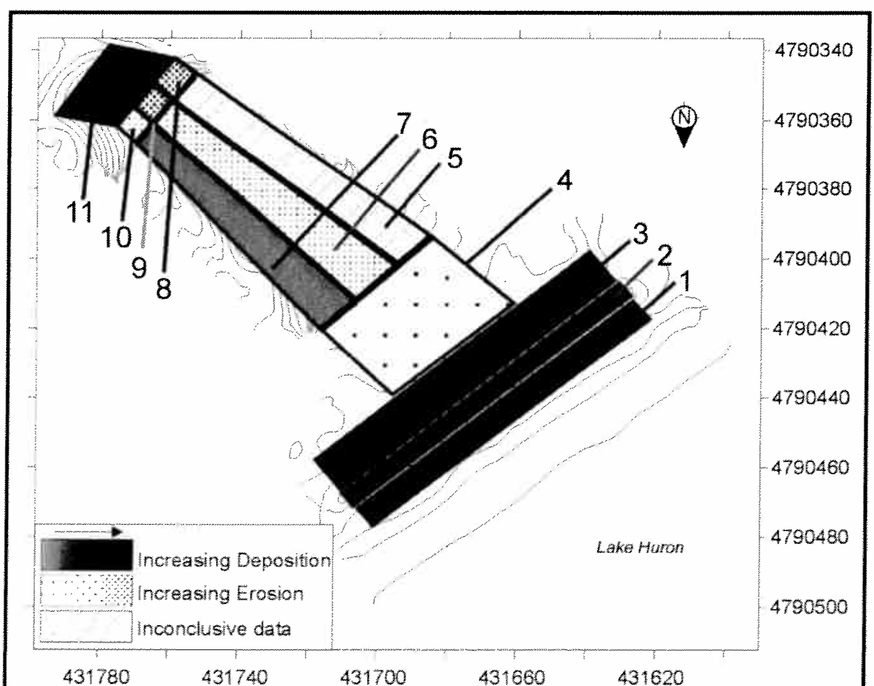


Table 1. Absolute and relative amount of volume change by subsection.

	Volume Change	Relative Volume Change
1	964.5	72.5
2	84.6	23.9
3	1210.0	152.1
4	-268.8	-0.7
5*	1768.9	168.4
6	-254.9	-40.9
7	29.0	5.7
8	-108.2	-130.6
9	-196.0	-199.3
10	-19.1	-15.4
11	119.3	18.7

During the 1999 surveying, large hummocks were not mapped due to a lack of time and technology using the total station. During the 2001 survey it was felt that these hummocks were important to monitor, and therefore were included in the survey data. The change in surveying protocol included the mapping of large amounts of sediment that were eliminated from the 1999 survey of section 5, and therefore section 5 data is inconclusive. Sections 1, 2, 3, 7, and 11 all display areas of deposition, while the remaining areas exhibit net erosion. The greatest relative deposition occurs in the foredune area, especially on the landward side. The landward side of the blowout also shows a large amount of deposition. The volumetric results indicate the greatest erosion occurring through the throat of the blowout as well as at the crest of the blowout.

Discussion

Combining the erosion pin and volumetric data, we can conclude that there is definite erosion occurring through the throat and the crest of the blowout. Since the blowout first formed, this process has likely happened continually. During low lake levels, it is possible that more sediment has moved through the blowout, depositing on the leeward side of the dune, and hence migrating into the more heavily vegetated zone. Sand trap evidence supports this. Both the upper and lower traps indicate sediment moving predominantly landward. Additionally, during the low lake level study period, far more sediment moved through the blowout than during the high lake level period.

The large amounts of sediment being captured on both the landward and lakeward side of the foredune demonstrate a significant growth in the foredune which may lead to a new stable ridge. Therefore, a new natural coastal defence system is being created by natural processes which can protect the landward ecosystem from storm waves and potential lake level rises.

This information is relevant to park managers in understanding the dynamics of blowouts as erosional landforms. As the lake water levels lower, more sediment will be available for transport through the dune system. Vegetation can be used to stabilize this transporting sand, and therefore stabilize the dunes, as well as promote dune growth. Park managers should seize this opportunity to increase the wilderness zone lakeward to include the areas of new vegetation and dune growth. By reducing human traffic over newly formed dune ridges, vegetation will have a greater chance to survive through different environmental conditions. Park managers can use periods of low lake levels to try to stabilize areas of erosion, such as blowouts, by planting vegetation, such as *Ammophila breviligulata,* that thrive in continual deposition of sediment.

Acknowledgements

The authors would like to thank Terry Crabe and other Pinery Provincial Park staff for their assistance throughout the course of this study. The authors would also like to thank Alex Maclean for assistance with field surveying, Pam Schaus and Grant Simpson for technical assistance, and all those who helped carry equipment and sediment samples to and from the study site.

This research was partially supported by Wilfrid Laurier University Short Term Research Grant, Ontario Parks Research Grant and Human Resources Development Canada Supplement.

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An Exploration into the Operating Status and Visitor Use over Ontario's Provincial Parks System

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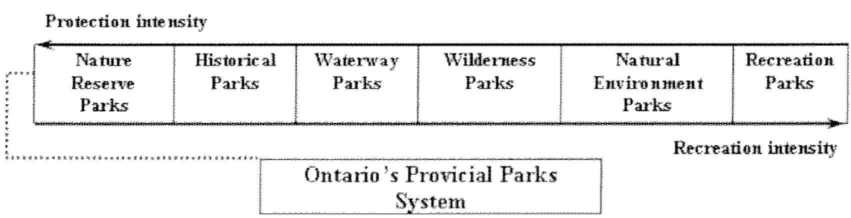
Abstract

In order to get a good understanding of the Ontario Provincial Parks System (OPPS), the authors have collected a complete set of basic data, including its classification, size, location and operating status for every single provincial park in Ontario. Then we created a small database to analyze the operating status and visitor use within the different classes. Based on the analysis, the authors have found some characteristics of OPPS while showing some concerns about human pressure upon some individual Nature Reserve Parks. The authors also made a recommendation that user data also should be collected for all non-operating parks, even if only on a sporadic basis.

Introduction

Keeping the balance between development and preservation has been constantly the main task for almost all provincial / state or national parks systems. This paper explores the balancing mechanism and how much it has been achieved in the OPPS. Ontario has a class system, ranging in recreation intensity, just as Figure 1 shows below.

Figure 1. The intensity of protection and recreation.



Nature Reserve Parks

Reconfirming the importance of natural heritage protection and preservation, the 1978 provincial park policies inherited the notion of Nature Reserve Parks from the

1967 classification. They are defined as *areas selected to represent the distinctive natural habitats and landforms of the Province, and are protected for the educational purposes and as gene pools for research to benefit present and future generations* (Provincial Parks Branch, 1978).

Among the four objectives of the provincial parks system, the Nature Reserve Parks mainly contribute to Protection and Heritage Appreciation. To guarantee the high-intensity protection, these parks use only three zones, including Nature Reserve Zones, Historical Zones and Access Zones. Scientific research is mainly related to life and earth sciences. All qualified researchers must gain the permission from the Ministry of Natural Resources. Recreational activities or facilities are extremely restricted, with only 11 types clearly allowed, and 9 possibly permitted in Access Zones. In Nature Reserve Zones and Historical Zones, none of the recreational activities are clearly allowed.

As of 2000, there are 98 Nature Reserve Parks among the 275 provincial parks. Within the 106 operating parks in OPPS, only two of them are Nature Reserve Parks. Table 1 contains basic information about these two parks.

Table 1. Operating Nature Reserve Parks information in 2000.

Name	Size	Location	Visitors	Day Use Visits	Visit Intensity	Day Use Rate
John E. Pearce	68 ha	Southwest	13,717	13,717	202 visits per ha	100%
Ouimet Canyon	777 ha	Northwest	32,489	32,489	42 visits per ha	100%

Table 1 tells us that John E. Pearce and Ouimet Canyon Provincial Nature Reserve Parks together accommodated roughly 46,000 day use visitors in 2000. There are no data for the other 96 parks of the class. However, it is realistic to assume that these parks did receive some level of usage.

Historical Parks

Historical Parks were first incorporated into OPPS in the 1978 policies. As a new class, they are defined as *areas selected to represent the distinctive historical resources of the Province in an open space setting, and are protected for interpretive, educational, and research purposes* (Provincial Parks Branch, 1978).

Historical Parks can be regarded as highly protected cultural heritage areas in Ontario. The main purposes were described as Protection and Heritage Appreciation.

Although this class provides for five different zones, Historical Zones and Natural Environment Zones cover the predominant proportion in theory and in practice. Within the Development Zones 17 recreational activities or facilities are clearly permitted, and 25 possibly allowed. In the Access Zones, only 14 are clearly permitted and 16 allowed, subject to a particular situation.

Up until 2000, there are four Historical Parks out of the total 275 provincial parks. Only Petroglyphs Provincial Historical Park holds an operating status. Table 2 conveys the Park's basic information.

Table 2. Petroglyphs Provincial Historical Park's Basic Information.

Name	Size	Visitors	Visit Intensity	Day Use Visit Intensity	Day Use Rate
Petroglyphs	1,643 ha	21,217	13 persons per ha	13 persons per ha	100%

Table 2 indicates that Petroglyphs Park hosted approximately 21,000 exclusively day use visitors with very little human pressure upon the park environment. It is probable that the other three parks received some use, but due to lack of staffing the use was not recorded.

Waterway Parks

The Wild River parks of 1967 were enlarged as Waterway Parks in 1978. Being concentrated in water bodies, they are defined as areas which *incorporate outstanding recreational water routes with representative natural features and historical resources to provide high quality recreational and educational experiences* (Provincial Parks Branch, 1978).

Waterway Parks involve both natural and cultural heritage; therefore, they serve all four objectives—Protection, Recreation, Heritage Appreciation and Tourism purposes set by the Provincial Parks policy. Theoretically, they are zoned into all possible six zoning types, among which Development Zones and Access Zones contain many recreational opportunities. Within Development Zones, 24 activities or facilities are surely allowed and 27 are optional depending on particular environmental considerations. In Access Zones, 16 activities or facilities are certainly allowed and 22 possibly permitted.

Until 2000, 30 Waterway Parks were established in Ontario, but only Missinaibi Provincial Waterway Park, located in the northeast region of the province, holds the operating status. Its related information is provided in Table 3.

Table 3. Missinabi Provincial Waterway Park's Operating Status, 2000.

Size	Visitors	Day Use Visitors	Camper Nights	Visit Intensity
99,090 ha	8,260	61	8,621	0.08 visits per ha

The difficulties of managing and operating Waterway Parks can be substantial even though Table 3 demonstrates this enormously large park hosted a low number of camper night visitors in 2000. It is highly likely that the other 29 parks in the class received use that was undocumented.

Wilderness Parks

Wilderness Parks originated from the Primitive Park class of 1967. In the 1978 policies, they are defined as *substantial areas where the forces of nature are permitted to function freely and where visitors travel by non-mechanized means and experience expansive solitude, challenge, and personal integration with nature* (Provincial Parks Branch, 1978).

By the standard of protection in life and earth sciences, a Wilderness Park, with its larger area size, provides an opportunity to protect extensive faunal or flora communities, a complete ecosystem or a wide ranging landscape instead of a specific species or a single geological wonder. Wilderness Parks principally function with 3 of 4 purposes — Protection, Recreation and Heritage Appreciation. Wilderness Parks have a four-type zoning system: Nature Reserve, Historical, Wilderness and Access Zones. Typically, the overwhelming proportion is taken by Wilderness Zones. Wilderness Parks provide limited recreational options. Fifteen activities or facilities are surely permitted and 12 possibly in Access Zones, whereas in Wilderness Zones 15 activities or facilities are certainly granted, four possibly allowed.

Up to 2000, eight Wilderness Parks had been established, among which four parks hold operating status. The operating parks' information is offered in Table 4.

Table 4 indicates that most of the visitors data came for overnight use in the four Wilderness Parks located in Northern Ontario, while the visit intensity is relatively low. Wabakimi Provincial Wilderness Park only receives 5 visits per sq. km. It is probable that the four non-operating Wilderness parks also received visitation, but this is not documented.

Table 4. Operating Wilderness Parks' information, 2000.

Name	Size	Location	Visitors	Day Use Visits	Camper Nights	Visits / ha	Camper Nights Rate
Killarney	48,500	Northeast	98,802	20,299	78,503	2.037	79.45%
Quetico	475,782	Northwest	133,976	3,628	130,348	0.282	97.29%
Wabakimi	892,061	Northwest	4,552	-	4,552	0.005	100%
Woodland Caribou	450,000	Northwest	11,264	4,971	6,239	0.025	55.87%

Natural Environment Parks

Natural Environment Parks have played a very important role over the history of the OPPS. The 1978 policies defined them as areas which *incorporate outstanding recreational landscapes with representative natural features and historical resources to provide high quality recreational and educational experiences* (Provincial Parks Branch, 1978).

Natural Environment Parks can be understood as relatively large-sized areas with a strong recreation-oriented purpose. They serve all four objectives – Protection, Recreation, Heritage Appreciation and Tourism, but the latter three functions involve much more than Protection. Being similar to Waterway class parks, an average Natural Environment Park contains all possible six zoning types, and with an extra type of Recreation-Utilization Zone in Algonquin. Theoretically a Natural Environment park is predominantly occupied by Wilderness Zones and Natural Environment Zones with a relatively large proportion of Development Zones, while Nature Reserve and Historical Zones are sporadically distributed in the park. Within the Development Zones, 23 kinds of recreational activities certainly and 30 possibly are allowed; while 14 are surely, and 23 possibly permitted in Access Zones.

As of 2000, 65 Natural Environemnt Parks have been established, while 41 of them hold operating status, with a big share of 38.7% within the 106 operating parks. The 41 Nature Environment Parks had an annual record of 4,320,735 visits, which is 38.3% of all visitor use in the OPPS. On average, each park hosted 105,384 visits, much greater than those in the other classes.

Among these parks, Algonquin Provincial Natural Environment Park hosted the largest number of visitors. The parks with the top 10 visitation are:

List 1. The Top 10 Largest Host Natural Environment Parks in 2000.

1. Algonquin: 939,634
2. The Pinery: 481,847
3. Sandbanks: 438,419
4. Kakabeka Falls: 292,946
5. Killbear: 263,163
6. Presqu'ile: 222,902
7. Lake Superior: 202,921
8. Bon Echo: 170,799
9. Rondeau: 159,453
10. MacGregor Point: 117,767

However, by the standard of day use visitation alone, Kakabeka Falls tops as 262,462, followed by Sandbanks with 252,701 and Algonquin with 240,865 respectively. By the standard of camper night visitation, the order is set by Algonquin with 698,769, The Pinery 382,596 and Killbear 247,786 respectively. It should be noted that Mono Cliffs, Forks of the Credit, Aubrey Falls and Short Hills are typically day use type parks without any camper night visitation, while the Massasauga Park does not have a record of day use visitation.

Due to high visitation and diverse recreational use, Nature Environment Parks experience substantial human pressure (List 2).

List 2. The Top 10 Most Intensively Used Nature Environment Parks (unit: visits per ha).

1. Kakabeka Falls: 585.89
2. Sandbanks: 290.34
3. Presqu'ile: 237.89
4. The Pinery: 190.30
5. Killbear: 149.87
6. MacGregor Point: 97.81
7. Arrowhead: 85.11
8. Forks of the Credit: 68.11
9. Rondeau: 49.00
10. Restoule: 44.53

List 2 indicates that Kakabeka Falls, Sandbanks and Presqu'ile can be ranked as the top class as most highly used parks, and followed by The Pinery, Killbear and MacGregor Point Parks. All of these sites require special attention by Ontario Parks.

Recreation Parks

Just as Figure 1 shows, Recreation Parks function as the most recreation-oriented areas within the OPPS. The pursuit of recreational value is a typical anthropocentric purpose of modern public parks. Therefore, Recreation Parks resemble urban parks to a great extent. The 1978 policies described Recreation Parks as *areas which support a wide variety of outdoor recreation opportunities for large numbers of people in attractive surroundings* (Provincial Parks Branch, 1978)..

The policy further addresses, "*Recreation Parks contribute principally to the achievement of the recreation, heritage appreciation, and tourism objectives*" (Provincial Parks Branch, 1978). However, this does not imply all the Recreation Parks ignore the protection of natural or cultural heritage. Theoretically, Historical Zones and Nature Reserve Zones are incorporated into the zoning system as secondary land use areas within Recreation Parks, although Wilderness Zones can not be seen here due to the small park size. Apart from the Access Zones, both Development Zones and Natural Environment Zones function as the primary land use areas to serve the main recreational purposes. As many as 23 activities or facilities are permitted for certain, and 40 possibly allowed to occur in Development Zones, while 17 are certainly and 20 possibly permitted to exist in Access Zones.

Up to 2000, 70 Recreation Parks had been established, among which 57 parks hold the operating status. Together, the 57 parks hosted 4,224,845 visits in 2000. The largest top 10 host parks are listed in List 3.

List 3. The Top 10 Largest Host Recreation Parks, 2000.

1. Wasaga Beach: 1,316,163
2. Sibbald Point: 241,429
3. Bronte Creek: 236,504
4. Balsam Lake: 140,325
5. Earl Rowe: 135,134
6. Voyageur: 105,410
7. Long Point: 104,740
8. Darlington: 103,172
9. Turkey Point: 101,478
10. Lake on the Mountain: 90,911

Wasaga Beach impressively tops the list, followed by Sibbald Point and Bronte Creek Parks. However, in terms of camper night visitation, Balsam Lake tops with 125,096 visits, followed by Sibbald Point with 117,089, Earl Rowe with 77,843 and Voyageur with 77,678 visits. It also should be noted that Wasaga Beach, Bronte Creek and Lake on the Mountain Parks are typically day use type of Recreation Parks without any camper night visitation. Bronte Creek's new campground will open in 2002.

Now we will explore another interesting and important issue with regards to Recreation Parks. The top 10 Recreation Parks with the most intensive use are listed in List 4.

List 4. The Top 10 most intensively used Recreation Parks, 2000 (unit: persons per ha).

1. Sauble Falls: 2,492
2. Port Bruce: 2,467
3. Springwater: 1,323
4. Oastler Lake: 1,224
5. Sibbald Point: 1,073
6. Sturgeon Bay: 1,057
7. Emily: 1,035
8. Lake on the Mountain: 874
9. Wasaga Beach: 861
10. Bass Lake: 812

List 4 shows Sauble Falls and Port Bruce as the most highly used parks, followed by the second class of Springwater, Oastler Lake, Sibbald Point, Sturgeon Bay and Emily. It also should be noted that five of the 10 are camper night type parks, including Sauble Falls with 78.51%, Oastler Lake with 92.19%, Sturgeon Bay with 95.77%, Emily with 83.54% and Bass Lake with 70.32% overnight visitation rates. In contrast, Port Bruce, Springwater, Lake on the Mountain and Wasaga Beach hosted exclusively day use visitors.

Operation and Visitor Use Comparison among the Six Classes

Looking into the 106 operating parks, we find that 57 are Recreation, 41 are Natural Environment Parks, and the other four classes combined comprise only hold eight parks with operating status. In regard to visitor use distribution, 48.7% and 47.6% of the total 8,869,857 visits are concentrated within Nature Environment Parks and Recreation Parks respectively. Only 3.7% of all visitor use is taken by the other four classes of parks. Among the top 10 largest host parks, seven of them are Natural Environmental Parks and three are Recreation Parks. The top three of them are Wasaga Beach (R), Algonquin (NE), and The Pinery (NE).

In terms of day use visitation, Recreation Parks hosted 2,425,210 visits, taking 61.1% of the total of 3,971,814; followed by Environment Parks receiving 1,450,222 visits with 36.5% of the total. The other four classes of parks only host 2.4% of the total day use visitation. Among the top 10 largest host parks in terms of day use visitation, seven of them are Natural Environmental Parks and 3 are Recreation Parks. The top three of them are Wasaga Beach (R), Kakabeka Falls (NE) and Sandbanks (NE).

Looking into the camper night visiting information, we find that 58.6% of all visitation, with 2,870,714 visits, are concentrated in Natural Environment Parks; while 36.7% visitation, with 1,799,660 visits, occurred in Recreation Parks. This implies that the other four classes of parks combined accommodated only 4.7% of overnight visits. Among the top 10 camper night host parks, seven of them are Natural Environmental, two are Recreation Parks and one is a Wilderness Park. Algonquin (NE) tops the list, Quetico as the largest camper night Wilderness Park ranks 7th, and Balsam Lake as the largest Recreation Park ranks 8th.

In order to get a precise value about the human pressure upon different classes of parks, we set the unit as visits per sq. km. The results are illustrated in Table 5.

Table 5. Human pressure upon different classes of parks in 2000.

Class	Recreation	Nature Reserve	Natural Environment	Historical	Wilderness	Waterway
Value (visits/km^2)	448,254	121,767	53,071	12,914	587	83

Table 5 shows that the operating Recreation Parks receive the highest average human pressure, seconded by Nature Reserve Parks and followed by Natural Environment and other classes of parks. According to the calculated results from the database, all of the top 15 parks receiving the highest human pressure are exclusively Recreation Parks. However, within the top 40 parks, 35 of them are Recreation Parks, four of them are Nature Environment Parks and the other one is John E. Pearce Provincial Nature Reserve Park.

Conclusion

Through the exploration of Ontario's existing provincial parks system, we can understand the following points:

1) As of 2000, the focus of the management and operation has been put on the Natural Environment Parks and Recreation Parks.
2) Too few operating Nature Reserve Parks have resulted in great human pressure upon highly protected areas such as John E. Pearce.
3) Much has been achieved in the designation of Provincial Nature Reserve Parks and Waterway Parks, while little has been done in their operation and management.
4) Based on much operating practice in Natural Environment, Recreation and Wilderness Parks, the park management principles, skills and techniques should be drawn out to support the operation of other classes

of parks.

5) The regular data input responsibility should be intensified to guarantee a more precise official statistics.
6) Use level data should be collected for all non-operating parks, even if in a sporadic basis.
7) The basic data in the official web site should be updated based on a dynamic database management system.

Acknowledgements

The completion of this paper owes much to help from Maggie Bowman and Felice Yuen at the Department of Recreation and Leisure Studies, University of Waterloo. Jim Porter of the Heritage Resources Centre is also acknowledged for aiding in the preparation of this paper.

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Vegetation, Species Management and Change

Dune system at Pinery Provincial Park (TJB).

The impacts of hybridization on the endangered red mulberry (*Morus rubra* L.) in Canada

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Abstract

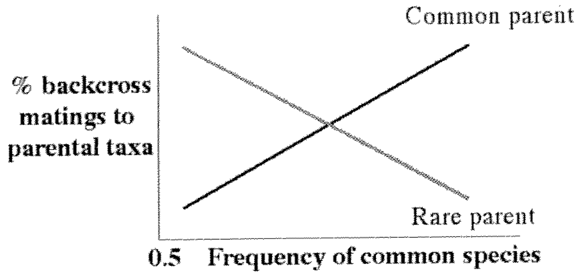
*We have developed a research program that uses molecular, morphometric and experimental approaches to measure the genetic and ecological impacts of hybridization on the endangered red mulberry (*Morus rubra *L.) by the introduced, white mulberry (*Morus alba *L.) in Canada. Although the genetic impacts of hybridization are discussed, this paper focuses on the ecological impacts of hybridization through its influence on the production of red mulberry offspring and their establishment. Results from a culling experiment show that although red mulberry offspring have similar fitness measures among culled vs. non-culled plots, the production of hybrid offspring is higher in non-culled plots. Results from transplant experiments show that red, white and hybrid mulberry are not ecologically differentiated and red mulberry is at a competitive disadvantage. This research provides insight into the evolutionary processes that occur when a rare plant hybridizes with a more abundant species, and represents an opportunity to implement management strategies based on experimental approaches that contribute to the Red Mulberry National Recovery Plan.*

Introduction

When two plant populations hybridize the impact of hybridization can be genetic and/or ecological (Arnold, 1997). Genetic impacts affect the frequency and types of novel gene combinations that are formed between hybridizing populations and have been the focus of much research in the hybridization literature (Rieseberg and Wendel, 1993; Arnold, 1997; Rieseberg and Carney, 1998; Rieseberg, 2000). The ecological impacts concern the viability of hybrids and their parents (Levin *et al.*, 1996, Wolf *et al.*, 2000), and may be equally important in determining the outcome of the hybridization process (Levin et al., 1996; Rhymer and Simberloff, 1996). For example, hybridization can create competition for the limited ovules of the hybridizing taxa as well as influence establishment through increased competition for suitable sites. Together, ecological and genetic impacts will determine the fate of hybrids and their parents.

When hybridization occurs between a small (or rare) plant population and a more abundant congener, the genetic and ecological impacts of hybridization on the rare parental population may be particularly acute (Huxel, 1999; Wolf *et al.*, 2000). As the proportion of individuals of the rare taxon decreases relative to the common congener, the percentage of backcross matings between hybrids and the common parent will increase while those to the rare parent will decrease (Figure 1).

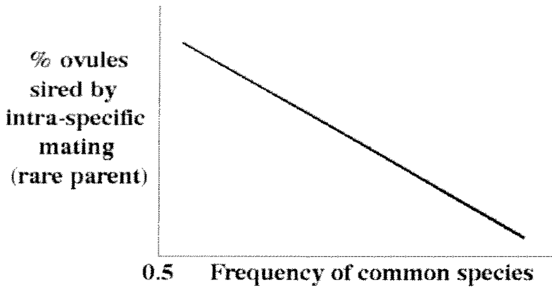
Figure 1. Genetic assimilation of the rare parent involves the incorporation of genes from the rare taxon into the genome of the common. This process is dependent on the formation of hybrids and the frequency of the common parent.



Such asymmetric gene flow between rare and common taxa, can lead to the incorporation of genes from the rare taxon into the genome of the common (Rhymer and Simberloff, 1996; Huxel, 1999). This genetic impact of hybridization on the rare taxon has often been referred to as genetic assimilation although several other terms in the literature have been applied to this process (Rhymer and Simberloff, 1996). These include: genetic deterioration, genetic takeover, genetic swamping, genetic aggression, and genetic pollution (Rhymer and Simberloff, 1996).

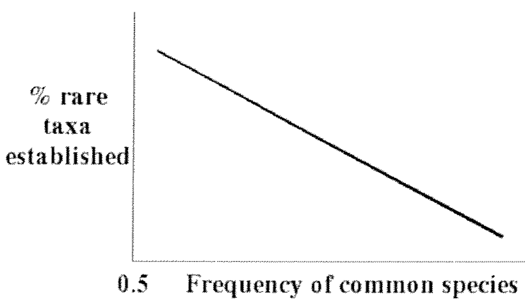
Although the genetic impacts of hybridization can have a detrimental effect on the rare parent, ecological impacts can also play an important role in their persistence (Levin *et al.*, 1996; Wolf *et al.*, 2000). For example, the rare parent may experience a mating disadvantage with the more abundant taxon. This can occur when the percentage of ovules sired by intra-specific matings among rare parents decreases as the frequency of the common species increases above that of the rare parent (Figure 2).

Figure 2. Rare parental taxa can experience mating disadvantage when the frequency of the common species causes a reduction in the % of ovules sired by intraspecific mating among rare parents.



Similarly the rare taxon may experience establishment disadvantage where the percentage of individuals of the rare parent that establish at a site also decreases as the frequency of the common species increases above that of the rare parent (Figure 3).

Figure 3. Rare parental taxa can experience establishment disadvantage when the frequency of the common species causes a reduction in the % of rare taxa that are able to get established at a site.



Hybridization and red mulberry

One rare plant species that is thought to be experiencing the genetic and ecological impacts of hybridization with a more abundant congener is red mulberry (*Morus rubra* L.) (Ambrose *et al.*, 1999). Red mulberry is a wind pollinated under-story tree species, listed as endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). In Canada red mulberry is restricted to the Carolinian zone of southern Ontario and is only found in six core populations that contain five or more trees. These include the Hamilton Royal Botanical Gardens, Ball's Falls Conservation Area (Niagara Peninsula Conservation Authority), Niagara Glen (Niagara Parks Commission), Rondeau Provincial Park, Point Pelee National Park and Fish Point Provincial Nature Reserve (Pelee Island). Apart from habitat fragmentation due to increasing urban and agricultural land use, hybridization with the introduced and more abundant white mulberry (*Morus alba* L.) has been identified as a significant threat to remaining populations (Ambrose *et al.*, 1999). The hypothesis that hybridization is occurring between these two species is based on two lines of evidence. The first of these is the high occurrence of white mulberry at four of the remaining core populations in southern Ontario where the percentage of white mulberry within a 25 m radius of red mulberry can be as high as 92.6% (Husband and Burgess, 2000). Secondly, individuals with intermediate leaf morphology have also been found at the same populations although their parentage has yet to be confirmed with molecular markers.

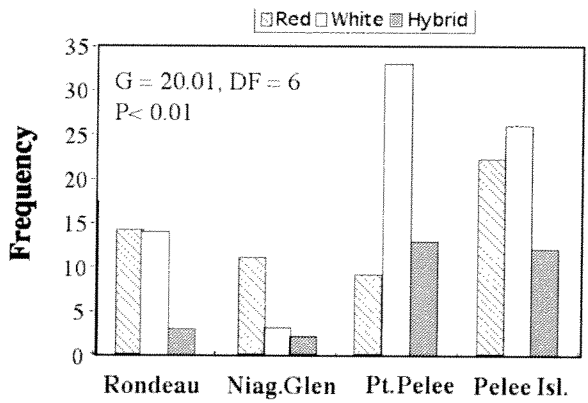
Given the suspected threat of hybridization to red mulberry in southern Ontario, both the management and scientific community have expressed an interest in this particular conservation problem (Burgess and Husband, 2001). Land managers have expressed the need for immediate restoration of the species, whereas the scientific community has developed an interest in hybridization per se as a mechanism of endangerment to small populations of red mulberry. More specifically, the primary focus of management is to reduce the impact of hybridization (which involves the identification and removal of hybrid and white mulberry). Alternatively the scientific community is interested in investigating the biology and ecology of small populations of red mulberry and achieve a mechanistic understanding of extinction by hybridization in these populations (i.e., the role of genetic assimilation, mating disadvantage and establishment disadvantage in red mulberry).

We have established a research program that attempts to meet both the needs of management and those of science (Burgess and Husband, 2001). In this paper we will present the objectives outlined in the red mulberry research program as well as preliminary results that address these objectives. The research program has two basic objectives: 1) to determine the genetic impacts of hybridization by determining the genetic structure of the population and patterns of morphological variation; and, 2) to measure the ecological impacts of hybridization i.e., the role of mating disadvantage and establishment disadvantage. As the results presented here represent preliminary work of the primary author's Ph.D. thesis, please keep in mind that a more thorough analysis of the data presented in this paper will be published in the primary literature in the future. This aside, we want to demonstrate work done to date and how we are attempting to meets the needs of both land managers and science.

Genetic impacts of hybridization

Results from our on-going genetic studies using species-specific Randomly Amplified Polymorphic DNA (RAPD) have confirmed the occurrence of hybridization at four key locations where red and white mulberry co-exist (Husband and Burgess, 1999; Husband and Burgess, 2001). As seen in figure 4, a high frequency of hybrid mulberry were detected in populations that also have the highest occurrence of white mulberry, namely Pelee National Park and Fish Point Provincial Nature Reserve.

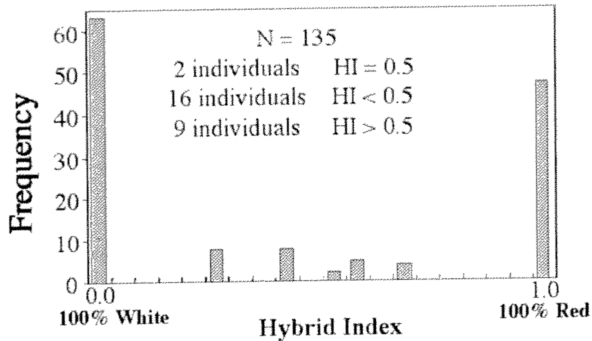
Figure 4. DNA analysis using species specific Randomly Amplified Polymorphic DNA (RAPD) showed that the variation in hybrid frequencies differs among populations in southern Ontario. Sites with the highest occurrence of white mulberry also had the highest hybrid frequency.



When individuals were ranked along an assigned value using a hybrid index (0=white, 1=red), few hybrids were found to be of first generation parentage (F1); but rather, the most hybrids were of later generation backcrosses and were more closely related to white mulberry (Figure 5).

This research gives insight into the direction of hybridization and the potential for genetic assimilation (processes of scientific interest). The results from our genetic studies also have conservation relevance; namely, the confirmation of hybridization as a potential threat to remaining populations and the existence of red mulberry in southern Ontario.

Figure 5. Hybrid index scores based on species specific RAPD markers. Of the 27 hybrids detected only two were F1 while the majority had DNA profiles that were closer to white mulberry.



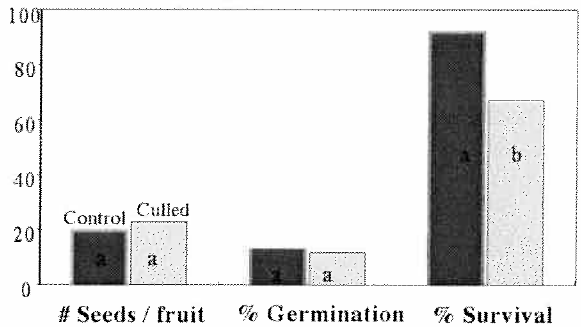
Ecological impacts of hybridization

The second objective of the red mulberry research program (and the focus of this paper) goes beyond measuring the magnitude of hybridization in remaining populations of red mulberry to investigating the impacts of hybridization on the abundance of red mulberry. Specifically we have established experiments that measure the impact of mating disadvantage and establishment disadvantage in determining the fate of red mulberry parental taxa (Husband and Burgess, 2000; Husband *et al.*, 2001, Burgess and Husband, 2002). To us, these experiments represent an adaptive management approach to addressing the conservation needs of this species, where management is conducted in an experimental framework. Once again this represents a work in progress and data from these experiments will be published elsewhere in the primary literature.

Mating disadvantage

At locations where red mulberry is less abundant than white mulberry we hypothesize that red mulberry may be experiencing mating disadvantage. Due to this numerical asymmetry we suspect that some of the red mulberry ovules which ordinarily would be sired by red mulberry pollen are being fertilized by white mulberry. To determine if red mulberry is experiencing mating disadvantage, we have established a culling experiment in two of the six remaining populations. In this experiment we identified 12 female red mulberry trees around which all white mulberry were either removed within a 25m radius (culled plots) or left standing (control plots). Seeds were then collected from each of these trees, germinated in growth chambers and grown in a greenhouse environment. Leaves were collected for DNA analysis using RAPD to determine the percentage of hybrid progeny produced in control vs. culled plots. Results showed that although there was no significant differences between treatments for the # of seeds/fruit and % germination, % survival was higher in control plots (Figure 6).

Figure 6. Results from a white mulberry removal experiment showed that although culling has no effect on seed production or quality, seedlings from control plots had higher survival rates.



Although not statistically different, the percentage of hybrids produced also tended to be higher in control plots. From a conservation perspective, this experiment not only allows researchers to determine if white mulberry removal is necessary for red mulberry restoration but also gives us an estimate for the scale of removal that may be required. From a scientific perspective these results suggest that mating disadvantage is occurring in this species.

Establishment disadvantage

At locations where red, white and hybrid mulberry co-exist we hypothesize that red mulberry may be experiencing establishment disadvantage. Because suitable habitat for red mulberry establishment is limited we suspect that white and hybrid mulberry are occupying sites that would normally be occupied by red mulberry. To determine if the conditions for establishment disadvantage are occurring in red mulberry, we established 3 transplant experiments. The first two are in a natural environment at Rondeau Provincial Park and the third is in a controlled environment at Ridgetown College. In the natural environment we established a seedling experiment in which 5 month old plants were planted into two environments representing red and white mulberry parental habitats, shade and sun respectively. In this experiment three cross-types (Red mulberry X Red mulberry (RxR); White mulberry X White mulberry (WxW); and each of the reciprocal crosses RxW and WxR (grouped as Hybrids) were randomly planted (N=36, 0.5m apart) in each of eight plots (four in sun habitat and four in shade habitat).

A similar design was used to establish a juvenile transplant experiment in a natural environment at Rondeau Provincial Park. In this experiment 11 month old plants of varying cross-types (RxR, WxW, and Hybrid) were planted into each of eight plots (four in sun habitat and four shade habitat).

The third experiment was established at Ridgetown College in a controlled environment. This is a common garden experiment in which RxR, WxW, and Hybrid seedlings were planted into one plot (N=333).

We then measured survival and height for each on these experiments over a period of two years and calculated cumulative fitness measures (survival of seedlings X survival of juveniles X height of juveniles) for each of the cross-types in each experiment. We then related the most fit cross-type in each environment to other cross-types in that same environment to calculate relative measures of fitness.

As seen in Figure 7, results from the seedling and juvenile experiments showed that hybrid and white mulberry significantly out-performed red mulberry in both sun and shade habitats. RxR mulberry had 13% and 6 % of the fitness of hybrid mulberry in shade and sun habitats respectively. Similar results were found in the common garden experiment where RxR mulberry had lower fitness measures than both WxW and Hybrid mulberry (Figure 8).

Figure 7. Relative fitness (seedling survival X juvenile survival X height of juveniles) of RxR, WxW and hybrid mulberry in shade and sun habitat. RxR mulberry had significantly lower relative fitness than both hybrid and WxW mulberry in both habitat types.

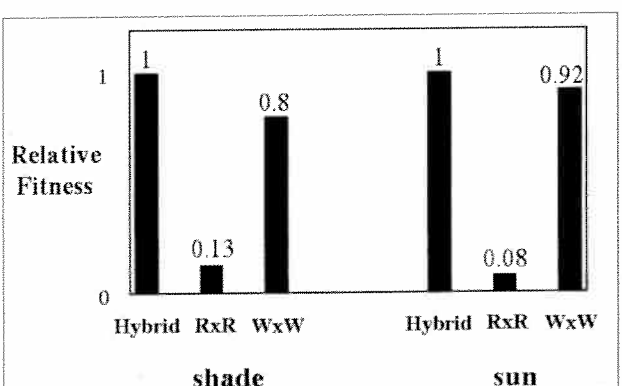
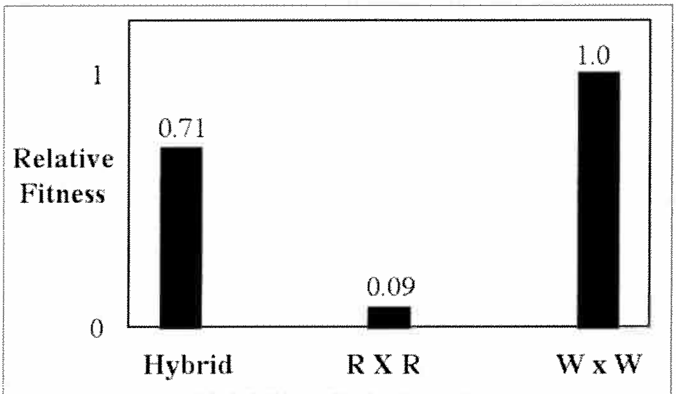


Figure 8. Relative fitness (seedling survival X juvenile survival X height of juveniles) of RxR, WxW and hybrid mulberry in a common habitat. RxR mulberry had significantly lower relative fitness than both hybrid and WxW mulberry.



The significance of the results from these transplant experiments is once again two fold. From a conservation perspective, the results provide a basis for a transplant protocol for red mulberry restoration as well as predictions on the success of such efforts. From a scientific perspective these results confirm that the conditions for establishment disadvantage are occurring in red mulberry.

Conclusion

In summary the red mulberry research program provides a balance of descriptive and experimental approaches to measure the magnitude and impact of hybridization. This not only allows us to gain new insights into the mechanisms of hybridization in rare populations but also provides the research necessary to implement and assess the conservation initiatives outlined in the National Recovery Plan for this species.

Statement of work in progress

We reiterate that this is work in progress and is part of the Ph.D. thesis of the primary author. The concepts and results presented in this paper will be also published in whole or in part in the peer review literature upon completion.

Acknowledgements

We are gratefully indebted to the various funding agencies and institutions that provided the funds necessary to do this research; World Wildlife Fund Canada & the Canadian Wildlife Service, Canadian Forest Service Natural Resources Canada, Ontario Ministry of Natural Resources, Latornell Endowment Fund, and The University of Guelph. We would also like to thank land managers and associated personnel for their valued expertise, assistance and support with this research; Hamilton Royal Botanic Garden (*Tyler Smith*), Niagara Peninsular Conservation Authority (*Dan Kaine*), Niagara Parks Commission (*Lorne Fast*), Rondeau Provincial Park (*Ric Hornsby, Sandy Dobbyn*), Point Pelee National Park (*Gary Mouland, Matthew Smith, Vicki McKay*), Fish Point Provincial Nature Reserve, Pelee Island (*Chuck Fawdry, Allan Woodliffe*), Ridgetown College (*Mike Gladstone, Ken Nentwig*),OMNR (*Allan Woodliffe, Melinda Thompson*) and the Red Mulberry Recovery Team (John Ambrose - Chair). We are also greatly indebted to our laboratory assistants for their dedication to the red mulberry research program; Amanda Bauman, Roxanne Beavers, Chris Hussel, Sean Spender, and Charles Leduc.

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Protecting Carolinian Canada: Controlling the Spread of Tree-of-Heaven (*Ailanthus altissima*) within Rondeau Provincial Park

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Abstract

*Tree-of-Heaven (*Ailanthus altissima*) is a proliferate, non-indigenous invasive species that is threatening the integrity of the largest remaining protected Carolinian habitat in Ontario, located in Rondeau Provincial Park. Given the invasive characteristics of* A. altissima, *including sexual and asexual reproduction, prolific growth habits and allelopathic properties, this species has the capability to become a threat to restoration efforts throughout the Carolinian Zone of Canada. This project investigated management methodologies for* A. altissima *within Rondeau Provincial Park, developing efficient and effective methods of controlling the spread of this invasive species in the Carolinian Zone. Using both qualitative and quantitative approaches based on a stratified random sample, this research examined the effects of prescribed burning, as well as chemical and mechanical methods of controlling* A. altissima *within Rondeau Provincial Park. Through the examination of these methods, the further expansion of* A. altissima *within Rondeau Provincial Park has been minimized, thereby assisting with the restoration of this unique ecosystem.*

Introduction

The loss of biodiversity is heralded as one of the most critical issues facing the world today. This problem is especially evident in the rapid decline of native vegetative species in the Carolinian Zone of Southwestern Ontario. Despite the scarcity and small size of the remaining Carolinian fragments in Southern Ontario, 351 of Ontario's 542 rare plants are located in this ecological zone (Oldham, 1990). Furthermore, this region contains more nationally endangered plant species than any other life zone in Canada (Allen, 1990). However, the fantastic biodiversity of this ecozone is being jeopardised by the invasion of non-indigenous species. Tree-of-Heaven (*Ailanthus altissima*) is a proliferate, non-indigenous invasive species that is threatening the integrity of one of the largest remaining protected Carolinian habitats in Ontario, located in Rondeau Provincial Park. The implementation of invasive species management techniques is necessary to combat the spread of such species and prevent the degradation of this rare ecozone.

Tree-of-Heaven (*Ailanthus altissima*)

Phenology of Ailanthus altissima

While a component of the success that *A. altissima* has had colonizing Rondeau Provincial Park is related to the presence of existing human-induced disturbance within the park, the phenology of *A. altissima* has greatly contributed to its invasive success. This plant is highly prolific, with an individual tree producing as many as 325 000 seeds per year (Bory and Clair-Maczulaijtys, 1980), which can produce 6000 - 7000 viable plants (Little, 1974). *A. altissima* also produces both sexually and asexually, thereby increasing its reproductive potential. *Ailanthus* grows quickly, with mature trees reaching heights of 15-20 m (Adamik, 1955), and is considered by some to be the fastest growing tree species in the northeastern United States (Petrides, 1978). It has also been identified as one of the 40 most invasive woody angiosperms from 40 different genera (Rejmanek and Richardson, 1996). The rapid growth of *A. altissima* is facilitated by the allelopathic properties possessed by *A. altissima* (see Heisey, 1990, 1991, for further information). Therefore, the phenological characteristics of *A. altissima* partially explain its invasiveness and resilience.

Ailanthus altissima at Rondeau Provincial Park

A. altissima is currently only established within the northern Development Zone within the park, but it is beginning to encroach upon the southern Nature Reserve zone. Although *A. altissima* is recognized as an important non-indigenous invasive species by The Nature Conservancy (Hoshovsky, 1999), it is not usually identified as a threat to forests (Cronk and Fuller, 1995) as it is thought to be unable to compete within a forest community (Bordeau and Laverick, 1958; Newton, 1986). However, Knapp and Canham (2000) have shown that *A. altissima* can out-compete native tree species and reach the top of the canopy. *A. altissima* is "gap-obligate" as it is able to achieve dominance in forest communities in this manner through a single rapid release period facilitated by gaps in the canopy (Knapp and Canham, 2000). Kowarik (1995) also reports that *A. altissima* root shoots demonstrate "gap-facilitative" properties, and they are able to survive for many years under an intact canopy. *A. altissima* is able to utilize these characteristics within Rondeau due to severe windstorm that occurred on July 24, 1998, which created numerous large canopy gaps within previously closed canopy areas (Larson and Waldron, 2000), creating ideal openings for non-indigenous plant invasions. Therefore, given *A. altissima*'s ability to not only invade and establish itself within disturbed habitats, but also to persevere in established woodlands, it poses a major threat to the integrity of the Carolinian community at Rondeau.

Methodology

Site Location

Rondeau Provincial Park is located in the Western basin of Lake Erie, 40 km southeast of the city of Chatham, in Kent County (Figure 1), in the Carolinian Zone of Southwestern Ontario. Rondeau was officially established as a provincial park in 1894 (OMNR, 1991) and is the second oldest provincial park in Ontario. Classified as a Natural Environment park in recognition of the provincially significant landforms, flora and fauna located in the park, Rondeau has 3254 ha of marsh, dune, savannah and woodland habitats (OMNR, 1991). Due to this classification, the preservation of these features, and consequently, the control of invasive non-indigenous species, is paramount to Rondeau Provincial Park.

Figure 1. Location of Rondeau Provincial Park within southwestern Ontario.

Experimental Design

Three treatment methods, plus a control, were replicated factorially four times in two disjunct areas based on a stratified random block, split plot design. The plot configuration was based on a 2x2 m block size. Treatments were randomly assigned to the stratified blocks and monitoring occurred over the 2001 and 2002 field seasons.

The first treatment method that was tested was a mechanical treatment method, which entailed the manual pulling of seedlings under 30 cm, followed by an application of mulch. Two chemical treatment methods, including a Cut Stump/Herbicide application, and the EZJect Capsule Injection System were also tested. The Cut Stump/Herbicide treatment involved the complete removal of all saplings and mature *A. altissima* trees within the identified plots through the use of a motorized or hand saw, with the application of the biodegradable spot specific herbicide, Roundup Transorb®, to the exposed stumps. The EZJect Capsule Injection system treatment, which consists of a 4.5 kg, 1.5 m long aluminum lance that inserts a .22 caliber casing filled with 0.15 g of dry glycophosphate herbicide gel into the trunk of the tree (Strobl, 1999a). The lance is gravity fed and spring-loaded, such that the pressure exerted by the operator forces the capsule into the tree. This method inserts the water-soluble herbicide directly into the sap, aiding in the translocation of the herbicide and subsequently killing the tree. The effects of a prescribed burn on *A. altissima* were also investigated. The area of the prescribed burn was spatially separated from the other three treatments and a separate stratified random block design, based on 8x8 m plots was established in an area of the burn zone. Four treatment blocks were located and identified in the areas that possessed stands of *A. altissima.*

Results

Cut Stump/Herbicide and Manual Removal Treatment Results

The examination of the means of each treatment across the dates on which observations were taken revealed that the number of seedlings of Tree-of-Heaven in the treatment plots decreased steadily across the observation dates, while the number of control plots remained relatively stable (see Table 1).

The results of the analyses of variance (ANOVAR) revealed that while the Cut Stump/Herbicide and Manual Removal treatments were significantly different than the Control treatment on each of the observation dates ($f=0.000$, $p=0.05$), there was no significant difference between the Cut Stump/Herbicide and Manual Removal treatments on any of the dates, at a 0.05 level of significance.

An analysis of variance of repeated measure was performed to determine if there were variations between subject effects, indicating differences between the two plot areas. The ANOVAR results indicate that there is no significant differences between the results of the two plot areas on either date. Consequently, the results were not unduly influenced by uncontrollable environmental factors. Hence, while the results indicate that both the Manual Removal and Cut Stump Herbicide treatments were significantly different than the Control group, they were not significantly different than each other. Therefore, it is necessary to not only take into consideration the means of each treatment, but it is also necessary to examine the efficiency of the treatment methods.

Table 1. Mean data scores from manual removal, cut stump/herbicide, and control treatment data.

Date	Number of *A. altissima* plants within the plots.		
	Manual Removal	Cut Stump	Control
May 25/01	2.97		11.0
June 27/01	5.36		10.84
July 24/01		2.81	10.63
August 02/01	3.81	2.25	10.47
August 13/01	2.91	1.56	10.47
August 28/01	1.74	0.75	10.31

EZJect Capsule Injection System Treatment Results

The results of the EZJect treatment were ranked upon a scale developed by the researcher that rates the decay of the injected trees, with 0 indicating no decay and 10 indicating complete death. The results of these analyses indicated that the impact of the EZJect treatment steadily increased over time, as seen in Table 2.

Table 2. Mean data results from the EZJect Capsule Injection System treatment.

Date	Decay Rating of *A. altissima* trees	
	EXJect	Control
July 24/01	3.52	0
August 02/01	5.85	0
August 13/01	7.5	0.5
August 28/01	8.43	1
September 27/01	9.09	1.5

The results of the Friedman Test (Chi-square=74.608, Asymp. Sig.=0.000, df=4) reveal that the ranks across the dates are statistically different than each other. The mean ranks from this test increase over time, from 1.20 on July 24/01, to 2.04 on August 2/01, to 3.17 on August 13/01, to 4.07 on August 28/01, to 4.52 on September 27/01. Consequently, it can be determined that the impact of the EZJect treatment on *A. altissima* increased in significance over time.

Burn Treatment Results

The mean percent coverage of *A. altissima* underwent a steady increase across the observation period, from 6.25 – 46.25%, with the exception of May 25, during which the percent coverage decreased to 1.25%. However, despite the steady increase in grass coverage, there were no significant differences in the percent coverage over the observation dates, except for the initial date immediately following the completion of the burn (May 1, f-statistic=81.00, Sig.=0.000, df=1, 7).

In order to evaluate the efficiency of the treatment methods, it is necessary to examine the financial, personnel and temporal requirements of each treatment methods (Table 3). Due to financial constraints imposed on many parks and protected areas, the fiscal implications of management techniques must be taken into consideration in planning an active management program for invasive species. Consequently, the choice of management techniques for *A. altissima* is dependent on the various costs associated with each methodology.

Discussion

A variety of factors must be taken into consideration when determining and developing a treatment program for the control of invasive, non-indigenous species. Not only must the life history and growth characteristics of the species be considered, but also the immediate and long-term needs and resources of the protected area. Consequently, the most effective treatment method is not always equivalent to the treatment that is best suited to the situation under consideration.

Treatment Determination

The unique setting of Rondeau Provincial Park complicates the development of a management program for *A. altissima*. With its large contingent of cottage residents and recreational uses, management programs at Rondeau must appeal to all visitor profiles, including nature enthusiasts and recreational day users. However, the underlying purpose of the management plan must remain rooted in the principles of ecological restoration and ecological integrity. Financial prudence is another key component, as government funding of Ontario Parks has decreased substantially in recent years. Consequently, the development of a policy to control the spread of Tree-of-Heaven within Rondeau Provincial Park is a complicated and intricate task.

Given the number of variables that must be taken into consideration, a decision matrix has been developed to assist in ascertaining the most effective and efficient method of controlling the spread of *A. altissima* within Rondeau Provincial Park (Table 4).

The significance assigned to the factors in this matrix were adapted from the Rondeau Provincial Park Management Plan, taking into account the park's objectives, operating principles, zoning and designated uses. This matrix reveals that a combination of EZJect Capsule Injection System and Cut Stump/Herbicide treatment methods would present the best management program against *A. altissima.* A dual approach would allow managers to effectively target both mature, seed-producing trees (EZJect treatment), as well as younger, fast-growing saplings (Cut Stump/Herbicide treatment). However, due to the high initial fees associated with the EZJect Capsule Injection System, this strategy is only efficient in situations where the EZJect will be used for multiple species, or is purchased in cooperation with other organizations. However, as Rondeau has already purchased this equipment, it is cost-effective to utilize it. In situations where the purchase of an EZJect Lance System has not been factored into the protected areas budget, the Cut/Stump Herbicide treatment would still be an effective stand-alone management program against *A. altissima*, and other invasive species with similar growth habits.

The Cut/Stump Herbicide and EZJect treatments method are favoured as a more effective and efficient treatment strategy in the control of *A. altissima* over the Manual Removal and Prescribed Burn technique based on a number of factors. While the statistical analysis revealed that there were not significant differences between the cut stump/herbicide and manual removal treatment methods, an examination of the mean number of seedlings/saplings present after the treatment across the dates indicates that the average means of the Cut Stump/Herbicide treatment (mean average = 1.84) was slightly more effective than that of the Manual Removal (mean average = 3.36). However, the decreases in seedling/sapling survival may have been a result of natural reductions in growth rate at the end of growing season. The degree to which this factor affected the results cannot be measured, but must be recognized in the analysis. Furthermore, given that the main threat posed to Rondeau is associated with the further spread of this species, it is critical that the reproductive potential is controlled.

Table 3. Efficiency Evaluation Matrix for each treatment method.

Treatment	Number of Persons Involved	Rate of Pay	Time Necessary to Complete (hours)	Equipment Necessary	Cost of Equipment	Total Cost
Manual Removal	1	1 student @ $8.50/hr	4 days x 6 hours/day = 24 hours	spade; mulch	spade = $10.00; mulch = readily available on site	$215.00
Cut Stump/Herbicide	4	3 students @ $8.50/hr 1 maintenance person @ $16.50/hr	4 hours	wick wand; herbicide; herbicide applicator's license	$20.00 for 500 ml of herbicide; $5.00 for wickwand herbicide applicator's license (including course and exam) = $280.00	$473.00
EZJect Capsule Injection System Treatment	2 (could be done by 1)	1 student @ $8.50/hr	6 hours	EZJect Capsule Injection Lance; EZJect Capsules	$800.00 for EZJect lance $700.00 for 4800 capsules	$1,550.00
Prescribed Burn Treatment	park personnel used during planning OMNR Burn Team	$16.50/hr Incidental costs only	preparation = 8 person weeks (total of planning and maintenance work) actual event = 2 days	Only direct costs not normally incurred by the Burn Team are paid by provincial parks (i.e., hotels, meals, overtime) and any consumable equipment costs	Costs paid by park for Burn team expenses / consumable equipment is approximately 25% of total cost of the burn	For a subsidized burn of up to 100 ha, the cost is approximately $10,000.00 (the cost would be higher for a non-provincial park)

Table 4. Treatment Evaluation decision matrix.

Treatment	Effectiveness (score x 7) Score: Low (1) Moderate (2) High (3)	Fulfills Rondeau Objectives (Score x 6) Objective 1 (4) Objective 2 (3) Objective 3 (2) Objective 4 (1)	Cost (score x 5) Score: Low (3) Moderate (2) High (1)	Negative impact on Cultural / Social Community? (Score x 4) Score: Low (3) Moderate (2) High (1)	Negative impact on Ecological Community? (Score x 3) Score: Low (3) Moderate (2) High (1)	Facilitates the restoration of the indigenous ecosystem? (Score x 2) Score: Low (1) Moderate (2) High (3)	Aesthetically Pleasing? (Score x 1) Score: Low (1) Moderate (2) High (3)	TOTAL
Manual Removal	1 x 7 = 7	2 x 6 = 12	3 x 5 = 15	3 x 4 =12	2 x 3 = 6	1 x 2 = 2	3 x 1 = 3	57
Cut Stump/Herbicide	3 x 7 = 21	4 x 6 = 24	2 x 5 =10	1 x 4 = 4	1 x 3 = 3	2 x 2 =4	1 x 1 =1	67
EZJect Capsule Injection System	3 x 7 = 21	4 x 6 = 24	1 x 5 =5	3 x 4 = 12	3 x 3 = 9	1 x 2 = 2	3 x 1 = 3	76
Prescribed Burn	1 x 7 = 7	4 x 6 = 24	1 x 5 =5	1 x 4 =4	3 x 3 = 9	2 x 2 =4	1 x 1 = 1	54

The EZJect Capsule Injection System is also necessary to effectively combat *A. altissima*. The EZJect system successfully controls the growth of saplings and mature trees (mean score after 2 months = 9.09), and also affects not only the treated individuals, but also clonal duplicates. However, due to the differences in measurement units, it is not possible to compare the results of the Cut Stump/Herbicide treatment to those of the EZJect treatment. Given the different life-stages that the two treatments affect, it is not necessary for the two to be mutually exclusive. It was observed that the Cut Stump/Herbicide treatment was most effective on samplings, while the EZJect treatment was most effective and efficient on mature trees. Given the cost associated with the EZJect treatment, it is necessary to use the capsules judiciously. This can be done by targeting only mature trees in areas known to reproduce clonally (i.e., large monotypic stands).

The EZJect treatment results in the rapid defoliation of *A. altissima*, thereby preventing photosynthesis and resulting in the death of the tree. However, the leaves of *Ailanthus* possess the same allelopathic properties as the bark and roots. Consequently, if immediate restoration of the area is the primary goal of the invasive species removal program, it is possible that the leaf litter could negatively impact the success of the restoration program.

Given the growth habits of this species, simply removing the young seedlings is not sufficient to control the spread of this species. While the young seedlings do produce allelopathic chemicals that can prohibit the growth of other species, this consequence is not very applicable at Rondeau Park, given that the majority of the stands of *A. altissima* are monotypic. Hence, until this species is brought under some semblance of control, the allelopathic properties of this species are nullified. Hence, the manual removal treatment is not sufficient to assist with the achievement of Rondeau's management program. Consequently, in order to prevent the further spread of this species into the Nature Reserve Zone of Rondeau, it is necessary to target mature, seed producing trees, thereby preventing the establishment of new seedlings.

Prescribed Burn Treatment Results

The results of the burn treatment allude to the importance of timing in the use of prescribed burns to combat invasive, non-indigenous species. If the primary goal of the treatment program is to encourage the growth of native species, it is preferable to perform the burn in spring, when the stored nutrients released by the burn will most benefit the newly emerging seedlings. Alternately, if the control of invasive, non-indigenous species is the underlying objective of the active management program, the prescribed burn should be implemented during the fall when the species in the targeted area are unable to regenerate enough energy to survive the winter. As the primary purpose of the prescribed burn carried out at Rondeau Provincial Park was restoration-oriented, it was implemented in early spring when enough moisture was still present in the ground to prevent damage to the existing native species. Consequently, control of non-indigenous, invasive species was a secondary goal of the burn, and included in this research only because it was a pre-existing management decision.

Despite the effectiveness of the burn, as evidenced by the high percentage of grass regrowth in the treatment plots, the percent coverage of *A. altissima* did not decrease significantly across the observation period. While an initial decrease in percent coverage of *A. altissima* was observed immediately following the treatment, this preliminary effectiveness can be attributed to the immediate stress placed upon individuals by the fire. The success of the treatment did not, however, progress beyond the first two observation dates. By implementing the treatment in the spring, the nutrients stored in the visible plant matter were released, providing an influx of available nutrients. *A. altissima* is an opportunistic species that is able to quickly utilize available resources and rapidly optimize ideal conditions through its prolific growth habits. Hence, the prescribed burn probably served to improve the conditions of the area for *A. altissima*, accounting for the elevated growth of seedlings and saplings immediately following the burn. The gradual decrease in numbers near the end of he observation period can probably be attributed to the end of the growing season rather than the increasing effectiveness of the treatment.

The results of the treatment effectiveness are insignificant without an examination of the efficiency of the methodologies. The provincial park system is not the recipient of as much government financial support as it was previously. Consequently, less funding is available for programs such as invasive species management. Therefore, economic factors have become an integral factor in the determination of treatment options. The resources that the protected area have available for use need to be utilized and cost analysis performed on treatment options prior to management decisions being made. The efficiency analyses that were performed on each of the treatment options discussed in this research revealed that while the EZJect treatment displayed the highest start-up costs, it is a cost-effective methodology for Rondeau Provincial Park as this equipment is already a component of the park's resources. The Cut Stump/Herbicide treatment is also a fiscally responsible option, as the wickwand apparatus can be homemade and the chosen herbicide is readily available and affordable. Both of these treatments also have minimal personnel requirement, thereby reducing costs further. Conversely, both the Manual Removal and Burn treatments require large inputs of personnel for longer durations of time, thereby elevating the efficiency threshold past the effectiveness threshold, nullifying any benefits derived from effectiveness alone. Therefore, combining the EZJect treatment with the Cut Stump/Herbicide treatment will provide the most effective and efficient method of controlling the spread of *A. altissima* within Rondeau Provincial Park.

Conclusions

The resiliency of invasive, non-indigenous species requires intense active management techniques if eradication is the long-term goal of the program. While actively managing the ecosystem in a protected area is sometimes discouraged, the elimination of invasive species requires intense intervention by park managers. The public needs to be educated as to the need for invasive species management and recognize that undoing the results of human intervention often requires additional human intervention. It is sometimes necessary to use relatively severe means, such as the use of herbicides, to achieve the desired outcome. Within Rondeau Provincial Park, such measures are justified, even in the Nature Reserve Zone, given the severity of the *A. altissima* infiltration within the boundary. Furthermore, the scale of the application needs to be considered in determining a management strategy. Hence, determining a management program requires evaluating the trade-offs between the advantages and disadvantages presented by the proposal.

Controlling invasive species requires the development of a multi-tiered, multi-stakeholder, and cross-functional approach. The program should proceed in a sequential fashion, taking into consideration not only the targeted species, but also the other management goals and usage patterns of the area, as well as the climatic variability of the region. In order to assure full support for the program, all affected stakeholders should be consulted, including, but not limited to patrons, park managers, surrounding residents, and any associated non-governmental organizations. The cross functionality of the program will help to ensure that an interdisciplinary approach to invasive species control is employed, thereby drawing from the social, ecological, and scientific aspects of the issue. It is imperative that all facets of invasive species control be addressed in a management program in order to facilitate not only the immediate success of the program, but also to ensure the achievement of program goals in the future.

Limiting the scale and scope of the program also helps to ensure the accomplishment of the management goals. Implementing multiple smaller strategies over a period of time can be just as effective as a singular large-scale undertaking. In fact, staggering the onset of an invasive species restoration project can help combat the infestation, as the effectiveness of the strategy can be evaluated prior to the execution of the rest of the project, thereby saving valuable time and resources. Additionally, implementing the management program in stages may allow the program to impact any dormant growth habits of the species. Hence, it is possible to effectively and efficiently combat invasive species within the Carolinian Zone of Canada.

As Rondeau Provincial Park represents one of the last remaining examples of the vast Carolinian forests that once existed across Southern Ontario, it is crucial that the invasive non-indigenous species within the park be controlled in order to assist in the propagation of indigenous Carolinian flora. Research into the protection of the remaining remnants of Carolinian habitat through invasive non-indigenous species control will help to ensure not only that vegetation indigenous to Southwestern Ontario is preserved, but also that the community of faunal species which rely on this habitat is also preserved. In this manner, the presence of indigenous Ontario environments will be secured for the enjoyment of future generations.

Acknowledgements

Special thanks to the staff at Rondeau Provincial Park, especially Sandy Dobbyn and Ramsey Hart, for without their support and expertise, this research would not have been possible.

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Monitoring Fire Management of Oak Savanna and Tall Grass Prairie in Rondeau Provincial Park

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Abstract

Rondeau Provincial Park has recently begun a fire management program aimed at restoring significant oak savanna and oak woodland communities. The purpose of this paper is to provide an outline of the monitoring protocols developed as part of an adaptive management framework for the prescribed fire program. These protocols are based on review and recommendations outlined in a background report prepared by North-South Environmental Inc. (2002a) and they have provided to Rondeau Provincial Park in a report that provides detailed field data collection methods and data analysis techniques (North-South Environmental Inc. 2002b).

This paper includes an introduction detailing the following: an outline of site conditions; fire management in oak savanna and oak woodlands; the goal of the fire management program at Rondeau Provincial Park;the indicators selected to assess the management objectives; determination of the required sampling intensity for statistical certainty; the expertise required by staff conducting monitoring; and the monitoring logistics and schedule.

Following the introduction, the monitoring program is summarized to provide an outline of the following:site establishment; establishing sampling transects; and a summary of the objective, rationale, and a brief outline of the methods for each monitoring protocol (please refer to North-South Environmental Inc. 2002b for a detailed description monitoring protocol methods, data collection sheets and analysis methods).

Site Description

Rondeau Provincial Park is located on a cuspate sand spit on the north shore of Lake Erie. Fluctuating water levels have created a series of sand dunes parallel to the north-south orientation of the peninsula. The resulting ridge and trough topography, combined with sandy substrates has resulted in the formation of oak savanna and oak woodland vegetation communities considered uncommon in the province.

The oak savanna communities are located primarily along the eastern and northern edge of the peninsula. The savanna grades into a transitional woodland habitat towards the interior of the peninsula (Ontario Parks, 2001a). Large openings are present in the tree canopy in some areas and prairie species proliferate in many places in the understory.

The oak savanna and oak woodland habitats have in the past been impacted by mowing, planting of aggressive, exotic plant species, fire suppression and grazing by white-tailed deer. Mowing was discontinued in these habitats in 1994 and grazing by white-tailed deer has declined in the 1990s as a result of a culling program. Despite the large degree of disturbance to plant communities in the Park, many features and species indicative of the original savanna environment are still present.

Fire Management

The role of fire in the maintenance of oak savanna and woodlands is well established. The exclusion of fire from the savanna and oak woodland has resulted in an increase in woody vines, shrubs and trees creating a dense, shaded understory which excludes sun-loving prairie forbs and grasses. A century of fire suppression, combined with other impacts such as a large deer population and invasive plants, will mean that a substantial management effort will be required to restore the original character of the savanna and woodland habitats in Rondeau. A long-term management program that includes the application of regular prescribed burns will be a key component of this restoration program. Monitoring changes in savanna resulting from the application of prescribed fire will provide an indication of the response of vegetation to fire management and the degree to which the structural/functional features are being restored/maintained.

Goals, Objectives and Monitoring Indicators for Fire Management

The establishment of clear goals and objectives provides a framework that guides and directs resource management. Goals and objectives that relate back to the mandate and obligations of resource managers provide benchmarks against which the results of management prescriptions can be evaluated, thus providing an adaptive management framework that refines resource management prescriptions. This is particularly important where there is an imprecise knowledge of the effects of management intervention, such as is the case with prescribed fire, and where there are confounding factors, such as invasive exotic species and seasonal variation in climate. In adaptive resource management, monitoring is the tool that demonstrates when management actions are correlated with movement towards or away from goals and objectives. For example, if an objective of fire management is to achieve a particular degree of canopy opening, monitoring will reveal if this is being achieved and this information can be used to guide future burn prescriptions and/or indicate the need for mechanical removal of woody vegetation.

Six indicators have been selected to monitor fire management in Rondeau Provincial Park based on the goal and objectives that have been established in the background report to this document (see Table 1 and North-South Environmental Inc. 2002a). The indicators have been selected based on their ability to provide reliable, quantitative data that can be easily and rapidly collected by summer park staff with limited field experience who are under the direction of a Park Ecologist. The indicator data collected should clearly show whether the objectives of the fire management program are being met by the current prescribed burning or whether a refinement of management is required to meet the objectives.

Table 1. Fire management goal, objectives and corresponding indicators for Rondeau Provincial Park.

Fire Management Goal: *To restore the ecological functions and attributes of the oak savanna, pine-oak savanna and oak woodland habitats in Rondeau Provincial Park through the reduction of woody plants and exotic species, while at the smae time stimulating the production of native forbs, grasses, sedges and tress.*	
Fire Management Objectives	**Fire Management Indicators**
Increase the abundance of native graminoids (grasses and sedges) and forbs typical of oak savanna and oak woodland	indicator species, grasses and sedges
Decrease the abundance of non-native cool season grasses	grasses and sedges
Decrease the abundance of woody species (especially exotic species)	tree sapplings, shrubs, stand composition
Increase the plant and animal diversity of the oak savanna and woodland habitats	species diversity

Determining Sampling Intensity

Monitoring data available from 2000 and 2001 (Hart, 2002) permitted an analysis of the statistical power of quadrat sampling of plant populations at Rondeau using the software package MONITOR, version 6.2 (Gibbs, 1995). This analysis provided an understanding of the ability of the current monitoring program to detect trends in plant abundance over a ten-year monitoring period. The software allows the user to vary the number of monitoring sites and frequency of monitoring (in addition to other parameters), to determine the potential statistical power of the sampling design. A general rule used was to look for power estimates that exceed 0.80 (Gibbs, 1995), meaning that trends would likely be detected greater than 80% of the time.

Gibbs (1995) notes that it is generally easier to detect positive change then negative change over time in populations.

Using the power analysis software with data collected at Rondeau Provincial Park in 2000 and 2001, it was determined that 40 quadrats would detect a 6% negative trend 81% of the time and a 10% negative trend 98% of the time; 30 quadrats would detect a 6% negative trend 70% of the time and a 10% negative trend 93% of the time; and 20 quadrats would detect a 6% negative trend only 27% of the time and a 10% negative trend only 49% of the time. It was concluded from these analyses that 40 quadrats should provide good statistical power at Rondeau to show negative trends in the monitoring data and would provide excellent statistical power to show positive trends.

Expertise

The majority of the fire monitoring program for Rondeau Provincial Park has been designed for implementation by a team of three people. It is expected that the team will be composed of seasonal summer staff with little or no previous experience in vegetation sampling or plant identification. It is anticipated, therefore, that a one or two day training workshop would be held at the beginning of each field season to familiarize the team with monitoring protocols and that pressed plant specimens would be available for training in plant identification. The diversity monitoring protocol outlined below differs from the other protocols in that it is based on data collection by field personnel or researchers that are experts in sampling and identifying select groups of plants and animals.

The monitoring protocols have been selected to minimize errors in data collection. For example, the monitoring of prairie indicator species is based on species that they are highly visible and easy to identify for staff with limited field experience. Also the identification and monitoring of shrubs and trees should not pose serious problems to inexperienced field personnel due to the limited number of species that will be encountered. Where it is recognized that some extra attention and expertise will be required, such as in the identification of willow shrub species, protocols have been outlined for the collection and later confirmation of species encountered in sampling.

The more difficult monitoring protocol from a data collection and more importantly data quality stand point is the determination of grass and sedge abundance. This monitoring protocol is based on percent cover, a measure that has long been documented as having problems due to observer bias. To minimize observer bias, smaller quadrats ($0.25m^2$), visible in their entirety by the human eye, and a modified Braun-Blanquet cover abundance rank method have been used to achieve the highest possible level of consistency in data collection (Masters, 1997).

Monitoring Logistics and Schedule

The monitoring protocols have been developed to permit the completion of all data collection along a single transect before continuing on to the next one. Those indicators sensitive to trampling effects are sampled first. Indicator species and tree sapling abundance are conducted at the same time with one member of the monitoring team walking down one side of the transect line and the two other members of the team walking at the edge of the belt transect. Grass and sedge abundance is conducted on the opposite side of the transect to the previous sampling. Shrub abundance is sampled next as it is unlikely that the trampling effects of the latter sampling will affect shrubs. Stand composition could then be measured last from the centre of each transect.

After a few years of monitoring the field methods will no doubt be refined to make the best possible use of staff and time. It is expected that after five years, the frequency for some monitoring, such as stand composition, should be reviewed. If for example the changes in the stand composition data are not occurring on an annual or bi-annual basis, the time period between conducting sampling for stand composition could be lengthened to once every two years or more.

Monitoring Methods

The first step in establishing a monitoring program is to select a monitoring site such that it is composed of a single vegetation community. The second step is to determine the location and placement of transects for monitoring. The number and length of transects will vary for each monitoring site, however, there are specific requirements for locating transects that will dictate their location in the site and the total length required.

1. Transects must not be within 50 m of a vegetation community edge. This requirement is due to the 'prism sweep' requiring a radius of 50 m as well as a desire to minimize vegetation "edge effects" as much as possible.
2. To conduct the stand composition monitoring protocol there must be a minimum of four transects within each vegetation community. In addition, each transect must be a minimum of 100 m in length and located at least 50 m from any other transect.
3. The monitoring protocol for grass and sedge abundance requires quadrats to be located every 10 m along each transect. Power analysis (see above) allows a determination of the number of quadrats required for monitoring and this will determine a minimum total transect length. For Rondeau Provincial Park, a minimum of 40 quadrats is required to provide statistical power for data analyses and this translates into a minimum total transect length of 400 m.

If the vegetation community being monitored is sufficiently large, then transects could be located randomly within it. Random transects are not practical in Rondeau Provincial Park due to the ridge and trough topography as well as the location of the savanna and woodland communities in a narrow band (400 m wide) along the eastern shoreline of the peninsula. It has been determined that the placement of transects should be perpendicular to the shoreline and thus perpendicular to the ridge and trough topography; in this way sampling will capture the natural variability inherent in this community.

Monitoring Site Establishment

- Select and clearly define the monitoring site (e.g., burn blocks for 2003), noting that a site must be composed of a single vegetation community type.
- Within the monitoring site transects will be established for data collection (see below).
- An accurate map should be prepared to show the location of a monitoring site, including access to the site, the location of sampling transects and other general information that may be useful.
- Complete the site establishment data sheet with information such as observer names, date, site condition, etc.
- Using the Ecological Land Classification manual (Lee *et al.*, 1998) determine and record Habitat Information and Stand Description on a site establishment data sheet.
- Using the ELC manual (Lee *et al.*, 1998) or the field manual for describing soils in Ontario (Denholm and Schut 1993) complete the soil analysis information on the site establishment data sheet. Be sure to locate a soil auger sample within a permanent transect location.
- File paper and/or electronic copies of the site establishment data sheet where it can be located in the future.
- Every five years, briefly review and update where necessary, the site establishment data sheet.

Transect and Plot Establishment

- Define the number and length of transects required for monitoring. In Rondeau this must be achieved through a transect configuration with a minimum of 400 m of transect length, using four transects, each 100m in length.
- Define the number, location and size of quadrats. In Rondeau a minimum of 40 quadrats, 50 cm x 50 cm are recommended; this translated into a quadrat located every 10 m on each of the 100m transects.
- Establish transects by permanently marking the start and end locations with steel rods inserted into the ground with approximately 10 cm of

rod exposed above the soil.

- Paint the top of the steel rods with bright coloured spray paint to assist in re-location in future years.
- Determine the exact position (UTM grid coordinates) of the start and end locations using a Global Position System (GPS) unit. Differential correction of GPS readings should be considered to obtain sub-one metre accuracy.
- Take a compass bearing of the direction the transect follows from start to the end.
- Take a photograph from the start location along the length of the transect directly towards the end location. This photograph should be taken from a tripod with the lens 1.6m from the ground using a standard 50mm or 55mm lens.
- File paper and/or electronic copies of the transect establishment data sheet where they can be located in the future.
- Every five years, briefly review and update where necessary, the transect establishment data sheet.

Monitoring Protocol 1 - Plant Indicator Species

Objective

To monitor the change in the presence and abundance of native forbs typical of oak savanna and oak woodland communities.

Rationale

Sampling a few relatively easy to identify forb indicator species will provide information on how savanna forbs are responding to fire management. The indicator plants selected are species typical of oak savannas and woodlands. These species may not currently be present within all the transects, as the current vegetation communities being sampled have dense tree canopies due to past fire exclusion. However, by monitoring species that are expected to increase in frequency when the tree canopy opens, the restoration of the woodland and savanna communities can be tracked. Frequency sampling is considered highly objective, repeatable, rapid and simple, involving a minimum number of decisions limited to identifying a few easily recognizable indicator species and determining whether or not a particular individual is rooted within the belt transects.

Methods

- Monitoring is conducted along 2m wide belt transects with permanently marked start and end points (see site and transect establishment).
- A minimum 400m total transect length is recommended. For Rondeau,

four transects 100m in length are recommended.

- Sampling should be conducted once a year in August, at the peak of native forb flowering.
- Stretch a tape measure or rope marked in centimetre increments between the start and end points of the transect stakes as close to the ground as possible with the zero mark aligned with the start stake. Do not allow vegetation to deflect the alignment of the tape.
- Using a wooden dowel 2m in length (the centre point marked with a notch or permanent ink) or another suitable measuring stick two people walk along either edge of the wooden dowel, looking in towards the transect line searching for and recording any of the following indicator specimens:

  - butterfly weed (*Asclepias tuberosa*);
  - wild bergamot (*Monarda fistulosa*);
  - blazing star (*Liatris cylindracea*);
  - Canada tick-trefoil (*Desmodium canadense*);
  - pointed leaved tick-trefoil (*Desmodium glutinosum*);
  - round-headed bush-clover (*Lespedeza capitata*);
  - woodland sunflower (*Helianthus divaricatus*);and,
  - starry false Solomon's seal (*Maianthemum stellatum*).

Monitoring Protocol 2 – Tree Saplings

Objective

To monitor the change in the abundance of woody species (especially exotic species) within the oak savanna and oak woodland communities.

Rationale

Sampling the abundance of tree saplings within the savanna and woodland habitats will provide direct information on the change in abundance of woody species as well as indirect information on changes in community composition. Frequency sampling is considered highly objective, repeatable, rapid and simple, involving a minimum number of decisions limited to identifying a few easily recognizable species and determining whether or not a particular individual is rooted within the belt transect.

Methods

- Monitoring is conducted along 2 m wide belt transects with permanently marked start and end points (see site and transect establishment). A minimum 400 m total transect length is recommended. For

Rondeau, four transects, 100 m in length are recommended.

- Sampling should be conducted once a year in August. This monitoring protocol should be conducted in conjunction with Monitoring Protocol 1 - Indicator Species.
- Using a wooden dowel or other suitable measuring stick 2 m in length (the centre point marked with a notch or permanent ink) two people walk along either edge of the wooden dowel, looking in towards the transect line searching for any tree saplings (trees with DBH >2 cm and <10 cm).
- Record by dot (or dash) count tally on the data sheet, the number of saplings for each tree species that are rooted within the belt transect. Record the total number of counts made for each species per transect.
- Confirm the identification of the tree species. If the identification is not positive use a unique, tentative identification on the data sheet and collect a specimen for later identification. Attempt to determine the identification of as many dead tree saplings as possible to the species level.
- Continue until the end of the transect is reached.

Monitoring Protocol 3 - Abundance of Grasses and Sedges

Objective

To monitor the change in the abundance of native graminoids (grasses and sedges) and non-native cool season grasses in oak savanna and woodland communities.

Rationale

Monitoring the change in cover of graminoid species along a transect will provide an indication of changes in the understory of the savanna and woodland restoration sites. Changes in graminoids will provide information on whether the tree canopy is opening up as a result of prescribed fire as well as how subsequent fires will behave (understory composition or grasses and sedges is related to the fine fuels in prairies and savannas a factor that effects the rate of spread and heat attained during a fire). While monitoring plant cover and identifying graminoids to species is not simple, the use of small quadrats (0.25 m^2) and a cover abundance index instead of direct percent cover should reduce the amount of error associated with estimating cover, and capture only the most abundant graminoid species, reducing identification errors.

Methods

- Monitoring is conducted in minimum of forty, 50 cm x 50 cm quadrats located at 10 m intervals along each 100m transect.
- Sampling should be conducted once a year in August. After the first

year of monitoring if it is determined that identification of cool season grasses is not feasible, then consideration should be given to conducting sampling in July.

- Place a 50 cm by 50 cm quadrat frame open on one side at the designated monitoring interval beginning at the start of transect and every 10m along the transect. The quadrat frame should be placed perpendicular to the transect line, on the left-hand side of the transect, with the rear right-hand corner of the frame aligned with the designated interval on the transect line.
- Determine the identification of each grass and sedge rooted in the quadrat, to the species level. If an identification is not possible in the field use a unique, tentative identification on the data sheet and after the data is collected for the quadrat, collect a specimen for later identification.
- Assign each species rooted in the quadrat a cover abundance rank as described on the data sheet. Only one rank is given to each species per quadrat.

Monitoring Protocol 4 - Abundance of Shrubs

Objective

To monitor the change in the abundance of woody species (especially exotic species) within the oak savanna and woodland communities.

Rationale

The exclusion of fire from fire regenerated ecosystems will often lead to the proliferation of woody plants, particularly shrubs, creating shade that excludes the growth of sun-loving prairie grasses, sedges and forbs. Sampling the cover of shrub species within the savanna and woodland habitats will provide direct information on the change in abundance of woody species as well as indirect information on changes in community composition. The line intercept method is considered well suited for estimating cover of shrubs (Smith, 1980; U.S. Forest Service, 2002).

Methods

- Monitoring is conducted directly along the length of each transect.
- Sampling should be conducted once a year in August.
- Re-locate the transect start and end locations in the field. If the stakes have become difficult to locate re-apply spray paint to the tops.
- Beginning at the zero mark, and walking down the left hand side of the transect line, proceed down the length of the transect until a shrub is encountered that is touched by the transect line or lying under or over it. If a shrub thicket is encountered each shrub species should be

considered separately. Do not consider woody vines (riverbank grape, Virginia creeper) or tree saplings or seedlings.

- Determine the shadow, or distance covered by the downward projection of foliage, onto the transect line in centimetres. Be sure not to inadvertently move the tape or exclude any shrubs.
- Determine the identification of each shrub to species. If identification is not possible in the field use a unique, tentative identification on the data sheet and after the data is collected for the shrub collect a specimen for later identification.
- For each shrub encountered, record on the data sheet the shrub species, the point on the transect line (in centimetres) where the shadow or foliage projection starts and where it ends.
- Continue until the end of the transect is reached.

Monitoring Protocol 5 - Stand Composition

Objective

To monitor change in the abundance of woody species (especially exotic species) within the oak savanna and oak woodland communities.

Rationale

Stand composition, both tree species abundance as well as the basal area of the site, can provide information on changes in the tree canopy of the savanna and woodland communities. This protocol is based on the prism sweep method, which is relatively straightforward with limited decision making to introduce error in the data.

Methods

- Monitoring is conducted at the centre point of each transect (minimum 100 m in length).
- Sampling should be conducted once a year in August.
- A 'prism sweep' is conducted at the central point on each transect (50m mark) using a wedge or cruising prism with a 2x prism factor. The wedge prism is calibrated such that a prism sweep will include trees in the tally based on a combination of their distance from the sampling point and the diameter of trees in the field of view. The ELC manual (Lee *et al.*, 1998) outlines detailed methods for the use of a wedge prism.
- Record by dot (or dash) count tally-the number of individuals for each tree species encountered in each prism sweep. A single tally count is made for each species per sweep.
- Determine the identification of each tree to species. If identification is

not possible in the field use a unique, tentative identification on the data sheet and collect a specimen for later identification. Dead trees are counted and should be identified if possible.

Monitoring Protocol 6 – Plant and Animal Species Diversity

Objective
To monitor changes in the diversity of plants and animals inhabiting the oak savanna and oak woodland communities.

Rationale
Biodiversity, the different kinds of plants and animal populations present in a community, will provide information on the overall health of the prairie and oak savanna communities. With conscientious long-term tracking of the presence/absence of all species within a site (vegetation community), changes in the overall plant and animal species composition of the community will become apparent.

Methods
- Monitoring is conducted throughout each site (vegetation community).
- Observations are made throughout the year, whenever feasible and is when best suited for certain species observations.
- Create a database (checklist) of the plant and animal species present in each site (vegetation community).
- This database could be produced using plant and/or animal observations collected as part of other research and monitoring studies (e.g., Forest Bird Monitoring, small mammal trapping, *etc.*) or as part of normal park operations.
- If plant and animal observations for the site (vegetation community) are not available, a comprehensive survey will be required to produce one.
- Individual(s) with detailed knowledge of the park should compile all of the observations from research and monitoring studies as well as casual observations on an annual basis. Any questionable observations should be confirmed before they are entered into the database. Observations of any species that are not already in the database for the site need to be confirmed with a specimen (in the case of a plant) or by a recognized expert for animal species.
- Every five years, individuals with detailed knowledge of the site should review information gathered over the five year period and summarize changes in the animal and plant species composition of the site (vegetation community).

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Red Cedar Savanna:
A Disappearing Habitat at Point Pelee National Park

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Abstract

To assess the change in habitat of red cedar savanna (RCS) at Point Pelee over time, we compared geo-referenced historic air photos (1931, 1959, 1973, 1985 and 2000) using Geographic Information Systems (GIS). Red cedar savanna is a critical habitat for more than 25 % of the potential Species at Risk (SAR) of Point Pelee. It is an early successional community of mainly grasses and scattered trees that rely on frequent disturbance.

By analyzing historic air photos we have found that RCS has decreased in area by 37 % since 1931, with most of the change occurring between 1959 and 1973 due to natural forest succession. Large areas of RCS along the western shoreline of Point Pelee have developed into more shade tolerant hardwoods, mostly eastern hackberry (Celtis occidentalis). *This large drop in coastal red cedar savanna was somewhat offset by the increase of interior red cedar savanna created by the abandonment of agricultural and cottage sites during the 60s and 70s. Small declines in RCS habitat were due to shoreline erosion mostly occurring during the high water years of the 1970s. The west side of Point Pelee has been relatively stable since 1931, and has maintained a thin strip of RCS along the back beach area.*

We predict that the RCS habitat found in the interior of Point Pelee will likely disappear within the next 20 years without active management. The red cedar savanna along the shoreline will continue to persist, but is highly dependent on shoreline disturbance and the accretion of sand for its continued existence.

Introduction

Point Pelee is located in the extreme south of Canada and is considered a part of the Carolinean or Northern Hardwoods Forest Zone. The regional context of Point Pelee is shown in Figure 1. Point Pelee National Park protects 15 km^2 of marsh and forest as well as Middle Island 25 km to the south. Over 2/3^{rds} of Point Pelee is marsh, with the dry land forest, swamp forest, beach and red cedar savanna making up the remainder of the habitat types.

Kavanagh and McKay-Kuja (1992) (from Geomatics International Inc., 1994) described red cedar savanna (RCS) as a community where the principle arboreal species is red cedar *(Juniperus virginiana)*. The community is most widespread on dry sand substrate, usually on sand dunes where the associated tree species may include cottonwood *(Populus deltoides)*, hackberry *(Celtis occidentalis)*, and black oak *(Quercus velutina)*. It is an early successional habitat with sparse tree cover. Another name commonly associated with this type of habitat is sand prairie. The dominant grasses and herbs are characteristic of open prairie-like habitats such as little bluestem *(Andropogon scoparius)*, panic grass *(Dicanthelium acuminatum)*, and lyre-leaved rock cress *(Arabis lyrata)*.

Red cedar savanna in Point Pelee can be broken into two general habitat types (from Geomatics International Inc., 1994);

1) Coastal RCS: a thin area along the west and east beach of Point Pelee. Wind and wave action and the movement of sand create this habitat. High water levels and storm events can also destroy this habitat.

2) Old field RCS: found in the interior area of the park. This habitat type develops after cottage removal and farmland abandonment on sandy soils. Over time these areas are colonized by later successional species.

The red cedar savanna found at Point Pelee has been studied extensively due to its high numbers of endangered and rare species. In fact, of the 66 potential SAR (Species at Risk) found at Point Pelee at least 25% require savanna habitats (Table 1). SAR that require savanna habitat include: hop tree *(Ptelea trifoliata)* (SP-Special Concern), prickly pear cactus *(Opuntia humifusa)* (EN-Endangered), and prairie rose *(Rosa setigera)* (SP)(Table 1). As well many extirpated SAR species require savanna habitats including: blue racer *(Coluber constrictor)* (EN), hog-nose snake *(Heterodon platirhinos)* (SP), and eastern prairie fringed orchid *(Platanthera leucophaea)* (SP)(Table 1). This habitat also contains many provincially rare species such as green milkweed *(Asclepias viridiflora)*, wild potato vine *(Ipomoea pandurata)* and linear-leaved puccoon *(Lithospermum incisum)*.

RCS is a regionally rare habitat and is classified as extremely rare in Ontario (NHIC, 1996). Only small patches of RCS remain in Southwestern Ontario owing to habitat destruction due to pressures from human development. Protected areas of RCS are found on Pelee Island, Long Point Wildlife Refuge and Pinery Provincal Park. Park managers and biologists at Point Pelee recognize that the presence of red cedar savannah is vital to protecting and/or reintroducing many SAR and provincially rare species.

This project aims to quantify the amount of RCS found in the park since 1931 and determine how much has been lost to forest succession or shoreline erosion and how much has been gained from old field abandonment or shoreline colonization.

Figure 1. A map of southwestern Ontario showing Point Pelee National Park.

Methods

The first task of this project was to create five air photo mosaics for each of the air photo sets from 1931, 1959, 1973LS(large scale), 1973SS(small scale), and 1985. Each air photo set was taken at a different scale, altitude, and focal length (Table 2).

All air photos sets were scanned at 400 dpi using a flatbed scanner and saved in .jpg format. Each photo was then imported into Orthoengine (PCI) and geo-referenced using the 2000 Point Pelee basemap. The accuracy of the 2000 air photo basemap is approximately 1 m and has a 12 cm pixel resolution. All air photographs, with the exception of the 1985 photo series, were flown in the late winter or early spring before leaf out; this made it easier to identify individual red cedar.

All red cedar savanna polygons were delineated in ArcView 3.2 ESRI. The criterion for selecting red cedar savanna was based on two factors: 1) the presence of scattered mature red cedar; or, 2) the presence of scattered immature red cedar with

Table 1. Species at risk that require savanna or early successional habitat.

Park Rank[1]	Common Name	Sceintific Name	COSEWIC Status
PRE	Eastern Prickly Pear Cactus	*Opuntia humifusa*	Endangered
PX	Blue Racer	*Coluber constrictor*	Endangered
PX	Northern Bobwhite	*Colinus virginianus*	Endangered
PX	Timber Rattlesnake	*Crotalus horridus*	Extirpated
PE?	Climbing Prairie Rose	*Rosa setigera*	Special Concern
PRE	Blue Ash	*Fraxinus quadrangulata*	Special Concern
PRE	Common Hop-tree	*Ptelea trifoliata*	Special Concern
PRE	Dwarf Hackberry	*Celtis tenuifolia*	Special Concern
PRE	Eastern Yellow-breasted Chat	*Icteria virens*	Special Concern
PRE	Five-lined Skink	*Eumeces fasciatus*	Special Concern
PRE	Monarch	*Danaus plexippus*	Special Concern
PX	Eastern Hognose Snake	*Heterodon platirhinos*	Special Concern
PX	Eastern Prairie Fringed Orchid	*Platanthera leucophaea*	Special Concern
PRE	Eastern Fox Snake	*Elaphe vulpina*	Threatened
PX	Black Rat Snake	*Elaphe obsoleta*	Threatened
PX	Eastern Massasauga Rattlesnake	*Sistrurus catenatus*	Threatened

PRE : Present; PX: Extirpated; PE: Probable

Table 2. Air photo series used to create park mosaics.

Name	Roll no.	No. of Photographs	Scale (Approx.)	Date Flown	Altitude (ft)	Focal Length (mm)
1993	A3272	50	1:10500	4/18/31	2070	152.7
1959	A16449	111	1:4300	4/4/59	2575	152.8
1973LS	A23123	32	1:9200	13/01/73	5370	152.7
1973SS	A23123	32	1:9200	13/01/73	2070	152.7
1985	B30305	7	1:30300	NA/85	8840	152.1
2000	ERCA	N/A	1:6250	4/1/00	N/A	N/A

open patches of sand and/or grass. All open areas with some red cedar present were included in the calculation, although it should be acknowledged that some of these areas may not be considered prime RCS. Areas that were completely closed in with red cedar, shrubs or trees were not mapped as RCS, although if an area contained small pockets of shrubs of rough-leaved dogwood (*Cornus drummondii*) and staghorn sumach *(Rhus typhina)* the whole area was considered RCS. Areas where large patches (>0.5 ha) of shrub cover occurred were not considered RCS. Photo interpretation was done on screen and with a stereoscope using the hard copies (stereo-pairs) of the original air photos. Historical accounts of the vegetation of Point Pelee (i.e., Dodge, 1914; Maycock, 1977; and Geomatics,1994) were used to help delineate RCS areas. The total change in area (in hectares) of RCS from year to year was calculated using ArcView with Xtools extension and graphed using MS Excel.

Results and Discussion

Using the historic airphotos a map of RCS habitat was created for each year (1931, 1959, 1973 and 2000). A map of the distribution of RCS for each year is shown for 1931 (A), 1959 (B), 1973 (C) and 2000 (D). From 1931 to 2000 RCS dropped 84.2 ha or a drop of 37 % (Table 3).

Between 1931 and 1959, a large area (106.4 ha) of RCS remained stable, with only small losses or gains to forest succession (Table 4). There was little loss of RCS to succession during this period since most of the RCS was immature and growing on the sand dunes of the west shore or in recently abandoned farmland near the tip.

During the next period from 1959 to 1973, a large portion (approximately 100 ha) of RSC habitat along the western dunes succeeded into eastern hackberry forest (Table 4)(Figure 2). Because of the shade intolerance of red cedar it quickly died under the shade of the hackberry. Presently parts of this area are now succeeding into sugar maple *(Acer saccharum)* and ash *(Fraxinus)* forest as the eastern hackberry reaches its maximum life span of 100 years and begins to die.

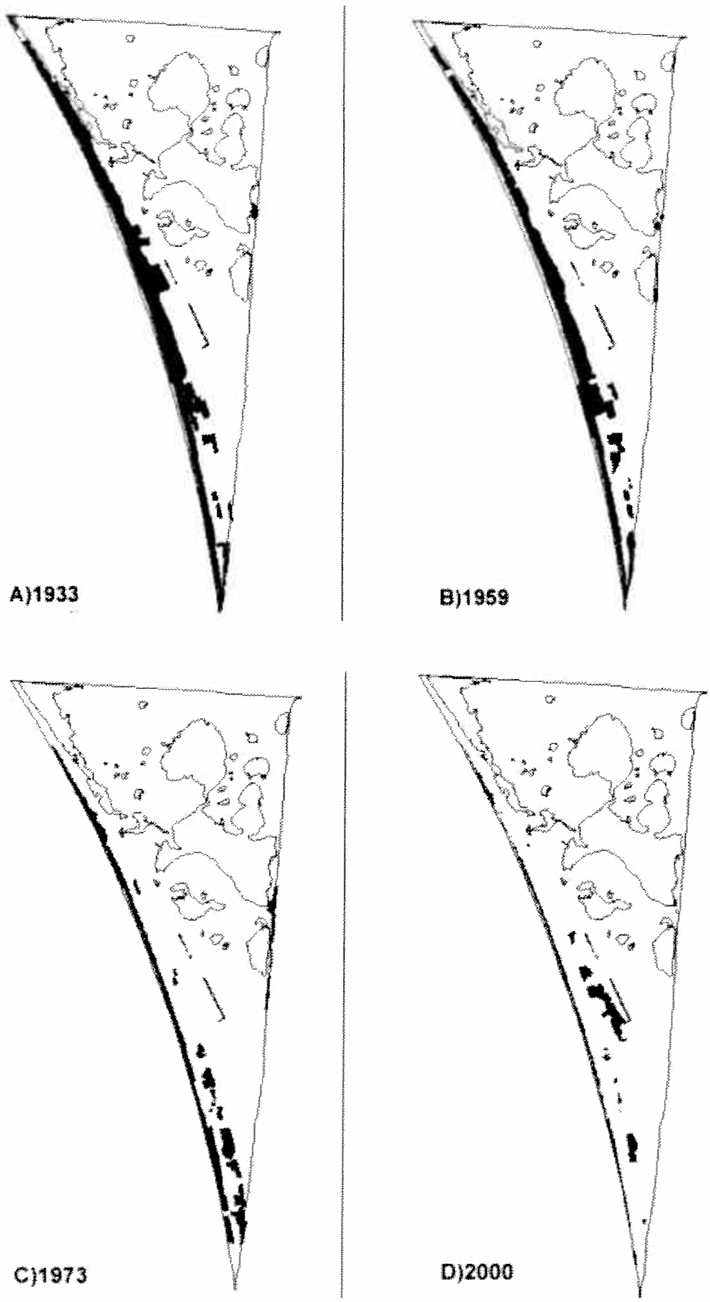
Table 3. Total change in RCS habitat at Point Pelee National Park since 1931.

Year	Total RCS	Period Change (ha)	Cumulative Change (ha)
1931	132.9	n/a	n/a
1959	130.1	-2.9	-2.9
1973	62.7	-67.4	-70.3
2000	48.8	-13.9	-84.2

Table 4. Origin of red cedar savanna habitat for three time periods (1931-1959), (1959-1973) and (1973-2000) and the overall origin (1931-2000).

Time Period	RCS created from Beach (ha)	RCS created from old field (ha)	Unchanged RCS (ha)	RCS Lost to Succession (ha)	RCS lost to Erosion (ha)
1931-1959	12.2	11.8	106.4	25.0	1.6
1959-1973	21.7	11.5	29.5	100.2	0.4
1973-2000	3.9	18.8	26.1	31.5	5.2
Total Change in RCS 1931-2000	**21.9**	**24.9**	**2.0**	**127.0**	**3.9**

Figure 2. The distribution of red cedar savannah (shown in black) at Point Pelee National Park a) 1931, b) 1959, c) 1973, and d) 2000.



SCALE: approximately 2 cm = 1 km

Between 1973 and 2000 much of the abandoned farmland developed into the old field RCS that we see today. The disturbance caused by farming in very sandy soil created excellent habitat for RCS species. One such area is found north of Delaurier House, one of the sites where red cedar savanna was burned in 1998 (Falkenberg, 2000). The large amount of area naturalized during the 1970s offset some of the losses of RCS due to forest succession (Table 4)(Figure 2). However, the total red cedar savanna area in the park dropped by 14 ha during this period (Table 4).

High water levels during much of the 70s and 80s saw a drop in the coastal RCS along the east side of Point Pelee (Table 5)(Figure 2). The east beach savannah area had developed from bare sand present in the 1930s. By the late 1960s, the savanna area was open grassy area with scattered red cedar. This large amount of the RSC found on the east side of the tip was completely washed away between 1973-1978. By digitizing the shoreline for each air photo mosaic we see an overall decrease in the size of Point Pelee since 1931. In fact, the overall size has decreased from 1553.7 ha in 1931 to 1488.1 ha in 2000 (excluding Middle Island). That is an overall decrease in total park size of 65 ha or 4.4 % since 1931. Most of the decline is due to losses on the east side of Point Pelee with the west beach remaining relatively stable.

Table 5. The total change in the park size, beach area, and beach as % of the park. Negative values indicate a drop in land area (erosion). Positive values indicate an increase in area (accretion). The average water level of Lake Erie for the month the air photo was flown is also given.

Year	Total Park Area (ha)	Total Beach Area (ha)	Beach as % of Park	Change in Park Area from previous Year (ha)	Water Level (Ft.)
1931	1553.749	88.194	5.68	-	173.84
1959	1524.337	35.524	2.33	-29.4	173.96
1973	1506.66	19.265	1.28	-17.7	174.66
1985	1475.522	24.232	1.64	-31.1	174.73
2000	1488.11	41.097	2.76	12.6	173.98

In the future, park managers must decide whether savanna-type habitat should be actively maintained in the interior areas of the park. Test plots burned at DeLaurier and the Nature Preserve indicated that intensive management would be required to reach desired results (Falkenberg, 2000). The native seed bank in each of these areas is virtually non-existent and transplants would have to be used to re-introduce some RCS species (Falkenberg, 2000). Since the park is small and has a diversity of communities, it is important that the park set out clear vegetation management objectives for the future. Clearly enhancing red cedar savanna is beneficial for many existing SAR and possible SAR re-introductions such as the blue racer. A study looking into the potential re-introduction of the blue racer have concluded that too little savanna habitat presently exists to support its recovery (M'Closkey and Hecnar, 1997).

Conclusions

In conclusion, the historic mapping of RCS habitat has spatially documented a dramatic decline in RCS in the past 70 years. Large amounts of RCS have disappeared due to forest succession, and to a smaller extent, shoreline erosion. New RCS habitat has developed in recently abandoned farmland, and along the western shoreline. In the future, the old field RCS areas will likely disappear due to forest succession in the next 30 years. Since RCS is important for many rare and endangered species more work needs be done to record the floral composition of all of these areas. We recommend a detailed assessment of each RCS area by well-trained botanists to determine its health relative to other patches.

If park managers decided to restore large portions of Point Pelee to RCS, a large amount of time and money would be required. We recommend that a small test area near the Visitor Centre be used for red cedar savanna research and education purposes.

We also recommend a workshop with local experts to determine the vegetation management objectives of the park. Currently the only disturbance maintaining RCS in the park is shoreline disturbance. More research should be done to better understand whether shoreline disturbance alone could maintain a viable RCS community at Point Pelee, or whether active restoration techniques like burning should be employed. Since RCS is so closely tied to water levels, disruption in sand movement along the coast, caused by shoreline development, may be having a negative impact on the long-term survival of coastal RCS habitat.

Acknowledgements

Funds for this project were provided [in part] by the Parks Canada Species at Risk Recovery Fund, a program supporting the National Strategy for the Protection of Species at Risk.

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The Status of Turtles in Point Pelee National Park: Species Loss and Shifting Population Structure

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Abstract

Point Pelee National Park (PPNP) was historically the location of the greatest turtle diversity in all of Canada. Recently there have been concerns regarding population declines and possible extirpation of several turtle species found at PPNP. Our objectives were to examine the status of turtle species at PPNP and causes of declines. A total of 510 turtles were marked in 2001: 305 painted, 145 snapping, 40 Blanding's, 11 map, and 9 stinkpot. No spotted turtles or spiny softshells were observed during this study. Populations of painted and snapping turtles still appear to be large but are significantly male-biased. Painted, snapping, and Blanding's populations have significantly top-heavy age structures. The distribution of carapace lengths (≈age) in 2001 when compared to data from 1972 suggests that there has been a significant shift toward older age classes for both the snapping and Blanding's turtles.

Introduction

Parks in Canada play an important role in protecting our natural ecosystems. However, despite over 100 years of protection there have still been declines and losses in many of the reptile and amphibian populations. Point Pelee National Park (PPNP) was the first national park in Canada to be created for it's biological importance (Crowe, 1999). It remains an important area for natural heritage because it contains substantial areas of two ecosystems that are of conservation concern: Carolinian forest and a deep freshwater coastal marsh. Historically PPNP was the location of greatest turtle diversity in all of Canada. Seven native species and three introduced species have been reported to occur in PPNP (Table 1). Recently there have been concerns of population declines and possible extirpation of a number of the turtle species found at PPNP. Turtles are of conservation concern in many areas worldwide. The most important threats to the status of turtles include: habitat loss, population isolation, subsidized predators, road mortality, collection as pets, interactions with exotic species, human recreation, disease, and effects of contaminants (Klemens, 2000). All of these threats could be affecting the turtles at Point Pelee. DDT concentrations in PPNP exceed the Ontario Ministry of Environment limits for DDT for Recreational/Parkland land use (Crowe, 1999). The effects of DDT on turtles at PPNP is not known. Previous studies in PPNP suggest that predation (mostly by raccoons) upon turtle nests is very high (Rivard and Smith, 1973; Kraus, 1991; Whitehead, 1997). Past attempts to protect turtle nests from raccoons have failed (T. Linke, pers. com.). Rivard and Smith (1973) recommended that a thorough study of turtles at PPNP be conducted, however until now that has not been done. The objectives of our study were to determine the status of turtle species at PPNP and to investigate possible causes of population declines. Specific objectives were to examine: (1) population size, structure, and distribution of turtles; (2) experimental nest protection methods; and, (3) to collect turtle eggs for contaminant analysis.

Table 1. List of turtle species that have occurred in Point Pelee National Park.

Scientific Name	Common Name	Conservation Status[1]
Chrysemys picta	Painted Turtle	
Graptemys geographica	Common Map Turtle	
Emydoidea blandingii	Blanding's Turtle	Threatened[2,3]
Clemmys guttata	Spotted Turtle	Special Concern[3]
Clemmys insculpta	Wood Turtle	Special Concern[3]
Sternotherus odoratus	Stinkpot	
Chelydra serpentina	Snapping Turtle	
Apalone spinifera	Spiny Softshell	Threatened[1,3]
Terrapene carolina	Eastern Box Turtle	
Trachemys scripta	Pond Slider	

[1]COSEWIC, 2001. [2]Threatened in Nova Scotia. [3]Status tracked in Ontario by the OMNR-NHIC.

Methods

Visual surveys were conducted from 29 April to 21 June 2001 and 16 sites for trapping were selected based on these surveys. Thirteen sites were in the park, one boarding the northern boundary, and two sites at Hillman Marsh. Mark-recapture methods were used to determine the population sizes of turtle species present. Baited hoop traps, basking traps, folding live traps, and hand captures were used to capture turtles. Captured turtles were marked, measured, sexed, and released at the site of capture. Sex ratios and age structure were compared to those reported in the literature and for Pelee (Rivard and Smith, 1973). Turtle nests were searched for from 23 May to 30 June 2001. Three eggs from each nest were collected for contaminant analysis. Nests were protected from predation using a variety of experimental methods (see Results-Table 2).

We compared observed data with expected results using *G*-tests with William's correction applied (Sokal and Rohlf, 1995). Spearman's rank correlation was used to compare abundance ranks of species captured by Rivard and Smith (1973) to our results. The distribution of carapace lengths for 1972 and 2001 were tested for normality using the Lilliefor's method in the Kolmogorov-Smirinov one sample test (SYSTAT®, version 9). The data was not normal and could not be normalized by transformation so we used non-parametric analysis. The carapace lengths of 1972 were compared to 2001 using a Wilcoxon test. We used a Kolmogorov-Smirnov two sample test to compare the shape and position of carapace length distributions from 1972 to 2001. This enabled us to determine if the age-size structure has shifted over the past three decades. Turtles from Hillman marsh were excluded from analysis.

Results

A total of 510 turtles (305 painted, 145 snapping, 40 Blanding's, 11 map, and 9 stinkpot) were marked from 5 May to 24 August 2001. No spotted turtles or spiny softshell were observed during this study. We can not determine population size yet because only a small number of recaptures were obtained. Species abundance ranks were the same in 2001 as 1972 for extant species, however box turtles and spotted turtles were not found in 2001 (r_s=0.982, n=7, p<0.02). Comparing ratios of turtle captures indicated that Blanding's and snapping turtle abundance compared to painted turtle abundance was greater in 1972 than 2001.

Populations of painted (2.46♂:1♀) and snapping turtles (1.84♂:1♀) still appear to be large but are significantly male-biased (G=41.31, n=225, p<0.001 and G=10.74, n=122, p<0.005, respectively). Blanding's were significantly female-biased (1♂:3.8♀; G=10.45, n=29, p<0.005). Compared to 1972 data, painteds were significantly more male-biased (G=8.531, n=225, p<0.005), Blanding's significantly more female-biased (G=5.66, n=29, p<0.025), and snappers were virtually the same (G=0.0004, n=122, p>0.05).

Painted, snapping, and Blanding's populations were found to have a significant top-heavy age structure (G=41.31, n=238, p<0.001; G=43.30, n=125, p<0.001; and G=7.27, n=30, p<0.01, respectively). The distribution of carapace lengths (≈age) in 2001 when compared to data from 1972 suggests that painted turtle age structure is similar (Figure 1), but there has been a significant shift toward older age classes for both the snapping and Blanding's turtles (Figures 2 and 3).

Figure 1. Distribution of painted turtle carapace lengths (representing age). Turtles captured in 2001 are shown in black and 1972-1973 in grey. Statistics: Kolmogorov-Smirnov and Wilcoxon ($D=0.063^{ns}$, $z=0.025^{ns}$, $n_{1972}=120$, $n_{2001}=238$).

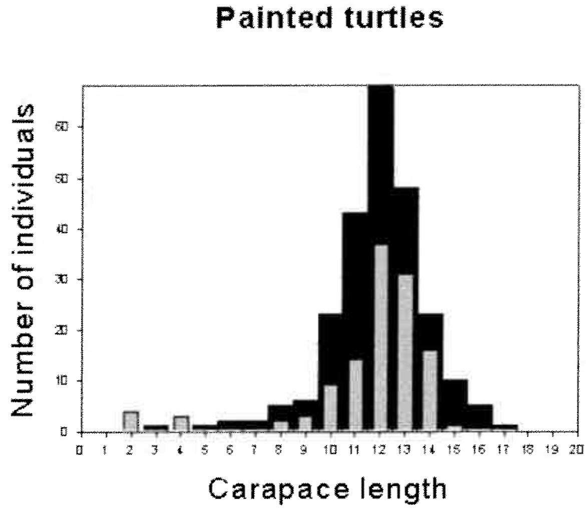


Figure 2. Distribution of snapping turtle carapace lengths (representing age). Turtles captured in 2001 are shown in black and 1972-1973 in grey. Statistics: Kolmogorov-Smirnov and Wilcoxon ($D=0.424^{***}$, $z=5.074^{***}$, $n_{1972}=93$, $n_{2001}=126$).

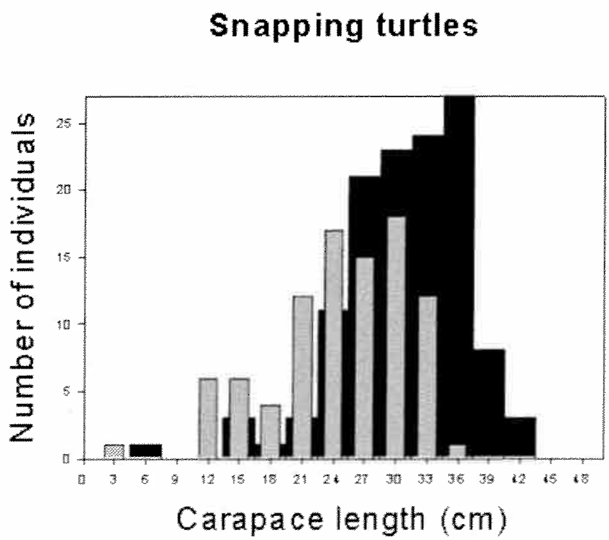
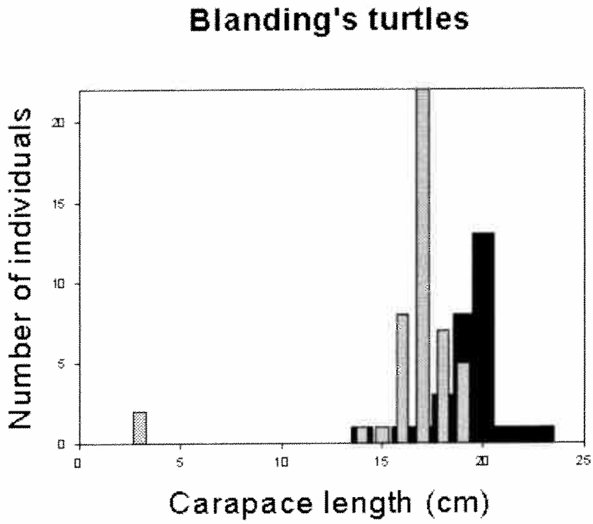


Figure 3. Distribution of Blanding's turtle carapace lengths (representing age). Turtles captured in 2001 are shown in black and 1972-1973 in grey. Statistics: Kolmogorov-Smirnov and Wilcoxon ($D=0.748^{***}$, $z=4.209^{***}$, $n_{1972}=46$, $n_{2001}=30$).



A total of 44 turtle nests were found (39 snapping, 4 painted, and 1 map) between June 2 and 23, 2001. A combination of wire-screen topped boxes and pepper spray was found to be effective in eliminating predation (Table 2). Predation pressures appear to be greater on snapping turtle nests than for painted or map (Tables 2, 3).

Discussion

Despite just one year of study, substantial evidence exists to suggest that there are several serious conservation concerns regarding turtles in Point Pelee National Park. The lack of recent records for the spotted turtle and spiny softshell suggests that extirpations have taken place. Although the spiny softshell was never common in PPNP, the spotted turtle was reported to be "equally represented as painted turtles" in early herpetofaunal surveys (Patch, 1919). Therefore, this is a substantial loss for the turtle community. Map and stinkpot turtles still exist in the park, however they are not common. We did not capture enough of either of these species to examine population structure. None of the three introduced species were found, therefore, it appears that none have established populations. This rules out the possibility that declines are caused by exotic species competing with natives.

Table 2. Type of nest protection and the outcome of the treatment for snapping turtles in five different locations.

Treatment	Outcome	Location: Roads	Blue Heron	Camp Henry	North Bound.	East Beach
Cayenne	not predated	0	0	0	0	2
Cayenne and objects	not predated	0	0	0	0	1
Box and cayenne	not predated	5	0	1	0	2
Box and pepper spray	not predated	7	0	3	11	0
Large box and pepper spray	not predated	0	1	0	0	0
Box and cayenne	predated	1	2	0	0	0
Cayenne	predated	1	0	0	0	0
Nothing	predated	2	0	0	0	0

Table 3. Type of nest protection and the outcome of the treatment for Emydid turtles in three different locations.

Treatment	Outcome	Location: Roads	North Boundary	East Beach
Box and Cayenne	not predated	0	0	1
Cayenne and objects	not predated	0	0	1
Nothing	not predated	1	2	0

Of the extant species there are serious concerns because of top-heavy age structures. Data from 1972 suggests that these concerns already existed (Rivard and Smith, 1973), and have worsened over the past three decades for Blanding's and snapping turtles. The majority of individuals had carapace lengths of 24-30 cm (snapping turtles) and 17 cm (Blanding's) in 1972, and 36 cm and 20 cm, respectively in 2001. It is possible that these may actually be the same turtles. Therefore, if these trends continue the majority of the population will likely die of old age within another three decades. It appears that recruitment is limited to such an extent that it will not permit the continued existence of these two species. A significantly greater male bias in painted turtles in 2001 than 1972 may mask a shifting age structure because male turtles typically have smaller carapace lengths than females. Although species abundance ranks are the same now as they were three decades ago, the number of captures indicate that snapping and Blanding's abundance has declined relative to painted abundance. Capture numbers were greater in 2001 than 1972 because trapping efforts were much greater in 2001.

Sex ratios were biased for all three species. It is possible that these biases may be normal for these populations. The female bias in the Blanding's population is consistent with other populations reported in the literature (Ernst *et al.,* 1994). However, the painted turtle population is significantly more male-biased than it was 30 years ago and has a greater male bias than other populations (Ernst *et al.,* 1994). A male bias may be caused by females being killed on roads while they are searching for nesting sites. Painted turtles would likely be more susceptible to road mortality because of their smaller size.

Past attempts to protect turtle nests with protective boxes have failed because raccoons were persistent and dug under the boxes (T. Linke, pers. com.). The combination of protective boxes and pepper spray (vegetable oil and cayenne pepper) was found to be 100% effective. Our observations are consistent with earlier reports of high predation on nests which suggests that juvenile recruitment may be insufficient to sustain turtle populations. Predation pressures appear to be much greater for snapping turtles than painted. This may explain why a shift in age structure was observed for snapping but not painted populations.

It appears that predation upon turtle nests is limiting recruitment to such an extent that snapping and Blanding's populations may not be sustained. However, further study is necessary to completely assess the impact of predation on turtle populations. There are a number of other possible factors that may cause declines in turtle populations which have not been examined. The cumulative effect of a number of factors may be causing declines rather than just one cause, therefore it is important that all aspects which may be significant be examined.

Future Directions

This study will form the basis for future research on turtles at Point Pelee National Park. A number of objectives have been set for 2002. Marking will continue to obtain population size estimates and population structure will be assessed further.

The effects of road mortality will be examined with the use of models once population size estimates are made. Predation rates upon turtle nests will be examined and the efficacy of the wire screen box and pepper spray nest protection method will be examined further. Relative population size of raccoons will be examined through line transect surveys to compare to nest predation rates. Hatching success of protected nests and contaminant levels will be determined and compared to each other.

Acknowledgements

We would like to thank the many people who helped with this project: our field assistant Carol Browne, park staff and volunteers. The Essex Region Conservation Authority provided access to their land at Hillman Marsh. Scholarship support was provided to C.L.B. by the George Ozburn Graduate Award in Aquatic Biology at Lakehead University. Financial support was provided by Premier's Research Excellence Award, Parks Canada, and the Natural Sciences and Engineering Research Council grant to S.J.H.

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Poster Manuscripts

Driftwood timber and flotsam decorate beaches on remote Lake Superior shorelines, Caribou Island. (PSK)

Restoring Highly Fragmented Populations of Herbaceous Spring Ephemerals in a Severely Grazed Corolinian Forest

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Abstract

High deer populations at a number of provincial parks (e.g., Rondeau and Presqu'ile Provincial Parks) throughout Ontario are seen to pose a threat to the natural state of the park. The effects of grazing by white-tailed deer (Odocoileus virginianus), *on the structure of a forest canopy were investigated at Rondeau Provincial Park in southwestern Ontario in response to the lack of investigation into landscape level change incurred by these high populations. Canopy gap data was compiled from analysis of three sets of air photos (1955, 1972 and 1978) for the park. Overall, average area and frequency of gaps increased over the 23 year period.*

Introduction

The effect of browsing by white-tailed deer (*Odocoileus virginianus*) on woody plant species has been well documented (Ross *et al.*, 1970; Sotala and Kirkpatrick 1973; Anderson and Loucks 1979; Tilghman 1989; Johnson *et al.*, 1995). Studies have linked intense deer browsing to changes in woody species composition (Ross *et al.*, 1970). For example, at extremely high densities (i.e., in situations of imminent starvation) deer will consume more than 99% woody plant materials (Dahlber and Guettinger, 1959 cited in Sotala and Kirkpatrick, 1973), which reduces rates of forest regeneration (Veblen *et al.*, 1989). Scarcity of preferred browse and starvation initiates shifts in deer diet to less preferable species (Veblen *et al.*, 1989). Additionally, saplings and shrubs 0.15 to 2.1m tall are targets for winter browsing (Ross *et al.*, 1970). When these two impacts are combined, entire cohorts of saplings and subcanopy shrubs are absent from forest understorey, which ultimately restricts canopy regeneration (Veblen *et al.*, 1989). Canopy gaps are locations in the forest that stimulate new growth, and when deer are present in large numbers they consume the newly germinating seedlings found there (Veblen *et al.*, 1989). Furthermore, weather and high wind events in particular, such as those that occur throughout southwestern Ontario several times per century, also affect canopy regeneration (Smith, 1981; Larson and Waldron, 2000).

Waller and Alverson (1997) state that white-tailed deer meet the criteria for a keystone species. They have been shown to selectively suppress or eliminate seedling and sapling growth and populations of palatable species like sugar maple (*Acer* *saccharum*), creating a competitive advantage for less palatable species like american beech (*Fagus grandifolia*), which affects the forest composition when these young understorey trees replace trees in the canopy. Also, when deer populations are extremely high, the seedlings and saplings of all tree and herbaceous species are removed, leaving areas of park-like openness for plants like ferns and grasses to colonize (Waller and Alverson, 1997). Once established, ferns effectively out-compete native tree seedlings for available light, continuing suppression of tree regeneration. This is presently occurring at Prequ'ile Provincial Park in southwestern Ontario (Koh pers. comm.).

Few studies have demonstrated the impacts of individual species at the landscape level. Two examples include the impacts of beaver (*Castor canadensis* Khul and *Castor fiber* Linn.) (Snodgrass, 1997) and lesser snow geese (*Chen caerulescens caerulescens* [L.]) (Kerbes *et al.,* 1990). These animals modify plant community composition and ecological functioning at scales that can be detected on aerial photographs and landsat images. The impact of acute deer herbivory on forests has not been previously examined at a landscape level. This study attempts to link the effects of herbivory of a high population of white-tailed deer with the state of the forest canopy at Rondeau Provincial Park by tracking changes in the integrity of the canopy over a 23-year period. Specifically, quantifying long-term changes in the size and distribution of canopy gaps was done. The major prediction was that the number and total area of forest canopy gaps along with mean gap size, has increased with increased deer populations.

Methods

Air photos of Rondeau from 1954, 1972 and 1978 were interpreted on acetate overlays to identify tree canopy gaps. Each year contributed one layer to a GIS database and years were compared for changes in total gap area. Air photos were flown by the OMNR (Ontario Ministry of Natural Resources) at two scales 1:15840 (1954 and 1972) and 1:10000 (1978). Major roads and hydrographic features were outlined to link interpreted overlay scans to the Rondeau base map when overlay scans were brought into the ArcView environment. For each year's air photos, canopy gaps were interpreted for the maximum forest cover extents and were identified as such, if they met one of three criteria: i) areas where there were obvious breaks in the canopy (no trees existed) and the ground could be seen; ii) areas with a low density of trees (i.e., individual trees could be identified within the forest profile and the ground could be seen within that site); and iii) areas where there was a break in the consistency of the height of the canopy (i.e., appeared to be a gap with shorter trees below). The completed overlays were scanned and imported into the ArcView environment where separate layers were digitized for each year. The area and perimeter of each canopy gap overlay for each year were calculated using an ArcView 3.2 Script File.

Statistical analysis of the canopy gap data was carried out using SPSS (Statistical Package for the Social Sciences). Once perimeter and area data were determined for each of the three years, using the ArcView 3.2 Script File for area calculations, a summation of the total number of gaps, mean gap area, median gap area and total gap area was calculated for each of the three years.

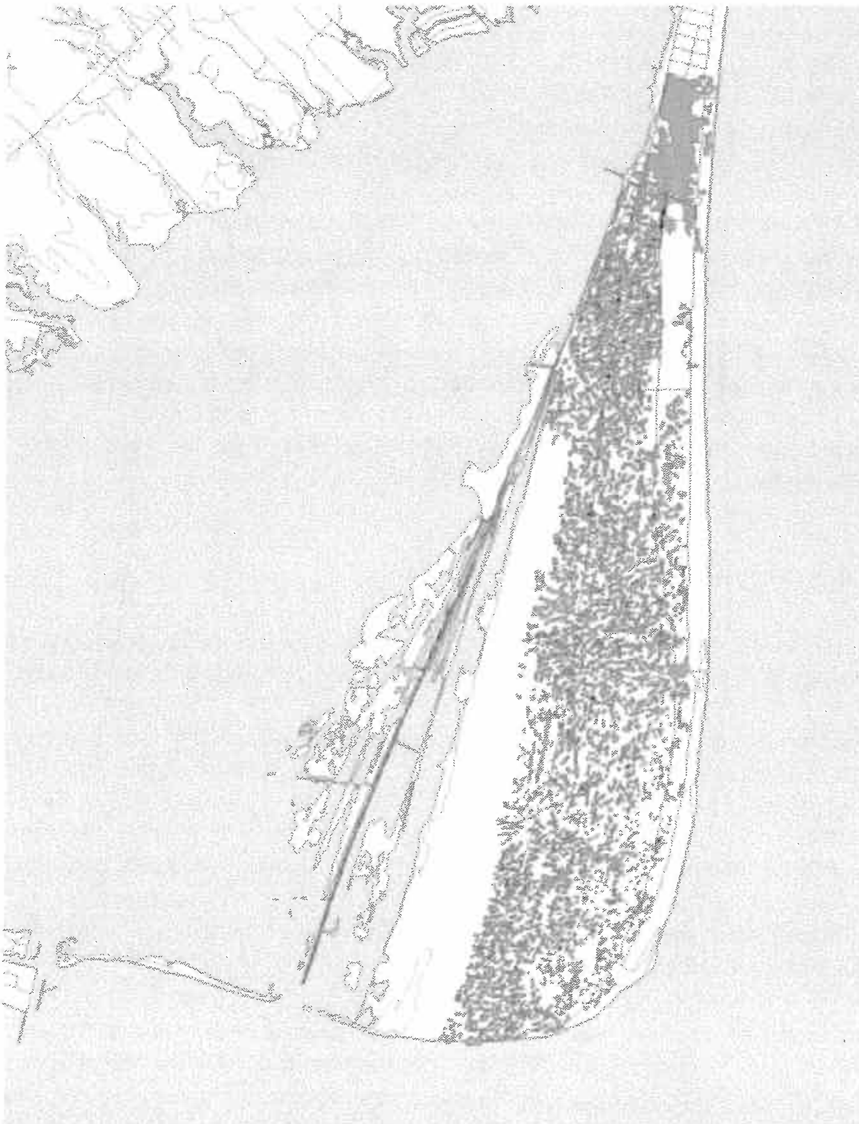
The total forest cover measured at Rondeau was 1100 ha as estimated by the forest delimitation set out by the digital map provided by OMNR. Visually, canopy gaps appeared to increase from year to year (shown as an increase in grey areas) (Figures 1-3). Overall, there were a higher number of smaller gaps and the distribution was skewed to the right (Figure 4). The canopy gaps increased both in total number and in median size from 1955 to 1978 (Table 1). There were more small gaps ($\leq$1250 m^2) in 1955 than in 1978. In contrast, in 1955 there were fewer large gaps (>1250 m^2) compared to 1978. In the intervening period, the 1972 data showed a brief reduction in the frequency of small gaps and an increase in the number of large gaps. This may have been due to some smaller gaps coalescing into large gaps. Total gap area increased by 26.6% from 1955 to 1978. The percentage of the forest occupied by gaps increased from 24.1% in 1955 to 30.5% in 1978.

Discussion

These results show that the impact of deer herbivory on forest plant communities can be observed at the landscape level at Rondeau Provincial Park for the period of 1955-1978. The increase in the number and size of canopy gaps at Rondeau Provincial Park can be attributed to the effect of intense deer herbivory on tree recruitment. When forest stand structure plots established in 1981 were re-recorded in 1996-7, 50-80% of trees were gone and had not been replaced (Timciska, 1997). Hynes (2002) found that shrub and sapling density was significantly lower in Rondeau and Pinery Provincial Park compared with forests having lower deer densities. Hynes (2002) also showed greater light levels in these parks. These studies combined with the results presented here create a strong case for decreased canopy integrity due to deer grazing pressure.

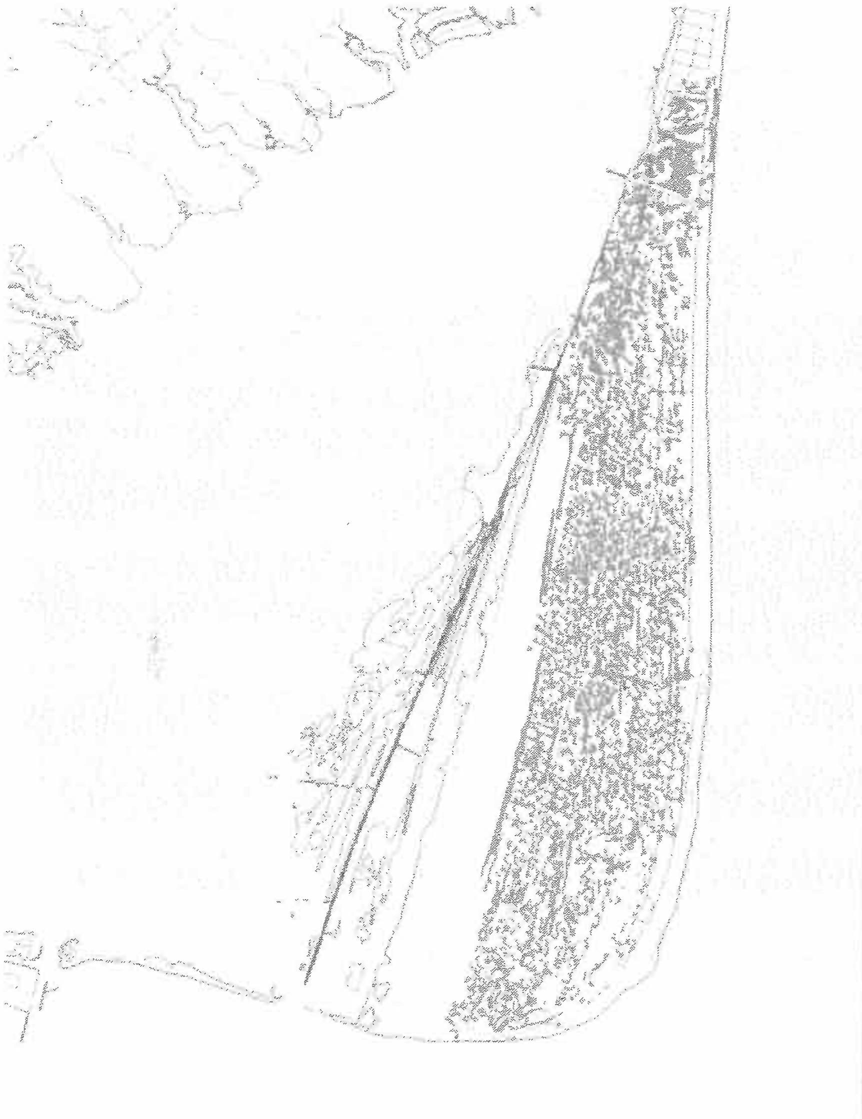
These results are in line with other research showing that mammalian herbivores including moose (Bergerud and Manuel, 1968; Bradner *et al.*, 1990), beaver (Johnston and Naiman, 1990; Snodgrass, 1997), greater snow geese (Kerbes *et al.*, 1990) and elephants (Ben-Shahar, 1996) can affect stand density, and therefore canopy, in forests around the world. However, to our knowledge, this is only the third study (after the beaver and snow geese) demonstrating a landscape level effect of herbivores.

Figure 1. Interpreted canopy gap profile for 1955 at Rondeau Provincial Park.



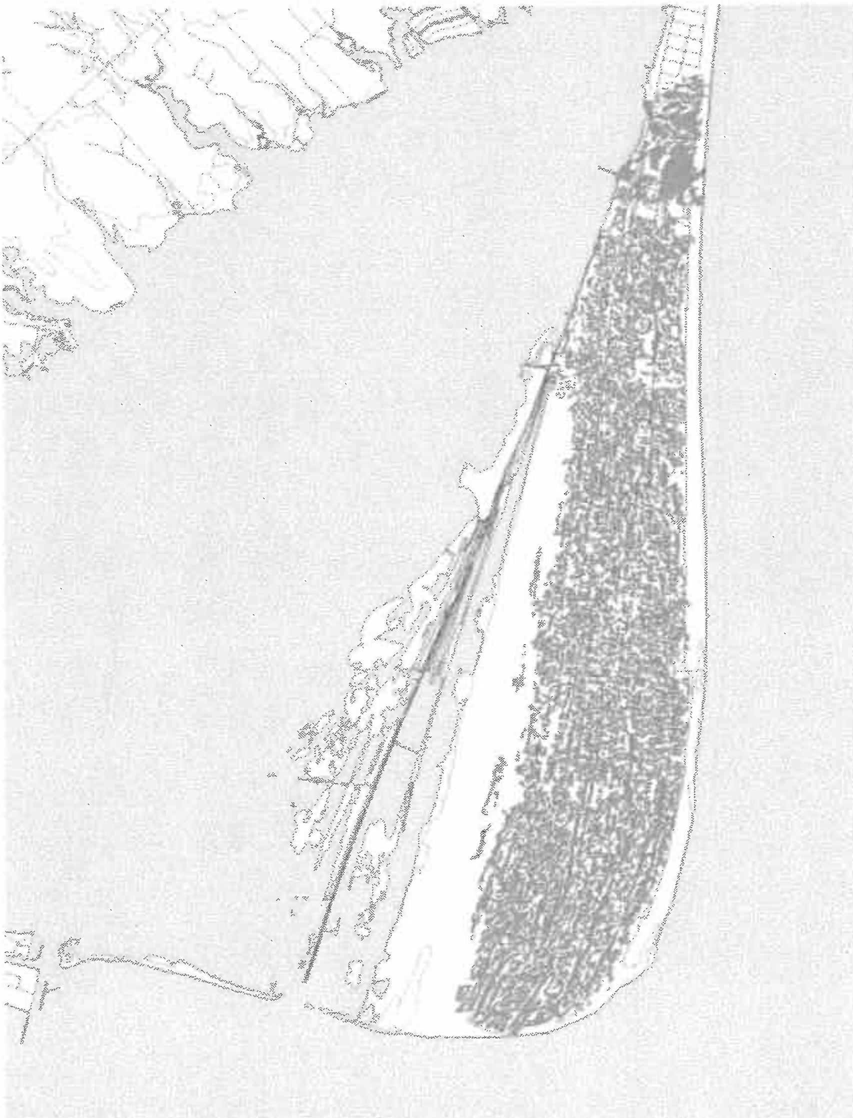
SCALE: approximately 1.5 cm = 1 km

Figure 2. Interpreted canopy gap profile for 1972 at Rondeau Provincial Park.



SCALE: approximately 1.5 cm = 1 km

Figure 3. Interpreted canopy gap profile for 1978 at Rondeau Provincial Park.



SCALE: approximately 1.5 cm = 1 km

Figure 4. Canopy gaps for the 23-year air-photo period at Rondeau Provincial Park.

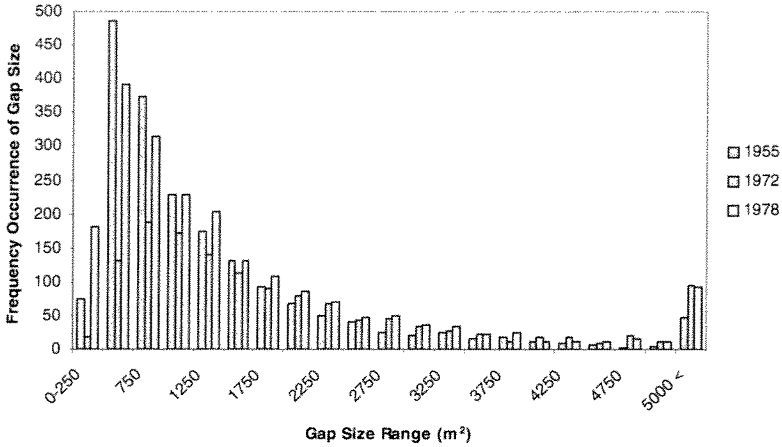


Table 1. Canopy gap statistics for Rondeau Provincial Park.

	1955	1972	1978
Deer Herd Count	60	130	390
Total Number of Gaps	1901	1358	2087
Gap Area Mean (m^2) (SE)	1396.6 (157.47)	2162.2 (111.51)	609.9 (71.94)
Gap Area Median (m^2)	765.4	1296.2	915.9
Total Gap Area (km^2)	2.65	2.93	3.35
Percent of total forest	24.1%	26.6%	30.5%

These results are in line with other research showing that mammalian herbivores including moose (Bergerud and Manuel, 1968; Bradner *et al.*, 1990), beaver (Johnston and Naiman, 1990; Snodgrass, 1997), greater snow geese (Kerbes *et al.*, 1990) and elephants (Ben-Shahar, 1996) can affect stand density, and therefore canopy, in forests around the world. However, to our knowledge, this is only the third study (after the beaver and snow geese) demonstrating a landscape level effect of herbivores.

Despite the fact that 1972 data show fewer gaps, the overall trend remains the same. Deer populations were controlled at Rondeau during the 1960s. The respite of deer grazing allowed small gaps to be filled in, while the large gaps remained open. The exact reason for the change in the gap size spectrum remains unclear.

While previous studies at Rondeau have examined the effect of deer on plant community composition and individual species (Koh, 1995; Koh *et al.*, 1996; Bazely, *et al.*, 1996, Koh, 2002; Hynes, 2002), none of them examined the forest ecosystem from a broader landscape scale. This investigation is unique in its approach to this seemingly frequent forest problem.

Interpretation of more current air photos was not done because recent air photos are now being photographed in infrared, which greatly reduces the effectiveness of the 3-dimensionality of the stereo-paired photos. This would ultimately affect the results as gaps may be misinterpreted. However, we would predict that since 1978 even more gaps would have appeared in all sizes, especially the larger ones, since herd populations during the 1980s and early 1990s were extremely high. Although there has been a reprise in the last five years in the size of the herd through mitigated population controls, a delayed response would be apparent in the forest canopy that would be manifested through gap coalescence.

Acknowledgements

Many thanks to: Rob Davis MNR Peterborough for providing access to OBM data; Rick Hornsby and Sandy Dobyn, Rondeau P.P. for herd data; Matt Smith Point Pelée N.P., Tim Marchand MNR London, John Sorrell York University, Bill Baskerville L.P.R.C.A. for GPS and GIS support.

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Ontario Tallgrass Prairie and Savanna Association

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Abstract

Saving Ontario's rare tallgrass habitats is the theme of this association, also known as Tallgrass Ontario. Much of southern Ontario was once covered in prairie, with only about 3% of the estimated pre-settlement area of 1000 km² remaining. Worldwide, tallgrass prairies and savannas are an imperiled ecosystem, and one of Canada's most endangered. As part of Ontario's natural heritage, over 200 plant and animal species officially designated rare at global, national or provincial levels find their habitat in these remaining tallgrass communities. Tallgrass species such as the karner blue butterfly and greater prairie chicken have already disappeared from Canada, with agricultural and urbanization land uses responsible for most of the loss of habitat.

Tallgrass Ontario is working as the recovery team for the southern Ontario 'Tallgrass Recovery Plan' (Rodger, 1998) This conservation effort tackles not the needs of an individual species, but an entire, rare ecological community in which many endangered species are at risk.

Association Overview

In the three years since Tallgrass Ontario (TGO) presented at a poster session at the Parks and Research Forum of Ontario in Guelph, Ontario, much has transpired. In terms of organizational development, the group has grown in size and in scope, and has been incorporated (October, 2001) as a non-profit organization. A founding Board of Directors has been struck, and a Tallgrass Recovery Advisory Committee (TRAC) has been established to deal with the issues raised by and brought to TGO: both are actively engaged in the implementation of the Tallgrass Recovery Plan (Rodger, 1998).

By incorporating a non-profit group, TGO has been able to solidify and organize its efforts more efficiently. Previously, as a loose amalgamation of interested individuals representing the public, conservation groups, academia, consultants, naturalists, and several government agencies and related NGOs, a direction and critical mass were created. Aims and objectives of the newly incorporated TGO group include:

- the identification, conservation, restoration and creation of tallgrass communities;
- the acquisition and holding of tallgrass lands for conservation;
- the acquiring and the utilization of funds by and for TGO;
- the implementation of conservation practices through management plans and technical assistance;
- the cooperation with other organizations in furthering the TGO mission;
- the education of the public through landowner contact, workshops, and seminars;
- the facilitation and conducting of research on tallgrass communities and species, and the dissemination of results; and,
- the promotion of re-introduction of tallgrass species into areas where they are seriously threatened or where they have been extirpated (Tallgrass Ontario Bylaw #1).

Funding for TGO projects comes from grants received from government and private sources, while membership fees, and the selling of articles such as T-shirts is a basic source of cost recovery for member servicing and a foundation of member contact and involvement.

Goals of the Recovery Plan include public awareness and communication, identifying and protecting remnant communities, encouraging sound management practices, promoting restoration and creation, aiding species at risk, and research. These are being undertaken through connecting interested groups and individuals, and in the development of an information base on tallgrass communities and the Recovery Plan.

Restoration projects are being undertaken in many Ontario communities as alternatives to cultivated landscapes, and to re-introduce viable areas of native habitat. The J.J. Neilson Arboretum at Ridgetown College is closely involved in Tallgrass Ontario and in the work of the recovery team.

As far as project activity is concerned, TGO has been working on a number of projects that address the goals of the Recovery Plan. A major initiative has been 'Save Ontario's Savannas', a landowner contact project that encouraged voluntary private land stewardship and increased awareness. In its first summer of landowner contact, the project was a great success, resulting in 33 voluntary landowner stewardship agreements that conserve 130 ha of tallgrass habitat. Other recent initiatives include intervening in the planning process of a golf course development in southwestern Ontario, where naturally recurring tallgrass habitat is in danger of being segmented, removed or eliminated. There is also work ongoing with the Nature Legacy Foundation regarding 'pocket prairies'-small remnants that are being identified and efforts made to protect them from development, encroachment, and supposed enrichment by interplanting with trees, etc.

TGO publishes and distributes the *Bluestem Banner* newsletter several times a year, with editorship currently shared among directors of TGO. Articles of interest and pertinence to tallgrass communities and project initiatives, and upcoming events, are presented. A biennial Tallgrass Forum has taken place in 1999 and in 2001 in southwestern Ontario, and is planned for 2003 in eastern Ontario. Attendances of nearly 200 at these events show a high level of interest by those most closely associated with tallgrass ecology and conservation, and public interest is also growing.

The J.J. Neilson Arboretum (JJNA) and Ridgetown College, Univeristy of Guelph (RCUG) have been actively involved in TGO activities since its early inception. In 1999 a Research Group meeting was held there to discuss high priority needs for applied tallgrass research, and the two forums have been located at this venue as well. Discussions have been underway regarding academic and research components of TGO, and the possibilities to develop a substantial self-sustaining organization for public and related group interaction. Representation of the JJNA/RCUG on the TGO Board of Directors is an important part of maintaining this relationship, and in developing future alliances. On the campus, two areas of native plant demonstration gardens (native flowers and tallgrass species) have been developed and are being maintained, and a forbs nursery area established in 1999 with the Rural Lambton Stewardship Network is well underway. These plantings of tallgrass species, although not specifically intended as habitat restorations, will demonstrate to the public, the landscape and agricultural industries, and to students, some of the charm, variety, usefulness, and management concerns of native species plant communities that are so little understood by most people.

From the Parks Research Forum of Ontario sessions that took place at Ridgetown College in May this year, some interesting things have developed. In addition to a poster session where TGO had a display, as in Guelph in 1999, a research project using the campus tallgrass demonstration plot has been suggested (Kevan, 2002). The pollination systems and breeding requirements of native grasses are the subject, and the (proposed) study would examine seasonal and daily patterns of both pollen release and stigmatic receptivity, along with weather conditions which are conducive to pollination. Other plans for the tallgrass demonstration plot include an MNR burn school project, where participants would receive training in the planning and implementation of simple prescribed burns for tallgrass restoration purposes. The interest in this management technique is increasing rapidly.

The poster session of TGO at the PRFO has achieved its goal in creating interest and sharing information. More of these activities are planned across Ontario and even into the United States, at locations where groups with similar interests are gathering.

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Overcoming Challenges to Grassroots Environment Remediation in the Rondeau Watershed

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Rondeau Watershed Coalition

Abstract

Rondeau Bay and its watershed contain important natural resources, species and natural communities which are of regional, provincial and national significance. Intensive agricultural and residential development within the watershed have caused serious declines in the extent and quality of natural features. A catastrophic loss of aquatic vegetation in the bay along with chronic problems of incremental wetland loss led to the creation of the Rondeau Bay Watershed Rehabilitation Program (RBWRP) in 1993. Since that time a number of successes have been achieved, yet many challenges still face the organisation. Challenges include maintaining active participation, funding, the need for education, and difficulties with navigating jurisdictional and bureaucratic networks. A new board of directors has provided new direction to the organisation in overcoming these challenges and in developing a positive future of grassroots watershed restoration.

Introduction

Rondeau Bay is one of Ontario's natural treasures. Located in the Municipality of Chatham-Kent, within the heart of Ontario's biologically diverse Carolinian zone, the bay is known as a vital waterfowl staging area, and the wetland and upland habitats of the adjacent watershed are home to a number of rare Carolinian habitats and species. By many measures, the watershed also represents the area of influence or "greater park ecosystem" for Rondeau Provincial Park, a natural environment class park with a very high number of significant species and habitats. Unfortunately, the watershed has suffered severe ecological losses due to land use practices, pollution, and a general lack of awareness in the local populace of the area's ecological significance. The environmental condition of the bay itself hit a low point in 1977 when there was a collapse of the submerged macrophyte vegetation (at the time dominated by the exotic Eurasian water milfoil) and dependent fish populations (Ontario Parks, 2001; RBWRP, 1995). Intensive development, combined with a high native biodiversity and many species of southern affinity create unique challenges for meeting conservation objectives. Rondeau Bay and the watershed have:

- only 4% tree cover (RBWRP, 1995);
- 54% of the Rondeau Bay shoreline has been severely altered (ibid.);
- 800 ha of provincially and regionally significant marshes (NHIC, 1998a);
- been designated a priority site for protection and rehabilitation under the Great Lakes Wetlands Conservation Action Plan (Environment Canada, 2000);
- extensive areas of submerged macrophytes have recovered (Ontario Parks, 2001) providing habitat for warm water fish species as well as staging habitat for migrating waterfowl;
- along with Rondeau Provincial Park, been designated an Important Bird Area (Cheskey and Wilson, 2001).
- remnant Carolinian forests, including Sinclair's Bush Areas of Natural and Scientific Interest (ANSI) (Allen, 1984).
- 18 species considered to be at risk by either the Ontario Ministry of Natural Resources (OMNR) (NHIC, 1998b) or the Committee on the status of Endangered Wildlife in Canada (COSEWIC).

In recent years, expansion of no-till or conservation tilling practices, now common in the watershed (Jack Rigby pers. comm.), has contributed toward improved water quality, but increased tiling and aggressive drain maintenance continue to contribute high loads of sediment to the bay. Monitoring of surface water quality is no longer being conducted, making it difficult to gauge the contribution of practices such as no-till cropping versus the filtering action of Zebra Mussels to improved water clarity in the bay.

The Rondeau Bay Watershed Rehabilitation Program (RBWRP) was formed in 1993 under the Great Lakes Cleanup Fund. The group has made gains toward it goals of integrating natural habitats, assisting the recovery of species at risk and improving water quality, however it has encountered increasing challenges as funding sources have dried up and public interest has dwindled. In addition, the group faces the need to maintain and increase involvement of the agricultural community, and must navigate complicated jurisdictional boundaries.

Since its inception, the program has been actively involved in habitat rehabilitation and species recovery measures. Projects to date have involved over 1535 volunteers and 277 partners, many local to the community. These projects have been made possible through the generous support of agency and private funding, community group and business contributions, and volunteerism.

Challenges in Grassroots Environmental Rehabilitation

Through the years the Rondeau Watershed Coalition (RWC) has had to overcome many hurdles in its efforts to facilitate a program of watershed rehabilitation. At present the group is experiencing very positive developments, yet many challenges still remain.

1. Maintaining Community Involvement

One of the foremost challenges has been maintaining active involvement of watershed residents and other interested parties in the activities of the program. Initially there was strong participation in the group from a wide range of sectors, and the board of directors consisted of 15 people. This participation waned to the point where there were only two active directors working with the Co-ordinator. Possible explanations for this decline include conflicting agendas and points of view within the board, burnout of key volunteers and a decreased sense of urgency with the recovery of the bay's aquatic vegetation. In the past year, there has been a marked improvement in participation and the RWC now has an active board of six members. Unfortunately there is not yet any representation from the agricultural community on the board.

In an effort to stimulate more interest and public involvement, the RWC held a community forum on April 13, 2002. At the forum, a local historian and local naturalist gave presentations about the past and present condition of the area's natural resources. This was followed by smaller group discussions that allowed participants to voice their opinions regarding the work of the RWC. The forum was reasonably well attended with 20 people from a variety of backgrounds. Ideas and suggestions from the forum are included in the discussion below.

In order to further stimulate interest and involvement in the RWC's activities the following options are being pursued:

- network with established agricultural organisations;
- increase profile through local media including farm papers;
- increase involvement of youth volunteers; and,
- improve its website including new URL and domain name.

2. Increasing Landowner Interest

In past projects there has, at times, been insufficient participation from landowners to meet project objectives. It is unclear whether this low participation is due to a genuine lack of interest in participating in environmental and conservation-related projects, insufficient outreach to potential participants, or inappropriate selection and design of projects. By re-establishing relations with the agricultural community and improving the visibility of the Coalition through enhanced outreach programs, we hope to stimulate increased interest and input from landowners. The re-location of the Coalition office from the MNR in Chatham to the Ag-Business Centre at Ridgetown College should help facilitate improved networking with agricultural organisations, several of which are located at the Centre.

3. Developing Awareness and Positive Attitudes

One of the long-term challenges that the RWC faces is the lack of environmental awareness and appreciation for natural areas within the general population. The RWC is addressing this challenge through educational activities with schools, which it hopes to increase in the future. It has been suggested the RWC develop curriculum-based education programs addressing local environmental issues. First hand exposure to nature is a key component of developing a positive environmental ethic, and the RWC will be enhancing its efforts to provide opportunities for experiential education. Outreach through local media, as detailed above, should also assist in overcoming this challenge.

4. Funding and Support

Though initially the program was started with substantial financial support from the Federal Government, this core funding has not been available for several years, forcing the program to finance itself through individual project applications. Two planned wetland restoration projects on Rondeau Bay could not be implemented largely because the funding dried up before they were completed, though jurisdictional and other bureaucratic impediments also came into play (see below). The constant need to seek funding sources means that little time is available for longer-term planning, research or activities that do not relate to "funded" projects. In order to increase operational funding for the RWC, community fundraising initiatives are being pursued. In the coming months the RWC will be incorporated as a non-profit organisation, which will increase its ability and flexibility to pursue funding opportunities. While these initiatives will improve our ability to fund our work, it is likely that funding will remain the key challenge in pursuing the Coalition's objectives.

Ontario Parks has made a commitment to working toward ecosystem management in the areas of influence around provincial parks (Ontario Parks, 2002). Despite this commitment, at Rondeau Provincial Park there has been no additional funding or staffing support provided to pursue or assist initiatives in the "greater park ecosystem". Further complicating potential partnerships with Ontario Parks is the concern of park managers that direct participation in watershed rehabilitation would give the appearance of over-stepping their bounds and create conflict within the local communities.

5. Jurisdictional Issues and Bureaucracy

Like other areas being rehabilitated around the Great Lakes, the Rondeau watershed has a large number of governmental agencies involved in its management.

These include provincial ministries (e.g., Natural Resources, Environment, Agriculture), federal departments (Fisheries and Oceans, Environment), the Lower Thames Valley Conservation Authority and the Municipality of Chatham-Kent. Navigating the maze of jurisdictions and responsibilities in developing projects for wetland restoration is a daunting undertaking and has complicated past efforts. In the short term, efforts will be focussed on working with landowners in the upper watershed to avoid the difficulties of working along the shoreline of the bay. In the future, partnerships with other groups more experienced in navigating the bureaucracy and building the capacity of Coalition members and staff will enable the RWC to take on more ambitious restoration projects along the bay shore.

6. Municipal Policies and Practices

During the community forum held on April 13 it became clear that there is a need to work with or pressure the Municipality of Chatham-Kent to introduce more progressive environmental protection through by-laws or incentive programs. Four areas of municipal jurisdiction are of particular interest to the RWC – the construction and maintenance of drains, the growth of intensive livestock operations and nutrient management, the taxation of woodlots and other natural features, and the absence of controls on tree cutting. The RWC will become active in fostering awareness of these issues within the local population, but it has not yet been decided whether or not the RWC will take a formal position and lobby the Municipality accordingly. Direct lobbying would be a departure from past approaches for the organisation, which has generally attempted to remain politically neutral.

Conclusion

The need to restore and protect the Rondeau watershed remains as great as it was nine years ago, when the Rondeau Bay Watershed Rehabilitation Program was formed. Significant challenges face the future of this grassroots organisation. Waning public interest and participation and a decline in funding may be among the greatest threats to the group's future effectiveness. Currently the RWC is attempting to generate increased public awareness and participation through community events and is investigating possible sources of funding on a project-by-project basis, as well as to maintain its day-to-day business. The RWC is also addressing a need to further involve the local agricultural community, a continued need to foster environmental awareness in the local population, and the necessity of navigating jurisdictional boundaries. Overcoming these diverse challenges will be an ongoing process requiring creative approaches to grassroots watershed rehabilitation.

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Appendices

Long Point Wildlife Area (Anon.)

APPENDIX 1: PARTICIPATION BENEFITS TO PRFO MEMBERS

Introduction

The Parks Research Forum of Ontario (PRFO) has just completed a very successful five-years of operation. From its beginnings at Buckhorn Lake near Peterborough, 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. Five major annual events 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, Parks and Protected Areas Research 2002: Protected Areas and Heritage Coastal Ecosystems (Lemieux *et al.*, 2003). Attendance has remained high. An average of about 130 individuals attended annual meetings with 400 attending the 2000 SAMPAA/PRFO joint conference. In 2003, approximately 170 people participated in the PRFO Annual General Meeting hosted by the University of Western Ontario. The special theme day for the PRFO 2003 conference was "Protected Areas and Watershed Management." Since its development, PRFO has served to satisfy a major need for a research forum, not only in Ontario but increasingly nationally and internationally.

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 very substantial in-kind contributions.
Excellency by striving to maintain the highest level of quality in all its 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.

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 2003 included: Ontario Parks; Parks Canada; Environment Canada's Ecological Monitoring and Assessment Network (EMAN); and, the Universities of Waterloo, Trent, York, Western Ontario and 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.

PRFO administrative operations have basically been undertaken through activities of its Chair, with major contributions from the University of Waterloo Heritage Resources Centre, Ontario Parks and Parks Canada, as well as its other members. The Centre and the Chair have provided the Secretariat for PRFO and have been responsible 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). The Heritage Resources Centre has, however, often provided critical organizational, student and other assistance for the local arrangements.

Looking to the Future

The contribution of the founding members has proven invaluable; however, there are many people involved in parks and protected area research who are not directly involved in the Steering Committee. A number of these can undoubtedly contribute to the guidance and operations of PRFO, and in turn benefit from the forum in terms of exchange of ideas and colleague support. With this in mind, PRFO will pursue an incremental approach to increasing membership and participation more reflective of the state of parks and protected areas in Ontario.

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 research 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 refers to participation of the Steering Committee members or other interested persons in planning or implementation of PRFO activities. Although difficult to quantify, these 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

If any membership growth is to be achieved, it is critical to provide a clear understanding of what benefits are offered to members in exchange for their valuable support of PRFO. These 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 pa-

pers 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, research seminars and lectures;
- 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.

This list highlights many of the benefits that can be gained by being a participating member of the PRFO Steering Committee. It is within this context and its successful previous five years of PRFO that the current members of the Committee will be inviting new participants.

PRFO Steering Committee and Members include:

J.Gordon Nelson, Chair, Parks Research Forum of Ontario (PRFO)
Barton Feilders, Ontario Parks
Bob Davidson, Ontario Parks
Bill Stephenson, Parks Canada
Tom Beechey, Canadian Council on Ecological Areas (CCEA)
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Appendix 2: Conference Program Overview

DAY 1: Thursday April 25. THEME DAY on Protected Areas and Heritage Coastal Ecosystems (Agri-Theatre)

8:45-9:00am. Welcome and Introductions

9:00-10:00am. PANEL ONE: Development of the Heritage Coast Planning Approach

· Coastal Conservation in Europe, Especially the United Kingdom (*John Marsh*, Professor - Trent University)

· Threats to Development of Heritage Coast Planning (*Evan Ferrari*, Director of Parks and Protected Areas - Wildlands League)

10:00-10:15am. Commentators on Panel

· *Jeff Robinson*, Habitat Biologist - Canadian Wildlife Service

· *Michael Troughton*, Professor - University of Western Ontario

10:15-10:30am. Audience and Panelist Questions

10:30-11:00am. Refreshments (Room 126)

11:00-12:00pm. PANEL TWO. Applications of the Heritage Coast Concept in the Great Lakes

· Progress and aspirations of Parks Canada Marine Conservation Initiatives (*Kevin McNamee*, Director of Park Establishment - Parks Canada)

· Great Lakes Heriitage Coast: Opportunities for Protection and Community Development (*Brian O'Donaghue*, Coordinator of the Great Lakes Heritage Coast Project - Ontario Ministry of Natural Resources)

· Progress and Opportunities of Heritage Coast Planning in the Lower Great Lakes (*Bill Stephenson*, Regional Conservation Biologist - Parks Canada)

12:00-12:15pm. Commentators on Panel

· *Doug Desmond*, Lawyer - Ridgetown

· *Brian Craig*, Network Science Advisor for EMAN - Environment Canada

· *Stephen Crawford*, Research Associate - Axelrod Institute/Ichthyology at University of Guelph, Chippewas of Nawash

12:15-12:30pm. Audience and Panelist Questions

12:30-2:00pm. Lunch (Upper Level - Willson Hall)

2:00-2:30pm. Rapporteurs on morning session

· *Dick Hunter*, General Manager - Conservation Ontario

· *Jim Faught*, Executive Director - Federation of Ontario Naturalists

2:30-4:30pm. SMALL WORKING GROUPS focussing on general lessons and the Heritage Coast Concept (informal coffee break at 3:30pm)

4:30-5:30pm. Report on Working Groups

5:30-7:00pm. Dinner at Ridgetown College (Upper Level - Willson Hall)

7:00-7:30pm. Report on the Status of PRFO and the 3-year Plan (2002-2005)

7:30-onwards. Evening Social at Campus Centre (Lower Level - Willson Hall)

DAY 2: Friday April 26. VOLUNTEERED PAPERS AND CONCURRENT SESSIONS on any topic relevant to Parks and Protected Areas.

9:00-10:00am. Poster Sessions (Room 126)

10:00-11:30am. Concurrent Sessions of volunteered papers (part I)

11:30-1:00pm. Lunch (Upper Level - Willson Hall)

1:00-2:30pm. Concurrent Sessions of volunteered papers (part II)

2:30-4:00pm. Concurrent Sessions of volunteered papers (part III)

DAY 3: Saturday April 27. OPTIONAL FIELD TRIP

8:00-4:30pm. An exploration of Clear Creek, Rondeau Provincial Park and surrounding wetland and coastal areas. Organized by Gordon Nelson with Mathis Natvik, Rondeau Provincial Park and other conservation groups.

Schedule for Concurrent Sessions

Volunteered Posters (Friday, 9:00am-10:00am)

Overcoming Challenges to Grassroots Environmetnal Remediation in the Rondeau Watershed (Ramsay Hart)

Restoring Highly Fragmented Populations of Herbaceous Spring Ephemerals in a Severely Grazed Carolinian Forest (Carrie Firanski and Dawn R. Bazely)

Establishing and Maintaining a Large Weed Identification Garden (Dave Bilyea)

Tallgrass Prairie and Savannah Association (Ken Nentwig)

The Challenge of Protecting Globally Significant Bird Species and Their Habitats in Southwestern Ontario - A Summary of the Greater Rondeau Important Bird Area (Sandy Dobbyn)

Restoration of a National Park: 80 Years of Restoration at Point Pelee National Park (Matthew Smith)

Abstracts for Volunteered Presentations (Friday, 10:00am-4:00pm)

Session 1. Civic Research and Planning (part I)
(10:00am-11:30am: Room 127)

Volunteer Capacity-Building for Horticultural Activities: A Model for Small Ontario Communities (Ken Nentwig)

Human-Environment Interactions in Prespa National Park, Greece (Stephanie Janetos)

Coastal Values and Quality of Life (Norman McINtyre, Kathryn Pavlovich and Lisa Hayes)

Management in a Planning Vacuum: Co-operation in the Quetico: BWCA-Voyageurs International Boundary Region (Brian Kutas, H. Doran, K. Hung, Stephanie Janetos, D. Strath, Roger Suffling and B. Woodman)

Session 2. Landscape and Bioregional Planning
(10:00am-11:30am: AG Theatre)

Planning for an Ecological Corridor: The San Pedro Riparian National Conservation Area, Arizona (Gordon Nelson)

Why Y2Y? Understanding the Role of Large Landscape Corridor Initiatives in Regional Conservation Planning, Using the Yellowstone to Yukon Conservation Initiative as a Case Study (Tanya McGregor)

The Countryside, Parks, Tourism and Foot and Mouth Disease in the United Kingdom (John Marsh)

The Georgian Bay Coast Project (Phase 1) (Jarmo Jalava, Wendy Cooper and John Riley)

Session 3. Business and the Environment (part II)
(1:00pm-2:30pm: Room 127)

Business Statistics on the Ornamental Horticultural Industry in Ontario (Ken Nentwig and Monica Moore)

Algonquin Provincial Park Visitor Expenditures and Impacts (Margaret Bowman and Paul Eagles)

Tourism-Related Financing Mechanisms for Marine Protected Areas: International Trends and Case Studies (Elizabeth Halpenny)

Ecotourism, Protected Areas and Community Development (Mike Stone)

Session 4. Environmental Analysis and Planning
(1:00pm-2:30pm: AG Theatre)

A Volumetric Analysis of Coastal Dune Morphology Change, Piner Provincial Park (Michael C. Bitton)

The Ecological Impact of Backcountry Recreation in Kejimkujik National Park (Bob Payne)

An Exploration into Operating Status and Visitor Use over Ontario's Provincial Parks System (Wang Lian-yong and Paul Eagles)

Session 5. Vegetation Management (part III)
(2:30pm-4:00pm: Room 127)

The Impact of Hybridization on the Endangered Red Mulberry (Morus Rubra L.) in Canada (Kevin Burgess and B.C. Husband)

Invasive Species Control in the Carolinian Zone of Southwestern Ontario: Controlling the Spread of Tree-of-Heaven (Ailanthus Altissima) within Rondeau Provincial Park (Colette Meloche and Stephen Murphy)

Environmental Monitoring in Support of Prescribed Fire Restoration at Rondeau Provincial Park (Brent Tegler)

Vegetation Management at Rondeau Provincial Park (Dawn Bazely)

Session 6. Species Management and Change
(2:30pm-4pm: AG Theatre)

Does Reducing Deer Numbers Increase Winter Food Availability? (Stacey Chopra, Saewan Koh and Dawn Bazely)

Red Cedar Savannah: A Disappearing Habitat at Point Pelee National Park (Matthew Smith)

Evaluating the Importance of Genetic Variability to Population Viability using a Reintroduced Population of Southern Flying Squirrels (Glaucomys volans) as a Model System (Ewa Bedancrzuk and Tom Nudds)

The Status of Turtles in Point Pelee National Park: Species Loss and Shifting Population Structure (Connie Browne and Stephen Hecnar)

Appendix 3: Participant Contact Information
List of Registrants

Note: this list includes everyone who had registered either before or at the time of the conference and includes contact information for authors in this proceeding.

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PRFO extends gratitude to the Rotary Clubs of Kitchener/Waterloo and Ridgetwon for their participation in the PRFO 2002 Conference.

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