1992

National and provincial park service responses to human-induced ecological change in Ontario

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National and Provincial Park Service Responses to Human-Induced Ecological Change In Ontario

By

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B.Sc.(Honours), University of Guelph, 1988

Thesis

Submitted to the Department of Geography
in partial fulfilment of the requirements
for the Master of Arts degree
Wilfrid Laurier University
1992

ISBN 0-315-78136-X

Abstract

This study examines the human-induced ecological changes occurring in Point Pelee and Pukaskwa National Parks and Rondeau and Lake Superior Provincial Parks as a result of external threats, as well as the methods used by park managers to prevent these changes. The primary objectives were to: examine the types of external threats and their implications to ecosystems in the selected parks; examine the responses of park managers to prevent changes in ecological integrity; determine whether or not the management techniques of park managers are rehabilitating and/or preventing ecological change induced by external threats; and make an initial comparison of national and provincial park approaches to specific threats. Point Pelee National Park and Rondeau Provincial Park are comparable as they are two peninsulas on the north shore of Lake Erie, with Carolinian floral and faunal associations. Pukaskwa National Park and Lake Superior Provincial Park are similar because both parks are situated on the north east shore of Lake Superior and are in the transition zone between the Boreal Forest and Great Lakes-St. Lawrence Forest communities. External threats to these parks included exotic species, global warming, adjacent land use, shore protection, pollution, and physical removal of resources. Management responses to ecological changes resulting from these threats have not been fully identified in the study areas. Where management has been identified, often it has not been fully implemented. Both provincial parks lag far behind their national park counterparts with respect to resource inventories, information on external threats, impacts and possible management responses. The establishment of these parks does not offer adequate protection. It is crucial that both the Park Services' goals of preservation be carried out in day-to-day operations. Many important resource management concerns for both national and provincial parks may never be thoroughly addressed due to time and personnel constraints, budgetary cutbacks, and a backlog of resource management projects.

Acknowledgements

I would like to express my sincerest appreciation to my advisor, Dr. Slocombe, for his guidance and patience throughout this work. Thanks also to the members of my defence committee, Dr. P. Eagles, Dr. G. Priddle and Dr. K. Hewitt for their comments and criticisms which were invaluable in the completion of this study. Acknowledgment also goes to the Canadian Parks Service and Ministry of Natural Resources for logistical assistance. Thanks are especially given to Dan Reive and Peter Deering, Point Pelee National Park; Greg Fenton, Pukaskwa National Park; Paul Wiper, Rondeau Provincial Park; Gary Babcock, Lake Superior Provincial Park; and Alan Woodliffe, Chatham MNR for their assistance in the gathering of research materials. Appreciation is also given to the Social Sciences and Humanities Research Council for support provided through the grant awarded to Dr. Slocombe. I am also indebted to Pam Schaus for convincing me to use Corel Draw for my maps and for her expertise in their production. Grant Simpson also deserves special thanks for his invaluable assistance when the 'computers just would'nt work right'. Sincere thanks also go to John, for his love and understanding, as well as his constant encouragement and helpful discussions without which this study would not have been completed. Last but not least, I would like to thank my parents for their love and support throughout my university education, and for always encouraging me to do my best.

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Chapter 1 Introduction

1.1 Problem Statement

Environmental deterioration resulting from human activities has received increased attention in recent years. Escalating amounts of toxic pollutants in food, air and water supplies worldwide has caused humankind to take notice of the impacts our lifestyles have on the natural environment. We have only begun to understand the detrimental effects of our actions on natural ecosystems and are therefore limited in our attempt to mitigate these impacts. As the human population continues to grow at an ever increasing rate, the impacts on the natural environment will undoubtably increase as well.

The few natural areas which remain today may not survive into the near future as they may not be able to withstand increasing rates of human assault. Many of these natural areas are our national and provincial parks. Parks are particularly at risk from environmental degradation because they are subject to stress and damage from both internal human uses and external influences. Canada's national and provincial park services have the responsibility of protecting the natural environment from these influences, while providing tourists the opportunity to experience natural values. The tension between resource protection and visitor use is difficult to manage (see section 2.3.5), as many vacationers view the natural environment only as a scenic backdrop for their recreational activities. In many cases, developments designed to service tourists cause an erosion of the environmental values which initially attracted people (Nelson 1978, Field 1990). One could argue that continued development of the tourist industry depends on the maintenance of the resources on which it is based. To some extent, visitor impacts may be controlled by reducing the number of visitors allowed into a park, or by restricting access to certain park habitats. These preventative measures are a beginning for preserving a park's natural environment.

For this thesis, the issues of special concern are the detrimental ecological changes occurring in national and provincial parks as a result of insidious external threats. Particular interest also lies in any methods used by national and provincial park managers to prevent these changes from occurring. A comparison of different park approaches when dealing with external threats may allow important aspects and trends to be observed more readily.

All too often park managers are overwhelmed by the difficulty involved in protecting park habitats from outside influences. Of great concern, therefore, is how park managers are to guard against many of the external threats and stresses of the modern world such as acid rain, global warming, air and water pollution, and toxins in the food chain. In most cases park habitats are changing despite their supposed protection. Often, these priceless areas are surrounded by rapidly changing land. Many parks are too small to adequately represent a region's biological diversity. The wilderness which once buffered many parks has retreated. Critical habitat outside many parks is fragmenting and shrinking due to extensive deforestation and the general proliferation of human activity.

Humankind has the knowledge to map crucial habitats of endangered species, protect them from human intrusion, and even improve them by active manipulation. In many cases the park services lack either the specialized personnel, funding, or the political power to accomplish many of the immediate research and resource management duties needed to preserve biological diversity (see sections 2.3.6 and 2.3.7). Many detrimental ecological changes occur as a direct result of human activity altering natural processes. These processes include frequency of fire, predator-prey relationships, and hydrological and geological cycles. The human-induced ecological changes associated with these cycles may remain unnoticed for many years. Once the changes become noticeable it may be too late to prevent further degradation or initiate rehabilitation. Difficulty also lies in distinguishing between naturally occurring changes and those which are human-induced.

1.2 Topic of Research

This thesis is an examination of the types of external threats and their implications for ecosystems in selected Ontario parks, both national and provincial, and the responses of park managers trying to prevent changes in ecological integrity. Recently, it has been proposed that national and provincial parks and other protected areas be used as benchmarks for measuring human-induced ecological changes. Human activities tend to simplify ecosystems by reducing species diversity and gene pools; disrupting or destroying food chains; and altering biological/geological cycles (Finkelstein 1990). It has been suggested that the effects of human activity on the natural environment can best be observed in preserved natural areas (Conservation Foundation 1985, Finkelstein 1990, Woodley 1990). Much of the literature agrees that serious human-induced ecological changes modify the natural environment which parks and related reserves are supposed to protect (Lamprey 1972, Parks Canada 1981, Dickenson 1985, Machlis and Tichnell 1985, Quigg 1987, National Parks and Conservation Association (NPCA) 1988, McNamee 1989, Finkelstein 1990, Graefe 1990). As undisturbed, natural areas become fewer and fewer, management techniques must be adaptive in order to meet the challenges presented by the modern world.

To protect ecosystems within park boundaries, both the national and provincial parks have set objectives which are to guide preservation. Management must then work towards these goals. The objective of the Canadian National Park System is "to protect for all time those places which are significant examples of Canada's natural and cultural heritage and also to encourage public understanding, appreciation and enjoyment of this heritage in ways which leave it unimpaired for future generations" (Parks Canada 1983). Provincial parks are "to protect the provincially significant natural environments incorporating cultural, natural and recreational features" and to "provide opportunities in areas of outstanding recreational potential associated with the natural environment of the park" (Ontario Ministry of Natural Resources (OMNR) 1979). Commercial activities based on natural resources such as timber harvesting, trapping, and fishing are also allowed in some national and provincial parks, which may be contrary to park policy. Preserving park ecosystems involves preventing ecological changes induced by internal and external threats.

For the purpose of this thesis, the following definitions will be required: internal threats arise from activities within parks, external threats arise from activities occurring outside park boundaries (Conservation Foundation 1985), and ecological integrity, as defined by Woodley (1990, p9),

> is a state of ecosystem development that is optimized for its geographic location, including gross energy input, available water, site nutrient capital and colonization history. For national parks, this optimal state has been referred to by such terms as natural, naturally evolving, pristine and untouched. It implies that ecosystem structures and functions are unimpaired by human-caused stresses and that native species are present at viable population levels. Ecosystems with integrity do not exhibit the trends associated with stressed ecosystems. [Parks] are part of larger ecosystems and determinations of integrity in [parks] must consider these larger ecosystems.

In summary, the primary objectives of this thesis are to determine whether or not the management techniques of provincial and national parks in Ontario are rehabilitating and/or preventing ecological change induced by external threats. It will also permit an initial comparison of national and provincial park approaches to specific threats. By focusing on both national and provincial parks, differences in management techniques and their effectiveness for similar threats in similar areas may be determined. There has been some work on the techniques park management may use to prevent ecological deterioration, but a comparison of park approaches and their effectiveness to specific threats has not knowingly been undertaken. This thesis is intended to contribute an original comparison of national and provincial park strategies to particular threats.

1.3 Practical Relevance of Research

The proposed thesis is of particular importance to ecological and other professionals managing for ecological integrity. In more specific terms, the principle objectives of this dissertation pertain to specific external threats, and management techniques which may assist managers in preventing detrimental changes in ecological integrity. Areas requiring further research, monitoring, or new techniques to be used in preventing ecological deterioration may also be identified. By examining the dynamics of external threats to parks in Ontario, a greater awareness of the complexities involved in maintaining ecological integrity may be obtained. A comparison of park approaches and their effectiveness to specific threats may assist park managers in the decision-making process of park management.

1.4 Methodology

The data used for analysis in this study was obtained at the park level. Four parks were chosen, to allow a comparative assessment, and an extensive review of the external threats, the human-induced ecological changes that have occurred or are occurring, and the current management practices used to prevent these changes. This involved:

1) a review of the appropriate literature such as the management plans and specific studies completed in or for these parks.

2) development of a checklist for reviewing threats, ecological changes, and management responses, based on the literature review. (see Appendix A).

3) the checklist provided a framework for interviewing permanent park personnel such as the superintendent and park wardens to obtain current data on park status, threats, and management procedures. Interviews were restricted to park staff as it was felt that they would be most knowledgeable and would be readily accessible. A greater number of personnel were interviewed in the national parks than provincial parks because national parks have more permanent staff positions. Interviews were also performed according to staff availability. These data permit a comparison of parks with each other, the literature, and their own goals and objectives. The four parks chosen were Point Pelee and Pukaskwa National Parks, and Rondeau and Lake Superior Provincial Parks.

The literature review was completed in May 1991 so that field research could begin with Point Pelee National Park in June. Research began in Point Pelee as permission was granted quickly and its location is relatively close to Kitchener-Waterloo. In the event of further data being required, this park could easily be re-visited. Visits to Pukaskwa National Park and Lake

Superior Provincial Park were combined in July to reduce travel time and expense. Research in Rondeau Provincial Park was delayed until permission was granted in September.

Data collection included 5-7 days of field research in each of the four parks except Rondeau Provincial Park. Three days were spent in Rondeau and two days in Chatham since information from Rondeau's library had been moved to the Ministry of Natural Resources office in Chatham. Time was needed between each field session in order to gain research permission for each park, travel to the parks, and to do an initial interpretation of findings to ensure accuracy and completeness of data. This ensured the initial objectives were met. Once the data had been collected in each park, 3-4 weeks were required for the compilation of data before analysis could begin. Data analysis was ongoing through the writing phase until completion of the thesis in April 1992.

1.5 Outline of the Study

This chapter introduced the topic, rationale and practical relevance of the research as well as describing the methods. Chapter two contains a review of the pertinent literature beginning with a short history of national and provincial park evolution in Canada and the reasons for maintaining ecological integrity in these parks. A summary of threats and future prospects of parks is also included. Subsequent chapters include a description of the study areas, results from the data collection, and a thorough discussion of the results. Finally, a review and summary of the key and unique observations as well as a few recommendations conclude the study.

Chapter 2 The Concept of National Parks and Their Problems

2.1 The Evolution of National and Provincial Parks in Canada

The term 'national park' was described as early as 1832 in the United States by George Catlin, a lawyer, artist, and explorer (Nelson 1978, Machlis & Tichnell 1985). He envisioned setting aside a portion of the northern Great Plains to preserve 'native man and beast, in all of nature's beauty'. In this way, people could witness the conditions that prevailed when the area was first visited by the white man. The original idea was that a national park would represent a vignette of primitive America. This wilderness image strongly reflected the romantic poetry, literature, and art with which it was associated during the 19th century (Nelson 1978, Bratton 1985). Unfortunately, the native Americans were incompatible with the economic aspirations of the settlers. This led to their elimination from the wilderness and eventually from the national park concept.

The idea of setting aside a portion of primitive America worked its way into the consciousness of the people and eventually into the legislation of the U.S. with the establishment of Yellowstone National Park in 1872. These lands were set aside to preserve spectacular scenery, curiosities, and wonders of nature for people to enjoy and to prevent otherwise inevitable commercialization and despoliation (Machlis & Tichnell 1985, Chase 1986, NPCA 1988 V.1). This concept rapidly diffused to many parts of the world.

The dawn of the national park concept in Canada began with the creation of the Rocky Mountain Park in 1885, which was later renamed Banff National Park (Seale 1982, Canadian Parks Service 1988). The first parks in North America were established in an environment of nationalism and romanticism, with the emphasis being placed on spectacular scenery and interesting natural features (Nelson 1978, Bratton 1985, Lothian 1987). Yellowstone was used as a model for Canada's first parks, but the motives were notably different. The U.S. set aside the Yellowstone Lake area because many people were appalled by the ability of the American economy to strip the land (Chase 1986, NPCA 1988 vol.1). Conversely, when the railroad workers discovered the hot springs in Banff in 1883, the Canadian government saw a commercial opportunity.

The primary reasons for the establishment of Canada's first National Parks were the anticipated tourism and associated economic returns (Seale 1982, Lothian 1987, Nikiforuk 1990). The Prime Minister of the day, Sir John A. Macdonald, intended them to become tourist resorts rivalling the great spas of Europe. As first class resorts they would attract a wealthy international clientele to generate desperately needed income for both the federal government and the Canadian Pacific Railroad, who were staggering under the economic strain of completing the transcontinental railway.

Canada's provincial parks were also born from this notion. Algonquin was the forerunner of the over two hundred parks that now make up the provincial park system in Ontario. This park was established in 1893 when the government reserved a portion of ungranted Crown land to be set aside as a Forest Reservation and National Park. Algonquin Park was also to be used as a refuge from city life and as a health resort. Management of these lands were later transferred to the provincial government and the name was changed to Algonquin Provincial Park.

The National Parks Act of 1930 dedicated the parks to the people for their benefit, education, and enjoyment. It also stated that the parks were to be maintained and used in ways that left them unimpaired for future generations (Parks Canada 1981). The Provincial Parks Act (1954) was similar in devoting land to the people for their enjoyment, and that the parks should be maintained for the benefit of future generations. Emphasis was not placed on leaving the provincial parks 'unimpaired' for future use, importance was placed on visitor enjoyment and education.

Ottawa accentuated commercial tourism which greatly influenced the early character of both national and provincial parks. Developing facilities to encourage tourist use and to increase visitation was the basis for establishing many parks. This trend lasted for decades. After World War II, with the production of quality light-weight camping equipment, rising mobility, incomes and leisure, as well as the installation of paved roads to remote spots, North American wilderness recreation increased tremendously (Iles 1981, Seale 1982, Bratton 1985).

During the 1950's a rationale for further establishment of Ontario Provincial Parks was developed. This resulted from a growing demand for diverse recreation and a government which set up departments to deal with recreation. Although Provincial Park Policy recognized recreation as the primary use, the type of recreation considered suitable in the parks changed during this time. The presence of private cottages on public lands was regarded as unsuitable and the government formulated a policy prohibiting further development of cottages (Wickens 1977).

In the late 1960's, the consciousness of the public shifted towards ecological awareness and the preservation of natural systems. This concern for the environment set the stage for the current Parks Canada Policy which was developed in the late 1970's (Bratton 1985). The Policy stated that national parks are to protect, for all time, representative natural areas of Canadian significance, and to encourage public understanding, appreciation and enjoyment of this natural heritage so as to leave it unimpaired for future generations (Parks Canada 1981). The primary objective of Canadian national parks is the preservation of natural heritage values. Recreation is only supposed to be encouraged if it is directly related to those natural resources, and only if the provision of recreational opportunities does not entail 'unacceptable' deterioration of the resources (Parks Canada 1981, Canadian Parks Service 1990). Examples of generally accepted activities are hiking, bird watching, canoeing, cross-country skiing, and camping. Examples of unacceptable activities include hunting by non-native people, and the use of snowmobiles, off-road vehicles and power boats.

Presently, the National Parks System Planning Framework classifies Canadian lands and waters into 39 Terrestrial Natural Regions (Fig. 2.1) and 29 Marine Natural Regions (Fig. 2.2) based on physiographic and biological features (Canadian Parks Service 1991a). The System's goal is to represent each natural region in at least one National Park. The National Park System is organized into three broad categories: National Parks, National Marine Parks, and National Historic Sites and Canals. Each category has its own set of goals and objectives, contributing to the National Park purpose. Of the 39 Terrestrial Regions, 21 are represented in the present system, of which eight contain more than one National Park. This means that the terrestrial portion of the system is 54% complete (Canadian Parks Service 1991a). Only one Marine Region

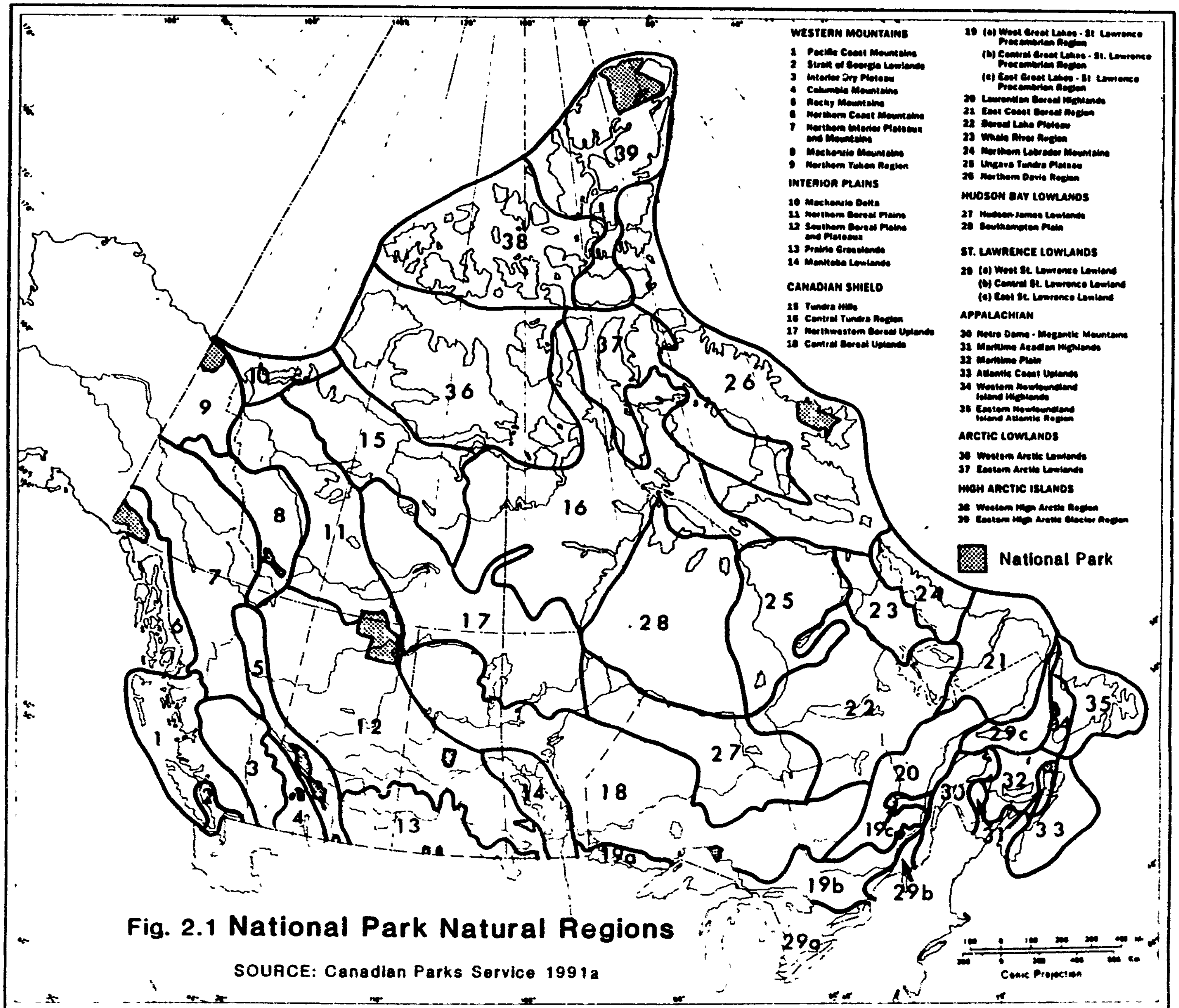
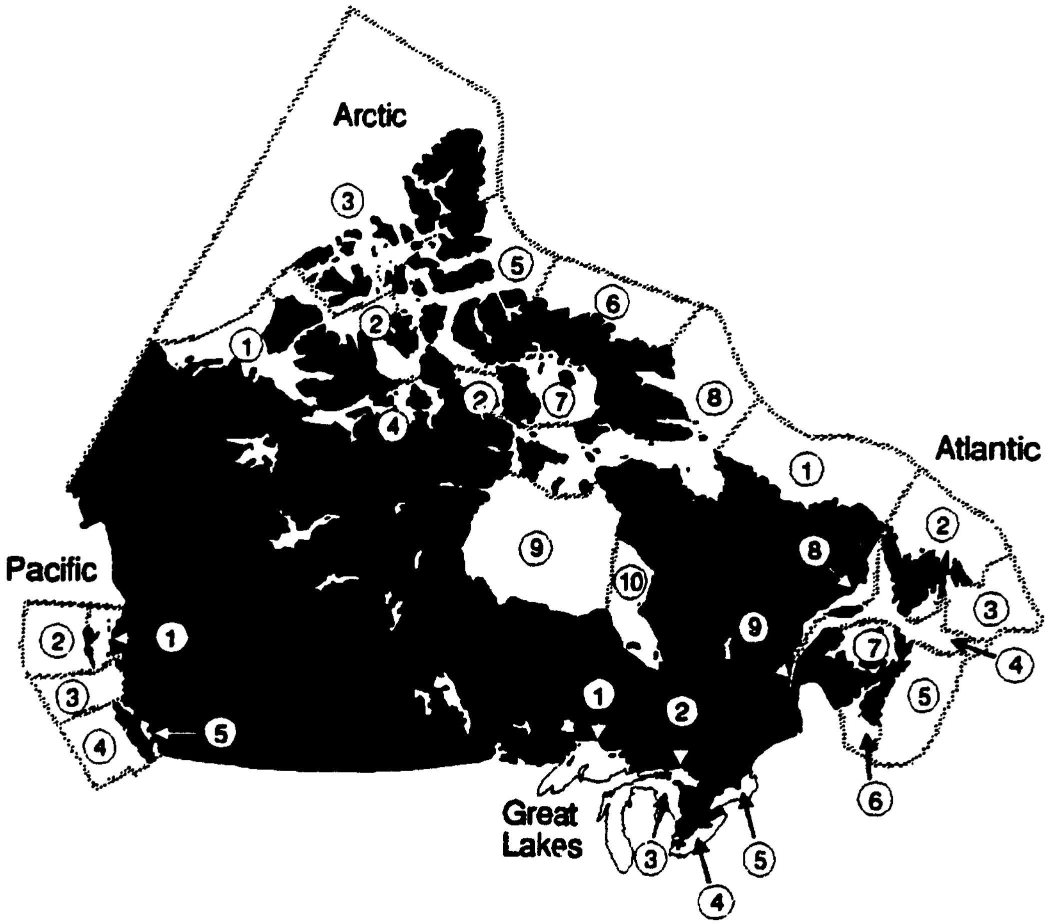


Fig. 2.1 National Park Natural Regions

SOURCE: Canadian Parks Service 1991a



Arctic Ocean

1. Beaufort Sea
2. Viscount Melville Sound
3. Northern Arctic
4. Queen Maud Gulf
5. Lancaster Sound
6. Eastern Baffin Island Shelf
7. Foxe Basin
8. Davis and Hudson Straits
9. Hudson Bay
10. James Bay

Pacific Ocean

1. Hecate Strait
2. West Queen Charlotte Islands
3. Queen Charlotte Sound
4. West Vancouver Island Shelf
5. Strait of Georgia

Great Lakes

1. Lake Superior
2. Georgian Bay
3. Lake Huron
4. Lake Erie
5. Lake Ontario

Atlantic Ocean

1. North Labrador Shelf
2. South Labrador Shelf
3. Grand Banks
4. Laurentian Trough
5. Scotian Shelf
6. Bay of Fundy
7. Magdalene Shallows
8. North Gulf Shelf
9. St. Lawrence River Estuary

Fig. 2.2 Marine Regions of Canada
Source: Canadian Parks Service 1991a, base map by Corel Systems Corporation, 1990.

is currently represented within a National Marine Park. Fathom Five is Canada's first National Marine Park, representing the Bruce Peninsula.

The present goal of the Provincial Parks system is to provide a variety of outdoor recreational opportunities ranging from high-intensity day use to low-intensity wilderness experiences, and to protect provincially significant natural and cultural environments (OMNR 1978). These parks are intended to provide visitors with opportunities to discover and experience the distinctive regions of Ontario. To accomplish this, the Ontario Provincial Parks System has classified its parks into six broad categories: Wilderness Areas, Nature Reserves, Natural Environment Parks, Provincial Waterways, Historical Parks, and Recreation Parks (OMNR 1978). Each of these broad categories has particular purposes, characteristics and management. This classification ranges from strictly protected natural areas to highly developed recreation facilities. Each park is also divided into specific zones which categorizes park lands according to their significance for protection and their potential for recreation within the context of the park's classification (Fig. 2.3). The individual parks contribute to the overall objectives of the Provincial Park System. Although all of these goals may not be met in each park, together, the six classes of parks are intended to achieve the System's purposes.

In much of Canada, tourism has been, is, and will be dependant on natural environments (Marsh 1982, Lothian 1987). Presently, national parks alone attract 20 million visitors per year; 2 million of whom are foreign visitors who spend more than $50 million during their stay in Canada (Finkelstein 1990). Parks are big business, only to become more so in the future as natural areas become scarcer. If future generations are to have a prosperous economy, we must

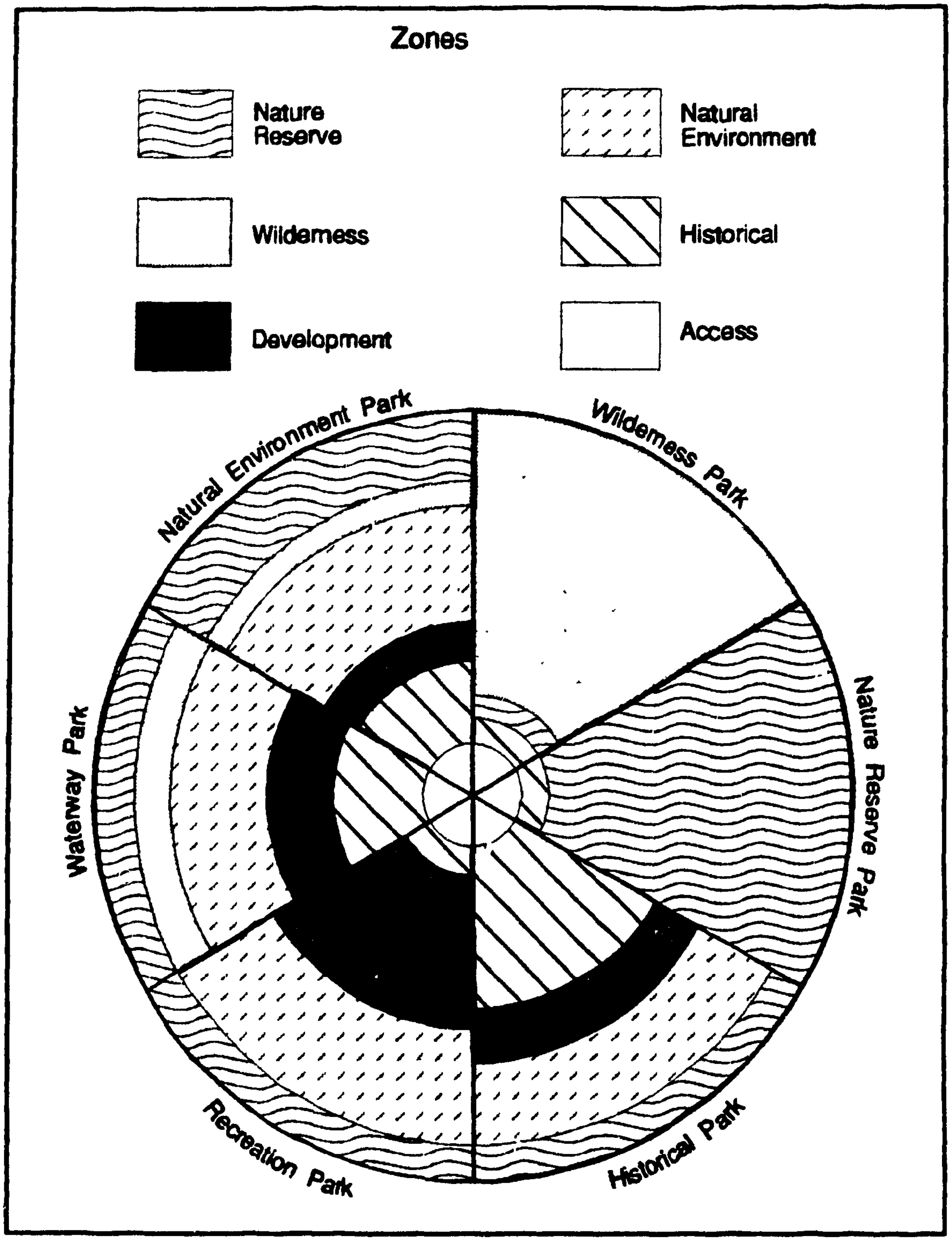


Fig. 2.3 Relation between Provincial Park Classes and Zones. This diagram illustrates the relative size and importance of various zones from each class of park, not how zones are related to each other within a park of any class. The absence of a zone within a class indicates the zone is incompatible within that class. Source: OMNR 1978

base ours on sustainable development. The Canadian Parks Service is slowly recognizing the importance of preserving our natural environment as an end in itself rather than to enhance recreation.

The past few decades have witnessed the re-emergence of native peoples in both the national and provincial park concepts. In many regions, especially in the north, park establishment cannot occur until native land claims have been settled. Traditional hunting and trapping are often the only types of resource extraction allowed. Native peoples are also becoming more involved in park operations and management.

There is a proposed Parks Canada Policy (Canadian Parks Service 1991b) which is currently under review. This proposed policy specifically stresses the mandate of protecting outstanding natural areas and historic places of national significance. The concepts in the policy clearly project the new environmental way of thinking, which has taken hold in many countries of the world. By preserving wilderness tracts and historic resources, Canadians are asserting a collective belief that the importance of these special places transcends their immediate contribution to our gross national product. Canadians are beginning to appreciate that protecting heritage resources is part of our responsibility to future generations as well as an international responsibility.

The proposed policy recognizes that ecological and historical integrity are Parks Canada's first considerations and must be regarded as prerequisites to use. The provision of recreational opportunities is similar to the present policy, in that activities which are directly dependent on heritage resources will be provided. This policy differs from past policy because it clearly recognizes the fact that public demand for outdoor recreational opportunities in a particular locality is not justification for Parks Canada's participation. The Canadian Parks Service is fully aware of the fact that they cannot be all things to all people. This proposed policy states that recreational activities which are not directly dependant on natural resources can be provided in areas that are not of national heritage significance. Provincial, territorial, municipal and private agencies will be encouraged to develop complementary recreational activities and facilities. It is likely that this policy will undergo many changes before it is accepted by the Canadian government. Hopefully, the changes will not alter its refreshing approach to greater environmental protection.

2.2 The Importance of Preserving Parks 'Unimpaired'

The idea of preserving parks 'unimpaired' began with the first national parks. The thought behind this concept was that parks were to remain unchanged for future generations. Since that time, it has become evident that landscapes are constantly undergoing change, and rather than being static, they are very dynamic. Gradually, the philosophy of preserving parks 'unimpaired' evolved to suggest that park ecosystems be allowed to follow a natural course of evolution. For this to be accomplished, park management must allow natural processes to operate unhindered by human influences. These natural processes would then be allowed to direct the natural course of evolution. Naturally occurring changes, such as succession, would be encouraged, while ecosystem changes resulting from human influences, such as the elimination of top predators, would be mitigated.

In most countries wilderness has been vanishing at an accelerating rate through urbanization and development. The pace of wilderness destruction over the past 50 years has been unparalleled since the dawn of civilization. With increasing rates of development worldwide, natural resources such as forests, minerals and clean water supplies are quickly nearing exhaustion. Conservation of the natural environment is imperative for the well-being of future generations (Myers 1983, Quigg 1987, McNeely 1989).

In order to understand the importance of these dangers, one must understand the significance of preserving parks 'unimpaired'. Protection of ecosystems is the vital reason for preserving parks 'unimpaired'. The importance of habitat preservation has been well documented in the literature (Curry-Lindahl 1972, Scott 1972, Theberge 1979, Boardman 1981, Norton 1987, Margules et al 1988). Through habitat preservation the protection of species diversity can be obtained.

Today, conserving all threatened species is beyond the combined capacities of the governments and organizations involved in conservation worldwide (International Union for the Conservation of Nature (IUCN) 1978 in Margules et al 1988). Accelerated rates of extinction have become evident within the last century. The acquisition of threatened and endangered species habitats should be the top priority of all park services if biological diversity is to be maintained. Since species will continue to evolve within these protected areas it is important that the population size is large enough for their survival, and provide enough genetic variability for their evolution to continue (Rapoport et al 1986).

The debate as to whether a single large park or reserve is more suited to conservation rather than a system of smaller reserves has continued for many years (Scott 1972, Rapoport et al 1986, Schonewald-Cox and Bayless 1986, Margules et al 1988, Margules and Stein 1989). Both large parks and groups of smaller ones are important for species diversity. In many situations groups of small reserves may encompass more species than a single, large reserve of equivalent area because they sample a greater range of habitats (Margules and Stein 1989).

Natural variety must be preserved in order to gain a scientific understanding of species, their individual characteristics, and the interrelationship between species. The importance of species diversity for future contributions to the world's nutrition and medicine has also been established (Scott 1972, Quigg 1987, Norton 1987). Preserving biological diversity means more than preventing species extinctions, it must prevent the loss of genetic diversity through the disappearance of races or distinct populations. The loss of genetic diversity equates to the loss of resiliency in species (Finkelstein 1990). Resiliency through a broad genetic base is critical for the survival of species and ecosystems during rapid environmental changes (Conservation Foundation 1985).

The diversity of a community also provides a degree of 'stability'. A very diverse community will be able to adapt and respond to disturbances more so than a habitat with fewer species (IUCN 1963). An example of this would be a mixed forest habitat containing both deciduous and evergreen trees as its dominant species. This very diverse habitat would be able to survive an invasion of spruce budworm better than a forest community containing only spruce trees.

By protecting parks we may be able to slow or reverse the current trend towards the simplification of ecosystems. Simplified ecosystems result when species are lost, gene pools are reduced, and food chains and biological/geological cycles are broken (Finkelstein 1990). Species from protected reserves may be able to re-establish themselves in former areas if unhindered by human intervention. Parks can serve many purposes such as: protection of watersheds and ground water recharge areas to insure adequate flow and quality of water downstream; minimize flooding and erosion; benchmarks for measuring environment health and change caused by human activities (Conservation Foundation 1985, Finkelstein 1990). They can protect ecological systems for the benefit of the wildlife, as well as providing unspoiled beauty to be appreciated by all people. Eidsvik (1989) listed 15 different reasons for establishing parks. He categorized these reasons as being ethical, environmental, and economic.

Finkelstein (1990) explains that human economic development must be compatible with the long-term maintenance of natural ecosystems and life support processes. Sustainable development relies on 'healthy' ecosystems where the natural life processes can operate unhindered and unaltered by human interventions and biological diversity of ecosystems are intact. Healthy ecosystems contribute to the long-term sustainability of our economies and greater qualities of life. An important reason for the conservation of wildlife and wildlands may be human survival.

2.3 Threats to Protected Areas

Today, protected areas in North America are surrounded by rapidly changing lands. There are many internal and external threats and stresses that the legal boundaries of parks cannot guard against. In 1980 the 'State of the Parks' report counted 4,345 individual threats to the U.S.

national park system, more than half of these originated outside the park boundaries (NPCA 1988, v.1). This report ranked the threats into seven major categories in order of the total number of threats reported by the park superintendents. These categories were:

1. Aesthetic degradation (land development, logging, etc.)
2. Air pollution (acid rain, pollutants, visibility, etc.)
3. Physical removal of resources (mineral extraction, poaching)
4. Exotic species
5. Visitor physical impacts (trampling, soil erosion, etc.)
6. Water quality and quantity (pollution, oil spills, etc.)
7. Park operations (utility corridors, biocides, etc.)

The most frequently reported internal threats were associated with heavy visitor use, soil erosion, exotic plants and animals, poorly designed boundaries, wildland fires, utility access corridors, poaching, inadequate facilities and park planning. The most frequently identified external threats were linked to air pollution emissions, roads, urban encroachments, and industrial and commercial development on park margins.

The 'State of the Parks' report confirmed that the problems were worse than ever before suspected: none of the parks were immune to external and internal threats; 75% of the reported threats were classified as inadequately documented and/or poorly understood. It has been argued that national parks in North America are not large enough to support the floral and faunal communities within them and the natural cycles that occur (Lamprey 1972, NPCA 1988 v.1, Finkelstein 1990). They cannot survive as intact functional ecosystems if the ecological integrity of adjacent lands is allowed to deteriorate. Protected areas which are not complete ecosystems have only recently become 'true islands' as they have been increasingly surrounded by rapidly changing land. For this reason, the impacts of many internal and external forces have only recently been felt.

2.3.1 Adjacent Land Use

The 'State of the Parks' report (1980) identified land and resource developments as the most common threat to the U.S. National Park System. Development on neighbouring lands has many profound ecological impacts including: destruction of critical wildlife habitat located outside park boundaries; increased potential impacts on watersheds within the park; species within parks are cut off from related genetic stocks preventing genetic exchange; fire suppression outside parklands may alter natural processes of succession and disturbance within parks; and air, water, and noise pollution sources are in close proximity to parklands (Telfer 1974, Winchester 1978, Dickenson 1985, Machlis & Tichnell 1985, Chase 1986, Quigg 1987, NPCA 1988 V. 1, 2, 3., McNamee 1989, Elfring 1990, Finkelstein 1990).

Growth activities of all types in and around the gateway communities of parks generate demands for services, infrastructure, and amenities within parks. While forbidding growth and change in all communities and on all public land is not desirable the NPCA (1988 v.1) stated that the public good can be served by encouraging citizens to identify and preserve those values that make their communities and public assets special.

2.3.2 Exotic Species

The proliferation of non-native floral and faunal species within parks poses a difficulty. Nearly all parks have some problem with non-natives (NPCA 1988 v.1, Finkelstein 1990). In Ontario's Point Pelee National Park 43% of the plant species are exotics (Finkelstein 1990). Some of these were introduced intentionally as ornamental flowers, trees, and shrubs to 'beautify' the park. In many national parks, such as Yellowstone, exotic species of game fish were introduced to improve the quality of fishing (Chase 1986). Accidental introductions also occur and the extermination or removal of the exotics may be difficult or very expensive.

The highest management priority is reducing the negative effects of the invading species. Indigenous components of some ecosystems have been genetically altered by hybridizing with exotic species. Alien plants and animals may reduce or exterminate many native species through predation, parasitism, and competition (Stone and Loope 1987). This may cause changes in ecosystems by reducing or eliminating populations of resident species and enhance foreign species distribution. The survival of the majority of indigenous species relies on the intensity and quality of the long-term management. Managers may never eliminate all exotic species in parks but they may reduce the impacts to preserve a considerable portion of the native habitat.

To condone exotic species would compromise the ideals of the parks. The National Parks and Conservation Association (NPCA, 1988 v.1) explains that countless compromises have already been made to accommodate visitors. Once the park ideal has been undermined, managers no longer have any absolute quantity against which to measure subsequent compromises. The ideal, though unachievable in practice, is absolutely essential if the Park Service is to maintain its identity. As unattainable as the absolutes are, the principles they represent must not be circumvented.

2.3.3 Dams

It has only been within the past 24 years that the U.S. National Park System ceased to be a prime target for dam builders with the implementation of the Wild and Scenic Rivers Act in 1968. Dams and impoundments impact the river ecology of many parks throughout North America. Controversy over how these dams should be operated still rages. Elfring (1990) discusses the question of whether operations should be set to maximum power production or should there be operational compromises to protect environmental values? There are of course many pros and cons to both sides, yet the ability of both U.S. and Canadian Park Services to demand priority for the parks is constantly challenged.

Widely fluctuating water levels are suspected to have affected the distribution and abundance of many park resources which in turn affects the overall biological production of the park (NPCA 1988 v.1, Elfring 1990). Dams have adverse affects on fish spawning and habitat, nesting habitat for waterfowl, muskrat, beaver, and other animals (NPCA 1988 v.1). An example of this is found in Barr (1986) who explained that many waterfowl must build nests close enough to water for easy access, yet far enough to prevent flooding when water levels rise. He stated that birds such as the common loon have evolved in habitats where water levels are subject to the natural rhythm of annual water level changes. The natural rhythm results in high water levels during the spring thaw, followed by gradually declining levels throughout the nesting season. During this period, precipitation seldom raises water levels enough to flood nests and the lack of it seldom leaves nests stranded far from water. Problems arise when the manipulation of water levels for hydro-electric power or reservoir impoundment disrupts the natural rhythm and exaggerates the range of fluctuation.

2.3.4 Pollution

Acid precipitation, heavy metals, and other pollutants have a wide range of detrimental effects on the environment. While the expanse of literature on this subject is endless, the role of pollutants in long-term effects on plants and animals is still not fully understood. Science is only vaguely aware of the combined effects of pollution on the environment.

It is well known, however, that acid deposition: disrupts inorganic nutrient processes such as cation exchange capacity; causes organic matter, nitrogen and phosphorous depletion; disrupts biological processes in soils such as microbial activity, soil invertebrate activity and mycorrhizal relationships; physically damages foliage; and reduces growth, resistance to disease and reproduction rates of aquatic invertebrates, fish and amphibians (Winchester 1978, Lozano and Morrison 1981, Amthor 1984, Darveau et al 1989, McNamee 1989, Federal/Provincial Research and Monitoring Coordinating Committee (FPRMCC) 1990).

There is evidence to suggest that acid precipitation also increases the solubility in runoff of several toxic heavy metals such as mercury, lead, manganese, aluminum and cadmium. These metals, formerly bound in sediments, become more soluble in waters of low pH and are available for assimilation by living organisms. Biological concentration of these metals are a potential health threat to mammals and birds which regularly consume aquatic biota. There is indirect evidence of a relationship between surface water acidification and high levels of mercury observed in many large sport fish in Ontario and of cadmium accumulation in moose and deer in certain areas (FPRMCC 1990). In these regions, some sport fish and the livers and kidneys of moose and deer have been declared unfit for human consumption.

The Assessment Report by the Federal and Provincial Research and Monitoring Coordinating Committee (FPRMCC 1990) summarizes the scientific understanding of the effects of acid deposition on terrestrial and aquatic ecosystems. Most noteworthy is the fact that the total number of aquatic species starts to decrease at pH levels less than 6.0 with an accelerating continuum of losses as pH declines further (Table 2.1).

Effects of acidification on aquatic biota, mammals and wetland birds occur through changes in abundance of both prey and predator species as well as the quality and quantity of their food supply. The FPRMCC stated that a pH of at least 6.0 must be maintained to ensure the continued presence of biota in aquatic ecosystems. Temporary episodes of acidification may also produce conditions that are lethal to aquatic biota. Storage of acids within winter snowpack can lead to the release of exceptionally high concentrations of sulphate during early melt stages which may cause short-term acidification of surface waters (FPRMCC 1990).

2.3.5 Visitors

National and provincial parks have a dual mandate: protection and use. The tension between natural resource protection and visitor use is difficult to manage. According to Canadian and U.S. national park policy, managers must allow compatible visitor uses which leave the natural environment unimpaired for future use (Parks Canada 1981, NPCA 1988 v.3). The application of these objectives to real parks is difficult because of the vague terminology such

	pH 6.0 - 5.6	pH 5.5 - 5.1	pH 5.0 - 4.0
Fishes	common shiner, fathead minnow, slimy sculpin, blacknose shiner, bluntnose minnow	lake trout, white sucker, walleye, smallmouth bass, lake whitefish	yellow perch, brook trout, Atlantic salmon
Algae	odiferous algae*, shoreline algal mats*		
Zooplankton	water flea	2 copepod species	
Zoobenthos	3 crayfish species, freshwater shrimp, 1 snail species, 7 mayfly species	1 amphipod species, 5 leech species, 3 mayfly species	4 mayfly species
Amphibians			many frog, toad, and salamander species
Wetland Birds	common loon	osprey, ring-necked duck	tree swallow

Table 2.1 Examples of losses or appearances (denoted by *) of aquatic species in Canadian waters for three pH classes between pH 6.0 and 4.0. In general, fewer fish, algae, zooplankton, and zoobenthos species are present as pH decreases. Source: Federal/Provincial Research and Monitoring Coordinating Committee (FPRMCC) 1990.

as 'compatible visitor use' and 'unimpaired'. Park managers must evaluate the environmental impacts of specific proposed developments and activities against these general terms and provide effective solutions to problems arising day-to-day.

In recent years the pressure to develop parks for tourism has increased dramatically throughout North America. Visitor impacts are the most frequently mentioned natural resource management problem (NPCA 1988, Finkelstein 1990). When many of the national parks were established in North America, they were islands of civilization in a sea of wilderness; the situation is now reversed. If development continues to erode the parks the opportunity to protect them will be lost. Without ecological integrity the parks will no longer represent the natural regions of Canada and will have contributed to the extermination of species. The wide array of resource impacts from visitor use and abuse can easily be found in the literature complete with lists of recommendations (Conservation Foundation 1985, Frome 1985, NPCA 1988 v.3, Graham and Lawrence 1990).

Most park policies recognize that nature preservation and tourism provision are worthwhile endeavours, yet it is still politically expedient to justify parks solely on the basis of tourism. The view that large natural areas are a waste of resources unless they can produce tourism revenue remains as a large obstacle. Total elimination of recreational uses from parklands is not an option except for extremely sensitive areas. This management option is not desirable because the contact between people and nature is more likely to increase public and political support for wilderness protection (McNamee 1989).

2.3.6 Political and Park Operational Threats

Within the U.S. and Canada chronic understaffing and lack of expertise in resource disciplines is found within the Park Services. There are growing records of politically-motivated interventions in park resource management and park protection decisions that are undercutting the mission of both National Park Services. The most disturbing political intervention is the manipulation of park boundaries for short-term economic gains such as logging, mining, and oil and gas exploration. Political manipulation of the boundaries intensifies the park's ecological inadequacies by reducing the area of protected habitat. The Canadian parliament can change park boundaries through legislation and has done so many times, often to the detriment of the park, and often late on a Friday afternoon with no public or parliamentary discussion (McNamee 1989). The boundaries of Banff National Park have changed 10 times since the park's establishment in 1885 (McNamee 1989), and it is now barely half its original size (Finkelstein 1990).

If the Park Services are to effectively care for the parks and their irreplaceable natural resources, resource management must have top priority. Finkelstein (1990) noted that in Canada there are very few field staff carrying out biological or ecological research on a full-time basis. Outside experts carry out research with park staff providing managerial and technical assistance. Park managers need to understand natural ecosystems if they are to answer the complex management questions of how to adequately protect parks from the numerous threats. Unfortunately basic research alone will not solve increasing problems and issues threatening protected areas. It must be professionally applied to park management in order to effectively preserve natural areas. Protected areas face many threats but ignorance is the greatest. To date, Finkelstein (1990) found there is little research to indicate how well Canadian protected areas are doing in meeting their conservation mandate, or even research on how to measure this.

2.3.7 Park Budgets

Budget restraint is a standard feature of the North American Park Systems. There are two forms of restraint that are used; the actual reduction of the annual budgets from one year to the next, or a yearly increase in the budget at levels below the rate of inflation (Eagles 1985). Park budgets are not equally distributed to all areas of management. In the U.S., for the period 1982 through 1985, nearly one billion dollars was appropriated to fund the Park Improvement and Restoration Program, yet only 0.6% was used for significant resource problems (NPCA 1988 v.1).

The Canadian federal government has drastically reduced the National Park System's budget over the past decade. The capital budget was reduced from $114 million in 83/84 to $89 million in 87/88, and less than 2% of the annual budgets are dedicated to research (Finkelstein 1990). During the same period the work force was reduced from 5144 person-years to 4962 person-years. With decreased staffing and budgets it is virtually impossible for the park service to adequately protect parks against escalating threats. Budget and manpower cutbacks in Canada and the U.S. have occurred in natural resource conservation, research, and interpretation (Eagles 1985, Finkelstein 1990).

Resource management research and interpretation are the basics of the mandate and philosophy behind the national parks, yet these functions are cut back before law enforcement, maintenance of visitor facilities, and transportation corridors. Resource management is often at a disadvantage when competing for available funds. Visitor needs are immediate problems that can easily be identified and remedied. Visitors also tend to complain about the lack or condition of facilities until changes and improvements are made.

Finkelstein (1990) stated that there is a positive side to the increasing fiscal restraint. Some parks are developing innovative means to carry out their mandates by developing volunteer programs, cooperative associations, as well as agreements with other government agencies and universities for research in the parks. This has also enhanced the regional integration of parks with the local communities.

2.4 The Future of Parks

The majority of the general public is unaware of the myriad problems faced by parks today. Parks are still conceived as islands of natural beauty, but it is becoming increasingly clear that they are no longer islands, and never really were. Tourists do not concern themselves with disrupted hydrological and geological cycles, broken food chains and the fact that non-native flora and fauna inside parks are altering and pushing out native species. This may in part be due to the fact that to a great extent, the outdoor activities humans engage in are having less and less to do with nature (Nelson 1978, Dearden 1982, Marsh 1982, Scale 1982, Henderson 1986).

Many people view the natural environment as something to be conquered, rather than appreciated. Wilderness has always been the setting for humankind to test physical, intellectual, and spiritual powers but the traditional sense of exploration, and harmony with nature are fading in practice (Henderson 1986, Van Tighem 1986, Lothian 1987). Today, a greater number of people participate in impersonal, sensational activities which have little to do with the outdoor settings they will conquer. As Henderson (1986) stated, the mountain is only the medium for risk and fantasy. The majority of tourists remain content as long as parks are green and contain beautiful scenery. In some cases, visitors become involved with the plight of parks when human-induced ecological changes directly influence their enjoyment of the natural environment. Public attention and support are gained when sport fishing is destroyed by acid rain, or clear-cutting ruins a scenic vista.

The pressure to develop parks for tourism has increased in recent years as large untouched natural areas become a rarity (Nelson 1984, Western 1989, Field 1990). Since the tourist appeal of national and provincial parks is scenic, the tourist industry and park services must preserve the resources upon which this industry is based. Many of the ecological changes that are occurring to park resources are irreparable. They represent a sacrifice by the public that, for the most part, is unaware that such a price is being paid. The NPCA (1988, v.1, pg.8) explained the situation well, not only for the U.S. but Canada as well,

> Threats to parks are not new, yet with each passing year the options to halt the destruction diminish. Sometimes the threats are obvious and immediate and come with stark consequences if ignored. But the most serious and insidious problems stem from ignorance and incremental degradation: deferred maintenance, a backlog of resource management projects, a lack of strong research and monitoring programs to provide critical information on which to base management, and a bureaucracy that has yet to fully commit to research-based management, is slow to respond to changing conditions, and is often buffeted by politics to the detriment of the parks.

Park threats will likely increase in both frequency and intensity in the future. Along with the increasing population and their demands placed on the parks for recreation, the growing economies of Canada and the U.S. will increase the demand for timber, water, energy and minerals (NPCA 1988 v.1, McNamee 1989). The 'North American lifestyle' and its demand for a wide assortment of goods and services ultimately affects the future of the parks.

Many conservationists have argued that we have institutionalized and segregated both conservation and resource development rather than creatively bringing the two together in the form of sustainable development (Myers 1983, Conservation Foundation 1985, Van Tighem 1986, Norton 1987, Quigg 1987, Meine 1988, McNeely 1989, Western 1989). Sustainable development relies on healthy ecosystems where the natural processes can operate unhindered and unaltered by human interventions and where biological diversity is intact. Human economic development must become compatible with the long term maintenance of ecological integrity and continued functioning of life support processes. The future of humanity may depend upon these conditions since our destructive potential has dramatically increased in our search for raw materials and energy.

If they are to work, conservation programs must be integrated into every aspect of our contemporary lifestyle, from economic development and extractive activities to improved recycling, energy efficiency and the development of alternative energy resources. If that is to occur, public education, cooperative management outside park boundaries, policies based on credible research and statutory enlargement of parks is essential to prevent the deterioration of protected areas (NPCA 1988 vol. 3, Finkelstein 1990). Park services must complete and update resource inventories and impacts of past management activities to effectively assess the state of each park. In order to solve the present and future plight of park wildlife, managers must have knowledge of all resources located within park boundaries and the state of those resources.

Chapter 3 The Study Areas

3.1 Location of Study Areas

Ontario parks were chosen for this study because most of Canada's population, industry, and development are located within this Province. For these reasons it may be assumed that a diverse array of park threats, of varying intensities, may be encountered. Parks were chosen in southern and central Ontario to highlight differences in the type and intensity of threats based on geographic location. One national and one Natural Environment provincial park situated in similar geographic and ecological locations were chosen to differentiate management techniques and their effectiveness on similar threats in similar areas. Point Pelee and Pukaskwa National Parks, and Lake Superior and Rondeau Provincial Parks were the chosen study areas (Fig.3.1).

Point Pelee National Park and Rondeau Provincial Park are two of the three peninsulas on the north shore of Lake Erie. These sites are believed to be good examples for comparison since both parks are located within a highly agriculturalized area, have comparable associations of plants and animals, park sizes, threats to the natural environment, and recreational activities (Parks Canada 1982a, OMNR 1989a). The original Carolinian forest and wetland environments of both parks have been similarly altered by human activity. Prior to their designation as parks, these areas were used for cottaging, forestry, fishing, trapping, hunting, recreation, and limited agriculture in Point Pelee.

Pukaskwa National Park and Lake Superior Provincial Park are believed to be comparable since both parks are located on the western shore of Lake Superior, have similar associations of plants and animals, park size, type and intensities of threats and past histories (OMNR 1979, Parks Canada 1982b). These parks have been logged, trapped, and hunted, and their location in northern

Fig. 3.1 Location of Study Areas

Source: Base map by Corel Systems Corporation, 1990

Ontario removes them from the highly populated areas of the south. Geographic location is an important factor when assessing the impacts of external threats since it includes many aspects such as geology, soil, climate and human influence.

The following descriptions of the four case-studies are essential to allow assessment of the impacts of external threats. Understanding the biophysical and management characteristics and histories of the parks are necessary when making comparisons of threats and management responses. Descriptions of the two southern parks and two northern parks, have been combined to reduce the amount of repetition since these parks are very similar.

3.2 Point Pelee National Park and Rondeau Provincial Park

Point Pelee National Park, located in Essex County, is part of a 15 kilometre long peninsula extending into Lake Erie, making it the most southern point of mainland Canada (Fig. 3.2). It is one of the smallest National Parks in Canada totalling 1564 hectares (Parks Canada 1982a). This area was established as a national park in 1918 because of its importance as a stopover for migratory birds. Point Pelee is located on major continental bird and Monarch Butterfly migration routes and as a result, many southern bird species which have their northern limits in southern Ontario can be found there (Rivard et al 1981). During the migratory phenomenon, the park experiences a very high number of daily visitors. The Canadian Park Service (1989a) stated that the annual attendance for Point Pelee National Park over the period 1983-84 to 1987-88 fluctuated around 500,000 people. The peak year was 1987-88 with 530,000 visits which puts great stress on the natural environment of an area as small as Point Pelee.

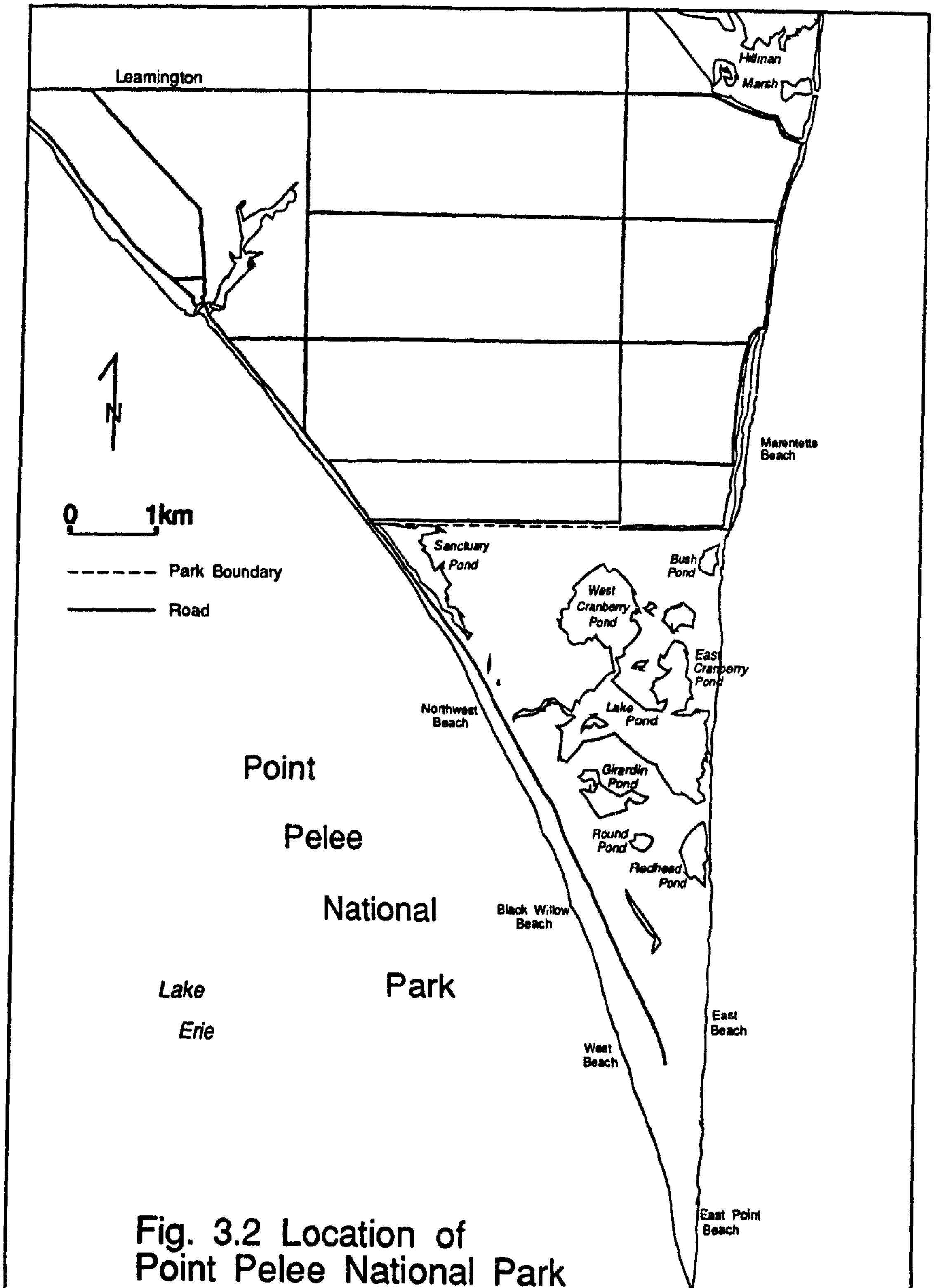


Fig. 3.2 Location of Point Pelee National Park

Source: National Topographic Series, sheets 40J/1, 40J/2 & 40G/15, 1:50000.

The Park's geographic location and physical characteristics provide an unusual habitat for several hundred plant and animal species unrepresented elsewhere in the Canadian National Park System. In recognition of its importance as one of the last large marshes remaining on the Great Lakes, Point Pelee was designated as a wetland of international significance during the RAMSAR convention in 1987 (Shaw 1989).

Rondeau Provincial Park is located in Kent County, 40 kilometres southeast of Chatham. Established in 1894, this park now comprises 3,254 hectares of dryland, marsh and part of Rondeau Bay (Fig. 3.3) (OMNR 1991a). The Rondeau Peninsula is a rounded cuspate foreland protruding 7 kilometres southward from the north shore of Lake Erie (Coakley 1985).

Rondeau is classified as a Natural Environment Park in recognition of its provincially significant landforms and associated flora and fauna, as well as its capability to provide a diversity of outdoor recreational activities (OMNR 1991a). Rondeau's unique Carolinian features are better representations of a Carolinian forest than Point Pelee. Point Pelee has southern affiliations but Rondeau's forests are more characteristic of a typical Carolinian forest. The Rondeau forest community has become well-known as one of Ontario's outstanding natural areas and the Park attracted a total of 170,800 people in 1990 (OMNR 1991c).

3.2.1 Geology

Point Pelee's origin and formation have been debated for more than fifty years. Contrary to conventional theories of sandspit formation, which generally account for their origin by the incremental accumulation of sediments deposited by converging littoral currents, Coakley (1976) and others have suggested that the Point Pelee and Rondeau forelands have undergone progressive

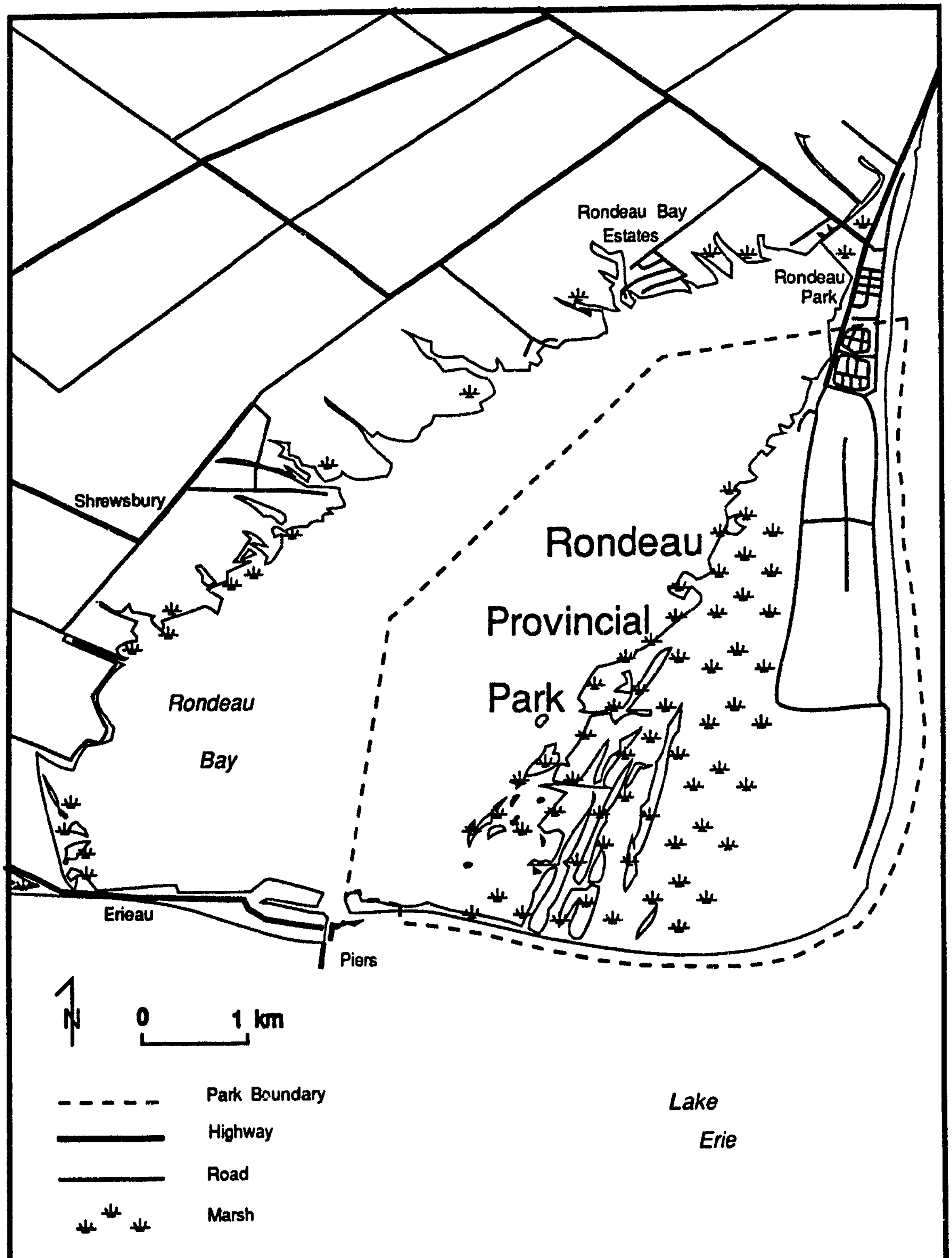


Fig. 3.3 Location of Rondeau Provincial Park

Source: National Topographic Series, sheet 40I/5, 1:50000.

erosion. Recent work confirmed that both the Point Pelee and Rondeau landforms developed initially by the progressive merging of beach ridges and dunes which formed on opposite sides of southward trending glacial moraines (Sly and Lewis 1972, Coakley 1976, 1977, 1985, East 1976, Trenhaile and Dumala 1978).

Detailed stratigraphic data collected from boreholes and seismic traverses in the Pelee area confirm the presence of a gently sloping till platform generally associated with residual deposits. The boreholes indicate limestone bedrock overlain by till and lacustrine clay, overlain by sand and peat (Coakley 1976). The average grain size distribution of the Pelee deposit is 2.5% gravel, 51% sand, 21.5% silt and 25% clay, while the average grain size distribution of the Rondeau deposit is 13% sand, 41% silt and 46% clay (Rukavina and St. Jacques 1978).

It has been suggested that the main process in the development of these forelands was the landward migration of beaches across each moraine as lake levels rose. Postglacial lake levels increased due to isostatic rebound of the lake outlet and the changing pattern of inflows from the Upper Great Lakes (Sly and Lewis 1972, Coakley 1985). It is believed that longshore movement of sediment was not an important factor in the initial formation of either the Point Pelee or Rondeau forelands (Coakley 1976, 1977, 1985, Shaw 1989) but has become the dominant process within the last 1000 years (Trenhaile and Dumala 1978, Shaw 1989). As lake sediment sources became exhausted, the role of bluff erosion and longshore movement of material increased. The source of sediment for the Pelee system is derived from the erosion of glacial material from bluffs near Colchester to the west and Port Alma to the east (East 1976). Eroded sands are carried to

Point Pelee by dominant longshore currents which flow down both sides of the foreland to the tip area. Similarly, the source of sediment supply for Rondeau is derived from the erosion of bluffs near Port Alma to the west and Port Stanley to the east (Fig. 3.4).

Coakley (1985) determined that the cross-lake morainic ridge which underlies Rondeau is at a much lower elevation than the Pelee-Lorain moraine. As a result it is not believed to have formed a land bridge across the lake during the early Lake Erie stage. He hypothesized that major sand accumulation along both sides of this broad promontory probably occurred, with the substantial littoral drift from the west eventually converting its shape into an asymmetrical cuspate foreland.

3.2.2 Topography

Point Pelee is triangular in shape with converging east and west beach ridges surrounding a central marsh. A large portion of the marsh has been drained to accommodate agricultural use. The park itself occupies the southernmost portion of the point, consisting of 451 hectares of dryland and 1113 hectares of freshwater marsh (Parks Canada 1982a). The eastern barrier ridge, along the eastern shoreline of the point, provides a physical barrier between Lake Erie and the marsh. It ranges in width from 15 to 90 metres, and is normally 1 to 4 metres high. The marsh is the largest and most significant feature of the park, with water depths ranging between 1 to 2 metres (Canadian Parks Service 1991c).

The dune complex contains the greatest local relief within Point Pelee National Park. It includes a series of roughly parallel ridges running down the northwestern flank, extending approximately five kilometres south of the park boundary. The dunes range in elevation from 2

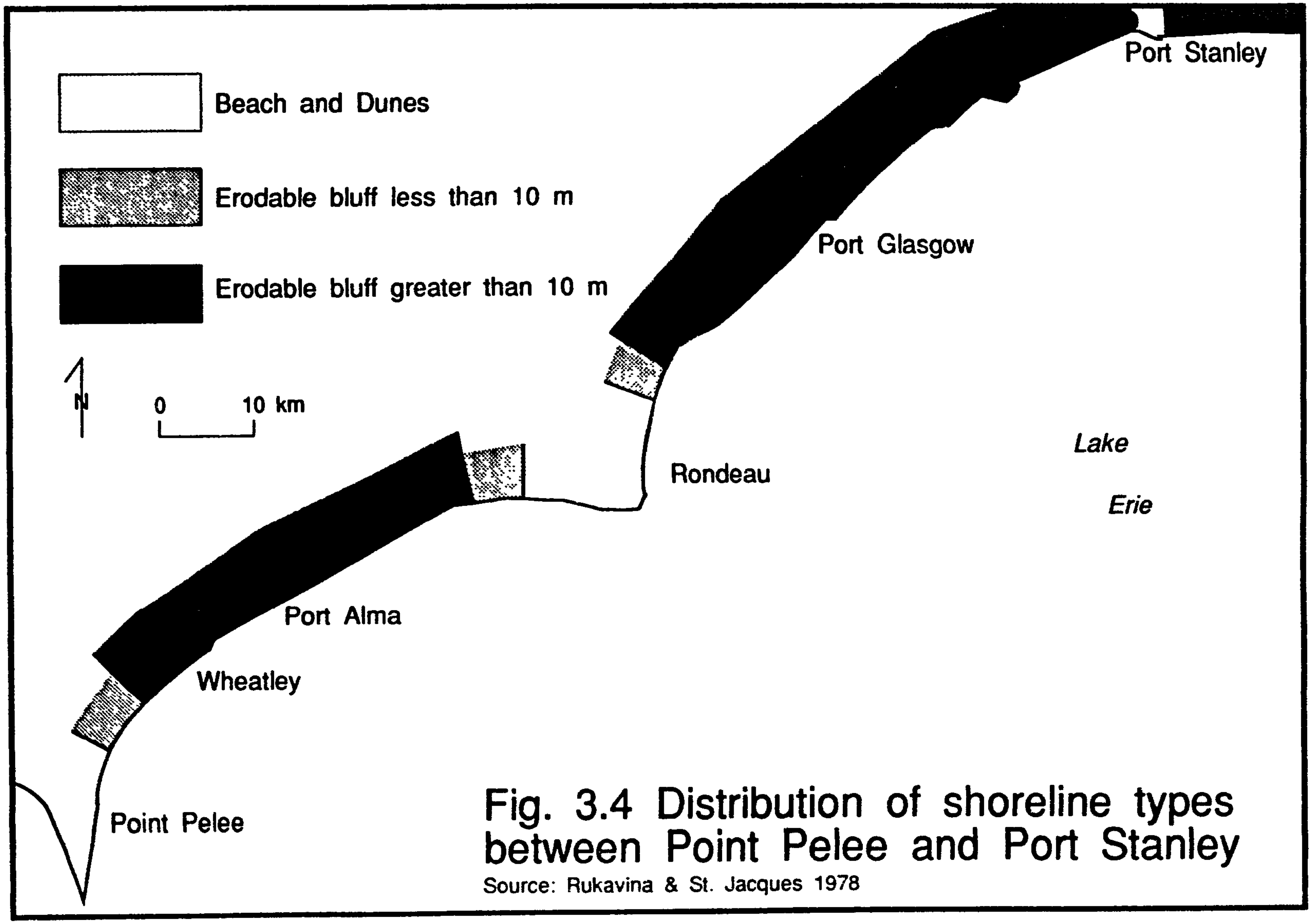


Fig. 3.4 Distribution of shoreline types between Point Pelee and Port Stanley
Source: Rukavina & St. Jacques 1978

to 8 metres above mean lake level (Trenhaile and Dumala 1978). A ridge and trough series roughly parallel to the western shoreline is located south of the dune complex. These low ridges are generally less than a metre in height and have flat bottomed intervening swales (East 1976). An extensive tract of low relief (1-3 m above lake level) separates the dunes and ridges from the marsh. These sand plains have a maximum width of 0.4 kilometres near the southern terminus of the marsh, tapering northwards for about 3 kilometres until the dunes impinge directly onto the marsh (Trenhaile and Dumala 1978). The parallel beach ridges on the west shore, combined with the westward migration of the eastern ridge, indicates that the point is gradually migrating westward.

The Rondeau Peninsula is also triangular in shape with exposed sides bearing approximately north-south and east-west (Crysler and Lathem 1973). From its junction with the shoreline, the eastern arm widens from approximately 0.5 kilometres to 2 kilometres near its southern extremity. The southwestern arm is much narrower (less than 100 metres in places) and is occupied in part by the town of Erieau (Coakley 1985).

This foreland totally encloses Rondeau Harbour comprised of 30 square kilometres of pond and marsh. The harbour averages less than 4 metres in depth. The entire Rondeau formation is made up of a system of linear ridges and swales generally aligned along a north-south axis (Warren 1974). At the western edge of the system, the sand ridges become lower and are eventually covered by the waters of the harbour. Toward the south end, the number of ridges increase and tend to be wider spaced with broad wet swales between them, giving the park a fan shape.

The ridges are usually less than 5 metres in height, and similar to Point Pelee, correspond to prior positions of the shoreline (Coakley 1985). The alignment of some of the major ridges, in addition to the relative widths of the beaches, indicate a gradual accretion and advance toward the east, while the west side is steadily eroding. It is noteworthy that this is the reverse of the situation at Point Pelee.

3.2.3 Soil

The soils of Point Pelee and Rondeau have developed in a deep cover of overburden on limestone bedrock and black shale (Sly and Lewis 1972, Chapman and Putnam 1984). The prevailing soil type of the area is Brookston clay-loam which is a dark-coloured gleysolic soil that developed under a swamp forest of elm, black and white ash and silver maple (Chapman and Putnam 1984). The terrestrial portion of Point Pelee National Park includes till, sand, and clay plains (Chapman and Putnam 1984), while the aquatic substrate consists of clay and peat overlain by sand (Canadian Parks Service 1991c). The soils of Rondeau Provincial Park are all fine, white, water washed sand. In the low areas, bogs consist of organic peat soil (Crysler and Lathem 1973).

3.2.4 Hydrology

Large portions of Essex and Kent Counties have such imperfect drainage that ditches and tile underdrains have been installed to provide satisfactory conditions for crop growth (Chapman and Putnam 1984). Point Pelee National Park is physically separated from the agricultural land by man-made dykes and ditches that run along the northern park boundary. As a result, Point Pelee's marsh is essentially a closed drainage system. Rondeau's marsh differs from that of Point Pelee in that it is in direct contact with Lake Erie via Rondeau Harbour. Since there are no rivers or creeks that drain either park, water movement in both Pelee and Rondeau is primarily in the form of groundwater. These forelands are supplied with water from a high water table associated with Lake Erie water levels. Seasonal variations of water levels in troughs are associated with groundwater movement in response to fluctuating lake levels and relative distance from the lake (Canadian Parks Service 1991c). The alternating pattern of land and water provides dry and wet habitats which contributes to species diversity.

Periodic breaches and percolation through Point Pelee's east barrier ridge allows water exchange between the marsh and Lake Erie. Changing water levels in Lake Erie cause adjustments in marsh water depths in the short term due to seiches, and in the long term in relation to cyclic lake levels (Canadian Parks Service 1991c).

3.2.5 Climate

Rondeau and Point Pelee have similar climates due to the moderating effects of the Great Lakes. Generally, these effects tend to reduce the daily range of temperature of both Point Pelee and Rondeau and prolong the frost-free season from 160 to 170 days (Chapman and Putnam 1984). Mean temperatures in the area range from 13 to 23 degrees celsius during the summer months of May to September (Environment Canada 1973a). During the coldest months of January and February the mean temperatures average -4 and -3 degrees celsius respectively. Rainfall in the summer averages 7 centimetres per month, while snowfall averages 25 centimetres for the period of December through March (Environment Canada 1973b). Prevailing winds throughout the year are generally from the west and southwest (Coakley 1977, Crysler and Lathem 1973).

3.2.6 Flora and Fauna

There are two ecosystems represented in both Point Pelee National Park and Rondeau Provincial Park, the Southern Great Lakes Marsh and the Carolinian Forest. The marsh and forest ecosystems are similar in each park as they are comprised of many plant and animal species which are typical of more southerly regions of eastern North America. Both ecosystems are visibly dynamic as they contain species adapted to a range of conditions. They respond to changes in the moisture regime through shifts in species composition. The transitional zones between marsh and terrestrial environments contain the highest vegetative diversity. These zones are susceptible to periodic and seasonal flooding causing the vegetation communities to reflect the changing moisture conditions over time.

In Point Pelee, the Southern Great Lakes Marsh occupies 71% while the Carolinian Forest occupies the remaining 29% of the total park area (Canadian Parks Service 1991d). The Southern Great Lakes Marsh ecosystem includes all the marsh area, including the open water and pond edges (Canadian Parks Service 1991d). The marsh and surrounding terrestrial habitat within the park provide food and shelter for approximately 350 species of birds, including 25 provincially rare species. The importance of Point Pelee and Rondeau as sanctuaries for migratory birds is emphasized by land use in the surrounding area. Presently, 97% of significant wetland habitats have been lost to other land uses (Canadian Parks Service 1991c).

Both southern parks support species assemblages of mammals, reptiles, amphibians and fish typical of the original West St. Lawrence Lowlands. The large community of reptiles and amphibians in Point Pelee consists of 34 recorded species, some of which are rare or endangered (Kraus 1990). The Park's marsh has a very productive and diverse fish community with healthy populations of sport and non-sport species. In Point Pelee, the Carolinian Forest ecosystem includes mature (closed canopy) forest, early successional (open canopy) forest, ridge and trough swamp forest, shrub thickets, Red Cedar Savanna, sand prairies, dune systems, and the transition zones among these vegetation types. More than 670 vascular floral species have been recorded at Point Pelee, 70 of which are rare in Ontario or Canada (Canadian Parks Service 1991c). Approximately 40% of the terrestrial area of the park is in early successional stages as a result of agricultural abandonment since establishment of the park (Canadian Parks Service 1991c).

The southern hardwood forest occurring within Rondeau Provincial Park is one of the largest remaining tracts in southwestern Ontario and a similar complex does not exist within the province (Haggith 1982). Besides its diversity of herbaceous species, with a total of 337 recorded species (Bakowsky 1988), the forest also contains many imposing individual specimens of trees. Twenty-two species of Carolinian trees and shrubs occur or have occurred at Rondeau (OMNR 1991a). The present forest is the result of regeneration and natural succession which occurred after selective logging in the late 1800's. The carrying capacity of the Rondeau Forest is limited mainly by the presence of light sandy soils and high water table, which makes it susceptible to windthrow (Yaraskavitch 1983).

Indigenous white-tailed deer, *Odocoileus virginianus* had become a controversial component of both Point Pelee and Rondeau due to the negative influence on the forest vegetation. The Canadian Parks Service proceeded with a cull in Point Pelee during the winter of 1990-91 with the intent of keeping the deer population at an acceptable size (Deering interview 1991). OMNR had planned a similar reduction for Rondeau's population during the winter of 1991-92 but has yet to execute the cull (Woodliffe interview 1991). The overpopulation of deer is not a new problem in Rondeau, the past 70 years have been marked by overbrowsing, sporadic deer control and fluctuating forest regeneration (Haggith 1982, Yaraskavitch 1983). Browsing of seedlings by deer was suspected to be regulating species composition and recruitment into the lower forest canopy. The current browsing pressure is curtailing the growth of saplings and herbaceous understory which will eventually change the canopy. There is evidence that a species impoverished forest is developing (Haggith 1982). The overall result may be a transformation in the future composition of the forest. The original forest may evolve into one dominated by species which are unpalatable to deer. This single factor has the potential to outweigh all other environmental influences on the forest vegetation as all species are subject, in varying degrees, to this pressure (Haggith 1982, Yaraskavitch 1983).

3.2.7 Management History

The Point Pelee area began experiencing major alterations to its landscape during the permanent settlement by Europeans in the early 19th century (Rivard et al 1981, Parks Canada 1982a, Eagles 1987). Forests were cleared, dunes were levelled, and wet areas were drained or filled in to facilitate crops and livestock. Extensive lumbering changed the ground cover and associated plant and animal habitats. By the early 1900's hunting and trapping were widespread throughout Point Pelee. Sand and gravel companies removed extensive amounts of material which is believed to have contributed to detrimental changes of the point (Sly and Lewis 1972, Coakley 1977, Eagles 1987).

The designation of Point Pelee as a national park did not interrupt the flow of change on the point immediately. Recreation was an important land use and by the 1920's many private cottages had been developed on the west side of the point. Early park management practices included planting exotic tree species to prevent erosion of the beach (Eagles 1987). Many activities such as fishing, farming and hunting were allowed to continue. Duck hunting has only recently been phased out (Canadian Parks Service 1991e) and sport fishing is currently the only extractive activity permitted in the park (Canadian Parks Service 1991d). Acquisition of almost all private lands has eliminated farming, orchards, hunting, and most cottaging (Parks Canada 1982a). Since the park land has previously been disturbed by a wide variety of human activities, the existing vegetation mosaic does not entirely reflect the outcome of natural succession (Canadian Parks Service 1991d).

European settlement in southern Ontario also drastically altered the composition of Rondeau. The tangled undergrowth made it next to impossible to proceed to the point so activities were limited to the northern portion of the park (Hitchcock 1932). During the 1880's the area became popular for picnics and weekend trips (Wickens 1977). The park lands were never seriously considered for agriculture due to the shallow sandy soil but timber, maple syrup, bog iron and fish were exploited (OMNR 1991a). Hunting of waterfowl and extensive trapping of furbearers was also allowed. Control of Rondeau was in the hands of the Dominion and the Provincial Governments in the late 19th century, until local businessmen realised the potential of the area to become a tourist resort and persuaded the government to establish a park (Hitchcock 1932).

At this time the park lands were transferred to the Provincial Government and Rondeau became Ontario's second Provincial Park (OMNR 1991a). People were then encouraged to build cottages on leased lots along prime waterfront areas. By the early 1900's the park was easily accessible by the many roads which serviced the cottages, local picnic grounds, aviary, pavilion, store, hotels, roller skating rink, tennis courts, croquet lawns, miniature golf course and two baseball diamonds (Hitchcock 1932). Rondeau's future as a recreation area had become firmly established.

3.3 Pukaskwa National Park and Lake Superior Provincial Park

Pukaskwa National Park is located on the northeast shore of Lake Superior, 288 kilometres east of Thunder Bay and 400 kilometres northwest of Sault Ste. Marie. Established in 1978, this park is Ontario's largest national park consisting of 1,878 square kilometres, and is an excellent example of the Central Boreal Uplands (Parks Canada 1982b). The 128 kilometres of Lake Superior shoreline included within the park are characterized by rocky headlands, sheltered coves, and sand and cobble beaches typical of the Canadian Shield (Fig. 3.5)(Foy 1990).

Many nationally and provincially significant natural and cultural resources are found within Pukaskwa. These include the many rare floral and faunal species, great blue heron and herring gull rookeries, woodland caribou calving grounds, and the arctic-alpine vegetation associations. The most important cultural resources are the archaeological sites, best represented by the Pukaskwa Pits found on the cobble beaches of Lake Superior. These stone edifices are believed to be remnants of food and shelter cache structures dating back to 1000 A.D. (Foy 1990).

Pukaskwa is considered to be one of the most accessible wilderness areas for the urban centres of southern Ontario and the mid-western United States. The mean annual attendance for Pukaskwa National Park for the period 1985 to 1991 was approximately 16,700. The peak year was 1988 with approximately 21,600 visitors (Fenton interview 1991).

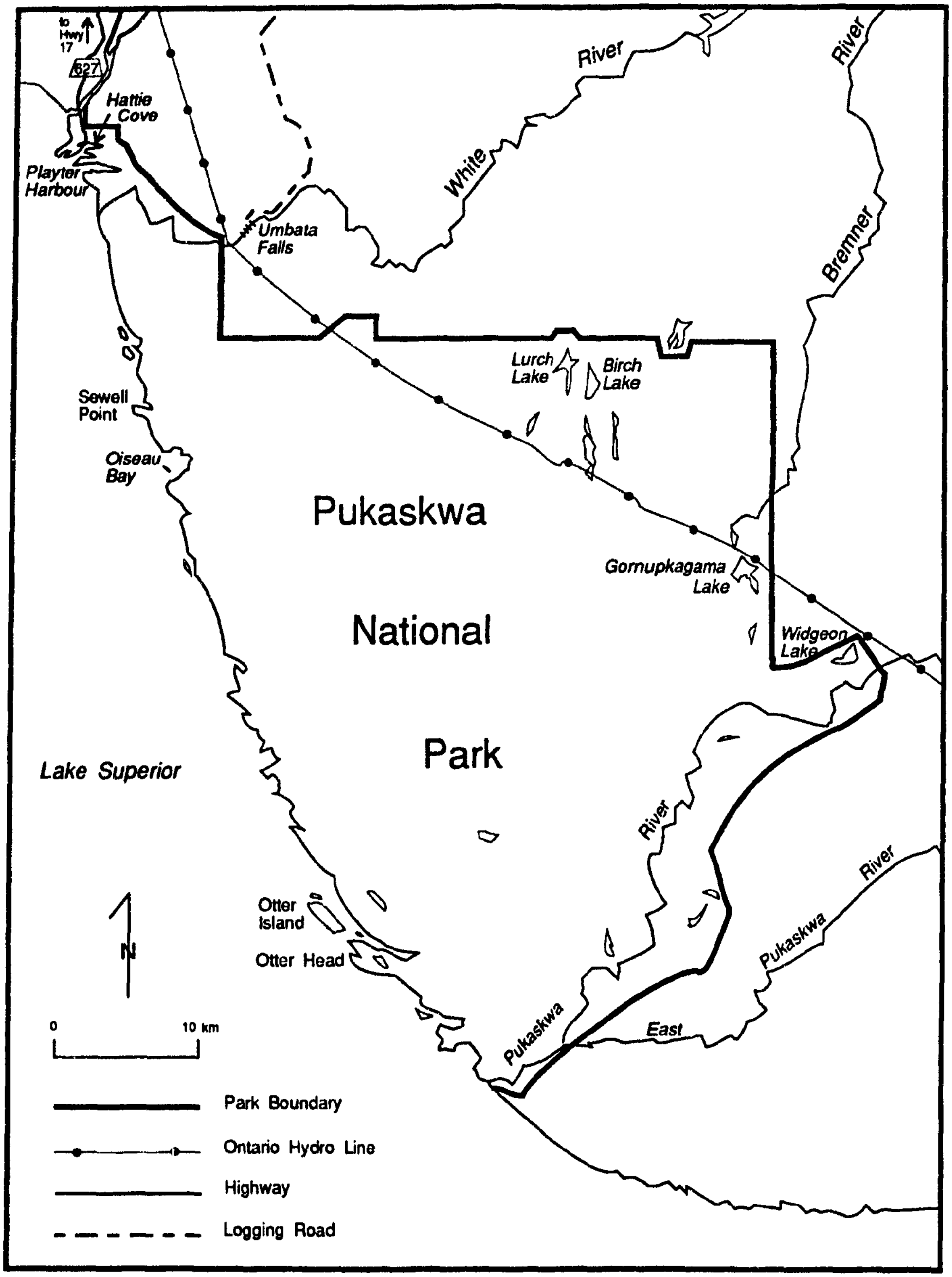


Fig. 3.5 Location of Pukaskwa National Park
Source: MNR 1983

Lake Superior Provincial Park is a large Natural Environment Park on the east shore of Lake Superior between Wawa and Sault Ste. Marie. The Park covers an area of 1540 square kilometres, which incorporates coastline and interior located approximately 10 kilometres south of Wawa (Fig. 3.6). In 1944 this area was designated as a provincial park to preserve an important section of Lake Superior's rugged coastline and interior forests (White 1988).

Similar to Pukaskwa, this park's location between the Boreal Forest and the Great Lakes-St. Lawrence Forest Regions contributes to its wide diversity of flora and fauna. Lake Superior Provincial Park, being farther south, has a greater representivity of the Great Lakes-St. Lawrence Forest community and less Boreal representation than Pukaskwa National Park. There is a noticeable change in vegetation from the south, which is dominated by the southern forest community, to the north end of the Park, which is more Boreal in nature. Many species occur in the park which are near their northern or southern range limits. Some of these species are nationally and/or provincially significant. This park also has an exposed rocky coast which harbours a community of arctic-alpine plants (Given and Soper 1981). There are many historical and geological features within the park which are significant at the regional and provincial levels.

The fact that this park is bisected by highway 17 makes the task of determining the number of visitors very difficult. Travellers have access to trails, picnic and display areas, and numerous fishing locations without contact with park personnel. It has been estimated that more than one million people travel along highway 17 through the Park each year. Annual traffic counts indicate that approximately 190,000 people stop to use picnic areas and trails, while 4,200 canoeists and hikers camp in the Park's interior (OMNR 1988).

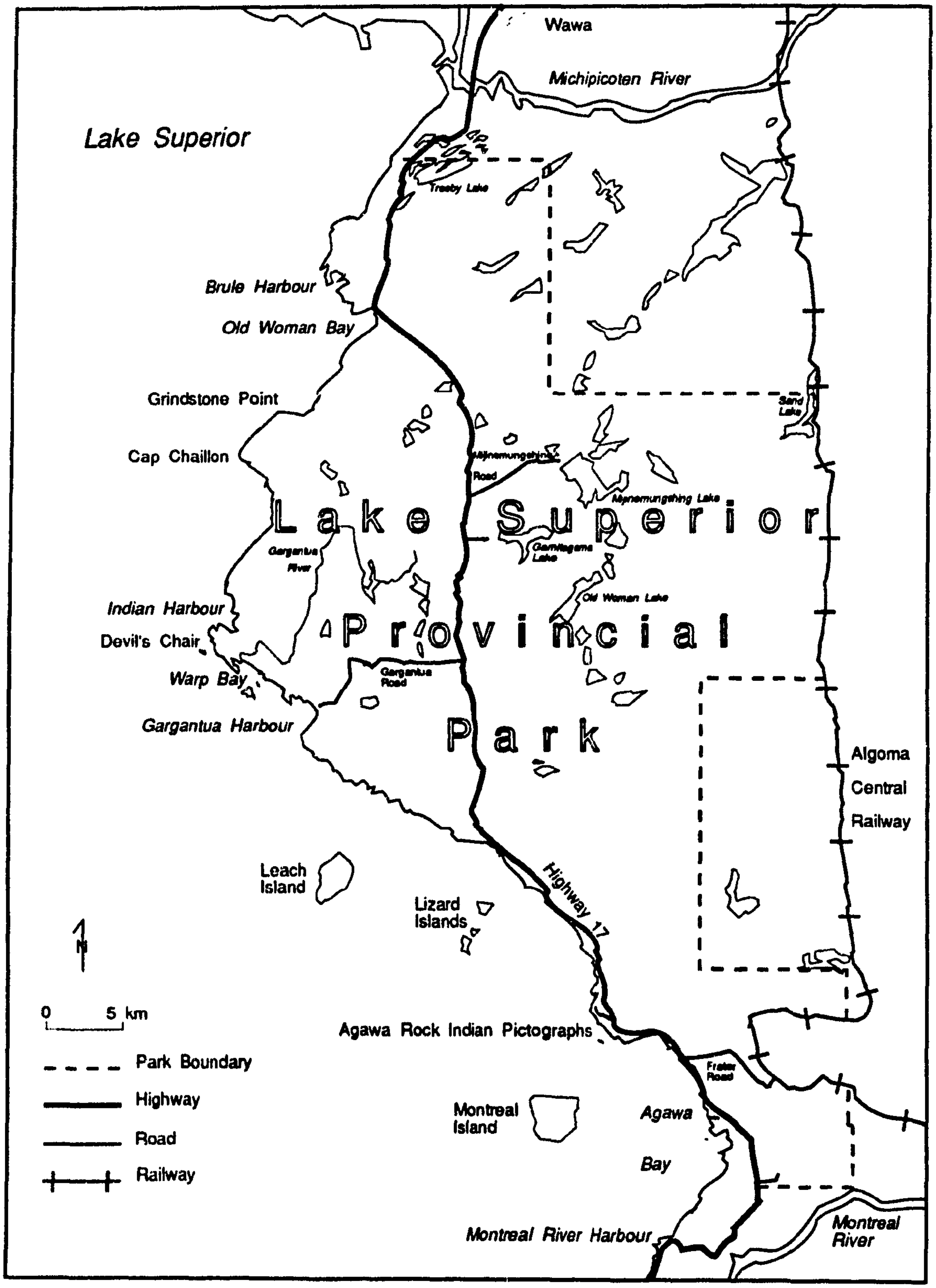


Fig. 3.6 Location of Lake Superior Provincial Park

Source. MNR 1988

3.3.1 Geology

Like most of Canada, Pukaskwa National Park and Lake Superior Provincial Park have been shaped by the Late Wisconsian glaciation which ended approximately 9,000 years ago (Senes 1986). Both parks are located near the southern edge of the Canadian Shield which consists of Precambrian, meta-sedimentary and volcanic beds which were severely faulted and intruded by magmatic rocks. The parks have experienced volcanic activity, mountain building, regional uplift, folding and faulting, as well as erosion and glaciation (Tracey 1971, Wilson 1985, Canadian Parks Service 1989b). Throughout the area, diabase, quartz, and gabbro dykes intrude the granite bedrock (Parks Canada 1982b, Wilson 1985, White 1988). These dykes generally strike northwest with a 50 degree dip to the northeast (Senes 1986).

3.3.2 Topography

Present topography in the region is the result of orogenic episodes followed by periods of erosion and sedimentation dating from the Precambrian era (Canadian Parks Service 1989b). Ancient mountains have been eroded through millions of years of weathering and have been scoured and gouged by continental glaciations. Cracks and fissures were gouged and deepened to form rock-rimmed basins that are now occupied by lakes (Parks Canada 1982b). This typical example of Canadian Shield topography is characterised by numerous steep-sided valleys and gullies, rocky knolls and drift-filled valleys (Tracey 1971, Parks Canada 1982b, Foy 1990). Among the steep slopes and bold massive hills are several canyons and cliff faces most of which are associated with faulting (Tracey 1971, White 1988). The topography is strongly influenced by bedrock lithology. Local relief varies from 15 metres to 120 metres (Parks Canada 1982b, Wilson 1985). The highest elevation of the region reaches 636 metres above sea level on Tip Top Mountain in Pukaskwa National Park, one of the highest points in Ontario (Parks Canada 1982b).

Other products of glaciation include lacustrine deposits along former shorelines of glacial Lake Superior. Receding water levels caused by the slow recession of meltwater and uplift of the land following deglaciation resulted in lacustrine deposits, old beaches, strand lines, dunes, and deltaic deposits now exposed on the land surface (Canadian Parks Service 1989b). There are also extensive areas of glacial material in the form of outwash plains, eskers, deltas, and moraines which cover much of the area to various degrees. The most extensive glacial deposit is a sandy ground moraine found as a thin (usually less than 1 metre thick) discontinuous mantle covering much of Lake Superior Provincial Park (Tracey 1971, Wilson 1985).

3.3.3 Soil

Soils are generally thin and impoverished along the Lake Superior coast and on the higher knolls, but better developed on more protected inland sites at lower elevations (White 1988). There are four soil orders found within the parks: podzolic, brunisolic, gleysolic, and organic (White 1988, Canadian Parks Service 1989b). These have formed from coarse-textured, acidic parent materials, and are subject to leaching (Baxter 1974). Shallow soils are underlain by the Precambrian Shield bedrock, which influences topography, and consequently produces drainage patterns that are predominantly bedrock-controlled. These soils are susceptible to erosion due to the undulating and often steep topography (Gimbarzevsky et al 1978). Shallow soils are made up of sand, alluvium, glacial drift, and organic deposits (Baxter 1974, Parks Canada 1982b). Local wet depressions and rock outcrops are widespread. Soil surveys in Pukaskwa National Park indicate that soils may be sensitive to acidification (Canadian Parks Service 1989b). The parent material is mostly coarse textured, acidic, and is generally less than 100 centimetres thick over granitic bedrock (Senes 1986).

3.3.4 Hydrology

Drainage in the two parks can best be described as deranged since they have had insufficient time to re-establish themselves following the retreat of the last ice-sheet. The major trend of the drainage system is northeast with each of the major rivers and all of the large lakes exhibiting this orientation which parallels the dominant direction of ice flow (Wilson 1985). Drainage patterns are of the trellis type, with water being channelled along the jointed and fractured bedrock. In many areas faults have caused displacements which control the present drainage patterns. These are often characterized by major changes in stream gradient. Waterfalls or rapids are frequently present at these locations (Gimbarzevsky et al 1978). The vertical drop from the sources of the rivers to their mouths can be considerable over short distances. For example, the Pukaskwa River drops 210 metres over 64 kilometres (Parks Canada 1982b).

The numerous lakes are largely the result of glacial scouring. Lakes are found at all elevations and frequently have poorly defined outlets due to inadequate time for development (Tracey 1971). Lakes and ponds often range in size from 5 hectares to approximately 200 hectares (Gimbarzevsky et al 1978, Canadian Parks Service 1989b). Many lakes are oligotrophic which indicates a water chemistry low in the basic nutrients necessary for primary production (Schiefer and Lush 1986, Environment Canada et al 1988). Park waters exhibit natural acidity due to the granitic nature of local bedrock and the predominantly coniferous vegetation cover. Beaver activity has resulted in numerous small ponds along secondary and intermittent streams.

3.3.5 Climate

Topography and proximity to Lake Superior results in two distinct climatic conditions for the parks, coastal and interior. This can be attributed to the maritime moderating influence of Lake Superior along the coastline (Canadian Parks Service 1989b). The mean annual temperature is approximately 2 degrees celsius with wide local variations (Environment Canada 1973a, Parks Canada 1982b). Temperature decreases with elevation, except along the coast in spring and summer when it generally increases due to inversions caused by Lake Superior. Temperature also varies as a factor of distance from the lake; the latter produces a gradient extending up to 16 kilometres inland, with higher summer temperatures and lower winter temperatures occurring as distance from the lake increases (Parks Canada 1982b).

As stated in Pukaskwa's 1982 Management Plan, the mean temperatures in January, April, July and October are: along the coast, -13, 2, 15, and 6 degrees celsius respectively; while in the interior these mean temperatures are: -17, 0, 16 and 5 degrees celsius. Mean annual precipitation along the shoreline is approximately 76 cm of which 40% falls as snow; while in the interior the precipitation generally increases to 91 cm annually, of which 55% falls as snow. The snow season along the coast is nearly one month shorter than in the interior. The coastline is exposed to the prevailing westerly winds that blow the length of the lake.

3.3.6 Flora and Fauna

Pukaskwa National Park and Lake Superior Provincial Park are located in the transition zone between the Boreal Forest and the Great Lakes-St. Lawrence Forest Regions. The vegetation reflects the dynamics of the number of ecological processes such as climate, fire, insect and disease as well as human impacts (Gimbarzevsky et al 1978, Given and Soper 1981, Senes 1986, White 1988, Foy 1990, Lopoukhine 1991). Generally Pukaskwa, being located a little farther north, contains more Boreal Forest species than Lake Superior Provincial Park. Conversely, Lake Superior Park contains a greater number of Great Lakes-St. Lawrence Forest Species. In both parks there is a continuum of Boreal and Great Lakes-St. Lawrence Forest vegetation types. There is a gradual blending of the two forest regions as one travels the length of each park (Gimbarzevsky et al 1978, Given and Soper 1981, White 1988). Due to the considerable sizes of the parks, the deciduous forests in the southern portions are quite different from the mixed forests of the northern portions of each park. At this latitude the Great Lakes-St. Lawrence Forest is limited in species composition compared to areas in the central part of the region, however the Boreal Forest is richer in species than it is farther north (Gimbarzevsky et al 1978, White 1988).

The Boreal Forest ecosystem in both parks is dependent on progressive succession and disturbance events such as fire and insect infestations (Pruitt 1978, Larsen 1980). Fire has been described as the essence of Pukaskwa's ecological integrity due to its prominent role in disturbance, regulation and cycling (Lopoukhine 1991). Regional diversity is increased by fires which maintain early post-fire communities in a mosaic pattern. Forest types also vary quite noticeably with moisture conditions, topography, and soil characteristics.

In both Pukaskwa and Lake Superior Parks, some of the coastal beaches and rock faces support disjunct colonies of arctic-alpine species which are quite removed from their range along the shores of Hudson Bay and James Bay. It is believed these plants migrated to the shores of Lake Superior shortly after the retreat of the Wisconsin glaciation and have survived because of the relatively cool microclimatic conditions produced by Lake Superior (Gimbarzevsky et al 1978, Given and Soper 1981, Parks Canada 1982b, White 1988, Lopoukhine 1991).

The fauna is also a combination of boreal Forest and Great Lakes-St. Lawrence species but the main difference between the two parks is that Lake Superior Provincial Park has more species affiliated with the Great Lakes-St. Lawrence Region. Noticeably, species diversity and abundance differs among different plant communities found within each park (Baxter 1974, Noble 1983, Pasitschniak-Arts 1985, Canadian Parks Service 1989b). The interior waterways and wetland habitats are very important for numerous species of nesting and migrating waterfowl some of which are rare or endangered nationally and provincially (Baxter 1974, Canadian Parks Service 1989b).

The isolation and topography of Pukaskwa has kept a large portion virtually unaffected by humans and as a result the species composition and distribution represent natural situations (Canadian Parks Service 1989b). Important factors in the distribution of wildlife are mild winter weather and limited snow cover. Some of the park's mammals include moose, black bear, lynx, red fox, beaver, snowshoe hare, and wolf (Parks Canada 1982b, Canadian Parks Service 1989b, Foy 1990). Portions of Pukaskwa's coastline provide sites for Great Blue Heron and Herring Gull rookeries as well as prime Woodland Caribou habitat. The Park is on the southern edge of the Woodland Caribou range in Ontario and supports an estimated population of 25 animals (Parks Canada 1986b). Woodland Caribou are also found within Lake Superior Provincial Park as a result of a relocation project conducted in 1989 to re-establish a mainland population in their former range (OMNR 1989b).

The distribution of fish species found in the interior lakes is restricted with relatively few fish species occurring in the majority of park lakes. As is characteristic of the oligotrophic lakes of the Canadian Shield, the productivity of lakes in the region is low (Parks Canada 1982b, Environment Canada et al 1988, Canadian Parks Service 1989b).

3.3.7 Management History

Aboriginal populations had minimal impact on the vegetation of the area (Canadian Parks Service 1989b). Upon arrival of the Europeans in the 17th century the north shore of Lake Superior was sparsely inhabited by the Ojibway, the descendants of whom still live there today (Parks Canada 1982b). Due to the transient nature of the early European occupants, the rugged coastline and hard to penetrate interior, relatively little environmental change occurred. Original activities included fur trading, prospecting, fishing and scattered lumbering. This area was bypassed by early loggers due to the rough topography, and the absence of large rivers for transport in close proximity to the small isolated pockets of marketable timber (Vosper 1984).

The north shore of Lake Superior was opened up by the building of the transcontinental railway in 1885 and by road to Thunder Bay and Sault Ste. Marie in 1953 and 1960 respectively. Throughout this time the demand for local timber increased to overcome the problems associated with topography. The wildlife habitat within both parks has since been greatly effected by the fire history and suppression as well as logging. The selective logging which occurred in Pukaskwa during this century, prior to park establishment, decimated many stands of large white pine, spruce and fir (Canadian Parks Service 1989b). In recent years major uses include boating, trapping, hunting, sport and commercial fishing (Parks Canada 1982b).

The most notable differences between the northern parks are that Lake Superior Provincial Park's east edge borders on the Algoma Central Railway, the Park is bisected by the Trans Canada Highway (Hwy 17) and it has been extensively logged by commercial practices. The arrival of the railway and highway 17 opened the Lake Superior Provincial Park area to more loggers who could harvest on a more profitable basis (Vosper 1984). The establishment of Lake Superior Provincial Park had little, if any, effect on the timber trade or mining activity. Prior to the Park's establishment, prospecting and claimstaking were permitted on Crown Land within the area of the Park (OMNR 1988). Mining activity continued on some park lands until 1956 while commercial logging continued until 1988 (Vosper 1984, OMNR 1988). There is also a great difference with respect to the remoteness of these parks. Lake Superior Provincial Park is not as isolated as Pukaskwa, due to the transportation corridors, therefore, there is greater visitor use.

Chapter 4 External Threats to Case-Studies

4.1 Introduction

Chapter Four has been organized according to external threats rather than individual parks. This was done to reduce repetition of threat description for each case-study, since some parks had similar threats. The external threats were placed into the following categories for ease of comparison: exotic species; global warming; adjacent land use; shore protection; pollution; and physical removal of resources. The case-studies did not necessarily have similar, or even any, threats in each of the six categories.

Exotic species are considered to be internal threats by some (see section 2.3) but for the purpose of this study they are included as external threats since they arise from activities originating outside and inside park boundaries. The literature does not always agree on the designation of exotic species. Some authorities believe that many of these can no longer be considered exotic species because they have become naturalized. For the purpose of this study, naturalized species will remain designated as exotics at each park.

Global warming, if occurring, may have stark consequences for natural areas, however, there has been very little, if any, research done on this phenomenon in the four study areas. The effects of global warming on local weather patterns, flora and fauna have not been thoroughly investigated as this is believed to be a recent development. Since climate is part of the complex factors which create specific habitats it is reasonable to assume that a large enough change in the local climate will have an effect on the flora and fauna of an area.

There remains some debate in the literature as to whether global warming is actually occurring. The effects global warming will have on the environment are unclear and difficult to substantiate. Specific studies are needed for confident decision making. Only possible effects will be described in this section, based on interviews of park personnel. Park staff have developed their own subjective opinions of the effects global warming may have on park ecosystems. Their views were established from direct experience. It is recognized here that park staff do not have the capability or time to perform appropriate evaluations of the effects of global warming. Staff opinions may, however, provide an understanding of possible effects and the complexities involved for the particular case-study. This may in turn affect management strategies in each park.

The adjacent land use category discusses threats associated with the types of human activities located on neighbouring lands. As stated previously (section 2.3.1), adjacent land use has many profound ecological impacts some of which overlap into other categories such as exotic species, pollution, shore protection and physical removal of resources. These will be discussed separately in the appropriate category. The main focus of the adjacent land use category is urban and rural development, habitat fragmentation and associated impacts.

4.2 Exotic species

Past and present human activities in and around the four case-studies have facilitated the introduction and establishment of exotic species. Alien species continue to invade via land, water, and air due to the anthropogenic changes of the landscapes in and around these parks.

4.2.1 Aquatic biota

Point Pelee, Pukaskwa and Lake Superior Parks have inventoried some of their exotic fish species. Current information on exotic fish in Rondeau's marsh was not available. Since this marsh is open to Rondeau Bay and consequently Lake Erie, it is reasonable to assume that non-native fish species found in Lake Erie may also be found in the Park's marsh ecosystem. Point Pelee's marsh also includes non-native species found in Lake Erie, such as carp, which are abundant in the marsh and form a major part of the fish biomass (Canadian Parks Service 1991c). Exotic goldfish are also known to occur in the marsh, although this population is believed to be small they readily hybridize with carp. More study on the effects of Lake Erie's exotic fish on the components of the marsh environments in both Point Pelee and Rondeau is necessary.

Pukaskwa's exotic fish species occur in many of the lower river areas of the Park and a number of small coastal lakes. Informal records suggest these areas were stocked with non-native species to improve sport fishing during the 1950's and 60's (Schiefer and Lush 1986). It is possible that Yellow Perch (*Perca flavescens*) and other species currently found in many small coastal lakes originated from these stockings. They are now being maintained by natural reproduction and have become naturalized.

Exotic fish species in Lake Superior Provincial Park include rainbow trout, and splake (a lake trout-brook trout non-reproducing hybrid) which have been stocked in highway corridor and some inland lakes to increase sport fishing (OMNR 1988). Rainbow trout, although common in the Park's coastal rivers, are not native to the Park. This species has the potential to spread to other lakes and streams and establish populations which could compete with native species. Splake are used for stocking lakes because they are unable to sustain their population. This species, therefore, poses less of a threat to native species than the exotic rainbow trout. The accidental introduction of Yellow Perch (used as bait fish) into some Park lakes led to the live bait ban currently in effect (Babcock interview 1991).

The prosperity of non-native fish species in each of the parks may partially be due to human-induced changes in the fish assemblage of the park through commercial and sport fishing (see section 4.7.2). Alien fish species may seriously impact native fish populations due to disease, their reproductive success, feeding strategy, and ability to hybridize with native and non-native species. Exotic species found in Lake Erie and Lake Superior, such as the sea lamprey (*Petromyzon marinus*) and Lake Erie's zebra mussels (*Dreissena polymorpha*), may also negatively impact native biota of the parks. Both northern parks are protected from invasion of exotics from Lake Superior by their rugged coastline which restricts upriver access. Available spawning habitat for exotic species such as rainbow trout (*Salmo gairdneri*), brown trout (*Salmo trutta*), and pink salmon (*Oncorhynchus gorbuscha*) are limited by waterfalls near the coast (Schiefer and Lush 1986). The sea lamprey's feeding strategy is of concern since it has caused serious damage to sport fish populations in both Lake Erie and Lake Superior through its parasitic attacks on adult fish. This species has been known to spawn in some streams in both Pukaskwa National Park and Lake Superior Provincial Park (Schiefer and Lush 1986, OMNR 1988). The spread of zebra mussels throughout the Great Lakes is also of interest since they have been known to cover fish spawning beds (Woodliffe interview 1991).

4.2.2 Herptiles

Point Pelee National Park was the only case-study to have identified exotic herptile species. Presently, there are only two species believed to be alien, the Eastern Box Turtle

(*Terrapene carolina*) and the Red-Eared Slider (*Pseudemys scripta elegans*) (Kraus 1990). The Eastern Box Turtle is not considered threatening due to its small population and habitat which limit competition with native turtles. The Red-Eared Slider is more of a threat since this turtle is primarily carnivorous and directly competes with native species. It is not known whether this species is still present in the park since the last reported sighting occurred in 1983. It is believed that both species of turtles have been brought into the park by visitors no longer wanting them as pets (Canadian Parks Service 1991c).

4.2.3 Birds

Point Pelee was also the only park to have identified non-native birds. These species are not yet known to pose a threat. Small populations of the Ring-Necked Pheasant and certain quail varieties have been introduced in the region for hunting and are known to occur in the Park (Canadian Parks Service 1991c). The Starling and English Sparrow, being successful competitors, have become naturalized and ubiquitous throughout southern Ontario.

4.2.4 Insects

Exotic insects, such as the gypsy moth which is believed to be a recent invader into Ontario, are of concern to each park because of its ability to defoliate large tracts of deciduous trees. The gypsy moth is primarily a pest of oak, poplar and birch trees.

4.2.5 Mammals

The alienated landscape to the north of Point Pelee and Rondeau infrequently contributes domesticated animals, such as dogs and cats, to the park environments (Deering and Wiper interviews 1991). In Rondeau, the cottage community of 299 private leaseholds, campers using the 226 campsites and day-use visitors are also permitted to bring pets into the Park. This often results in lost, unwanted or abandoned dogs and cats which may introduce disease and can reduce prey and predator species populations. There is no known permanent feral dog population in either park but there is a semi-permanent cat population in Point Pelee. This population requires recruitment through abandonment for population continuity (Canadian Parks Service 1991c). The cats adapt well to the warm climate and abundant food supply but are of concern because of the many rare and endangered birds and mammals such as the Prothonotary Warbler (*Protonotaria citrea*) and Eastern Mole (*Scalopus aquaticus*). It is believed that the feral cats contributed to the extirpation of Pelee's Southern Flying Squirrel (*Glaucomys volans*). This species is extremely vulnerable on the ground since it is not as agile as other squirrels (Canadian Parks Service 1991c).

4.2.6 Flora

Non-native plants have become established in both Point Pelee and Rondeau as a result of the high levels of disturbances within these parks. Introduced plant species can seriously effect indigenous vegetation by causing irreversible changes in the structure, composition, physiognomy and ecology of native communities (Stephenson et al 1980). Exotic plants are by far the largest concern in Point Pelee, since approximately 43% of the over 600 recorded plant species in the park are considered to be non-native (Finkelstein 1990, Canadian Parks Service 1991c). Some of these species have become firmly established in the park as a result of agriculture while others have invaded under their own power. Approximately 40% of the terrestrial area of the park was used for agriculture and abandoned fields remain as areas most heavily invaded by exotic vegetation (Canadian Parks Service 1991c).

Both Point Pelee and Rondeau contain privately owned buildings and as they are removed most horticultural and agricultural species are left to compete with native vegetation (Stephenson et al 1980, Wiper interview 1991). Some horticultural and agricultural species have not spread beyond their original invasion and have succumbed or were displaced in the natural process of succession (Mouland interview 1991). Others have the ability to hybridize with native species thereby altering genetic purity. In Point Pelee, the non-native White Mulberry (*Morus alba*) is currently hybridizing with the rare Carolinian Red Mulberry (*Morus rubra*) which could lead to its extirpation (Dunster 1990). Hybrids of alien and native species make it difficult to determine which are purely indigenous and may ultimately change the original flora and fauna of the park. Hybridization of the Red and White Mulberry has been so extensive in Point Pelee that it is now uncertain whether any genetically pure individuals of Red Mulberry remain in the Park (Deering interview 1991).

Several alien species, such as garlic mustard (*Sisymbrium alliaria*), found in both Point Pelee and Rondeau are opportunistic and have taken advantage of the disturbed conditions created directly or indirectly by human activities. The proliferation of garlic mustard is currently being suppressed in Rondeau by the large deer population which feed on this species (Woodliffe interview 1991). In Point Pelee, the present situation is more severe. Many of these species, including garlic mustard, have aggressively out-competed and often replaced indigenous flora which may require undisturbed habitat conditions (Dunster 1990). Several exotic species have begun to dominate the habitats of Pelee's more valued indigenous flora resulting in native biota and vegetation associations becoming rare or endangered. The botanically significant cedar-savanna which includes over 30 rare park floral species is rapidly being lost. The mature cedars are dying and the young are being out-competed as seedlings cannot establish in shade or in competition with exotics in old fields (Canadian Parks Service 1991c).

The overpopulation of the white-tailed deer in both southern parks has resulted in disturbed conditions throughout the parks. Point Pelee's deer population was significantly reduced by culling the herd in the winter of 1990-1991 (Deering interview 1991). Rondeau's deer population was slated for a similar cull in early 1992 (Woodliffe interview 1991). Overgrazing and trampling reduce vegetative cover and expose the soil which facilitates the invasion of exotic plant species. Presently, the exotic Japanese barberry (*Barberis thunbergii*), which is unpalatable to deer, is spreading prolifically in Rondeau (Wiper interview 1991). A checklist of Rondeau's exotic plant species and the potential threats they pose to indigenous flora was unavailable. This information may become available upon the completion of the vegetation management strategy. Current botanical inventories do not exist for the Nature Reserve and Natural Environment Zones which comprise most of Rondeau Provincial Park, therefore the level of exotic encroachment is unknown.

In Pukaskwa, park staff surmise that until recently, human impact has been localized in the Park area such that the invasion of exotics is a recent occurrence with limited extent. Staff in both Pukaskwa and Lake Superior believed that the majority of exotic invasions have occurred in areas of high disturbance. These areas include main visitor service areas, campgrounds, and linear developments such as trails and roads. In Pukaskwa, the Ontario Hydro right-of-way dissects the northeast portion of the Park. This right-of-way may also provide possible media for the introduction of exotics. It comprises an area of 238 hectares of cleared land that is not allowed to revegetate naturally (Lopoukhine 1991).

The current draft of Pukaskwa's Park Vegetation Plan (1991) contains very little information on the herbaceous understory and exotic plant species. Similar information for Lake Superior Provincial Park was unavailable. Monitoring of exotics in either park has not been undertaken. It is therefore, difficult to determine whether exotic species are currently invading these northern parks and their potential impacts on native flora and fauna. This information may become available upon the completion of the vegetation management plan in Pukaskwa. Information of exotic encroachment must be completed in order to maintain the current level of ecological integrity in both parks. Invasion of non-native species must be curtailed before their impacts become uncontrollable. It is unknown whether Pukaskwa and Lake Superior Park currently have many exotics but the likelihood of future invasion is great due to increased human disturbance in and around their boundaries. Since the Boreal Forest mosaic is maintained by natural disturbances, exotic species may be able to out-compete native species for openings in the vegetation. Similarly, the logging activity which has occurred in Lake Superior Park may provide access to parklands for non-native plants.

4.3 Global warming

If the world's climate is pursuing a warming trend, it would be reasonable to assume that increased temperatures may allow a greater variety of southern species (i.e. Carolinian) to increase their present range. Conversely, more northern species (i.e. Boreal) may not be able to maintain their present range and decrease in prominence. Each of the four parks may then more closely resemble areas presently found farther south.

When interviewed, Point Pelee and Rondeau personnel were undecided whether global warming would have an impact on these parks since they are located in the warmest part of

Ontario. It was also unclear whether the moderating effects of the Great Lakes would influence the effects of global warming. Personnel in Point Pelee felt that a larger impact would result if global warming were to affect precipitation and subsequently, the water level of Lake Erie. If precipitation and lake levels increased or decreased the water table for Point Pelee may be affected in a similar manner. The same may be assumed for Rondeau since both parks are similar in location, climate, geology, topography, hydrology and vegetative associations. A change in the water table may alter these ecosystems since diversity in both parks is largely a result of the alternate wet and dry habitats of their topography. This affects the vegetation by varying rooting depths to the water table (Canadian Parks Service 1991c). As lake levels rise and fall, habitat changes occur within the marsh communities and the many ridges and troughs throughout the parks. The level of impact would be dependant on the degree of change in lake levels and precipitation.

It is believed that a significant warming trend may have severe impacts on Pukaskwa National Park and Lake Superior Provincial Park since they are located in a vegetative transition zone. Since both parks contain Great Lakes-St. Lawrence Forest communities, global warming may increase their dominance with a subsequent decrease in Boreal Forest communities. Pukaskwa Park staff also expressed concern regarding the potential elimination of the disjunct arctic-alpine communities and Woodland Caribou herd which are currently on the extreme southern edge of their range in Ontario. If a warming trend were encountered, with a significant decrease in snowfall, an increase in white-tailed deer may result in the region. Deer are a potential threat to the moose and Woodland Caribou populations of the area because they carry the parasitic meningeal worm *Parelaphostrongylus tenius* which is lethal to moose and caribou (Canadian Parks Service 1989c, Parks Canada 1986b). Currently, deer are relatively non-existent in the area due to the lack of suitable range conditions and severe snow depths. Deer are poorly adapted to cope with deep snow and cold. Should winters become mild with less snow in the future, deer could become more abundant in the region. This would most likely result in a decline or elimination of the moose and caribou populations.

4.4 Adjacent land use

4.4.1 Rural and urban development

Threats posed by development on lands surrounding parks have profound effects, many of which are not fully understood. The conservation of the species of plants and animals that facilitated the establishment of Point Pelee National Park and Rondeau Provincial Park are seriously threatened. Point Pelee National Park is only a fragment of the total Point Pelee marsh. The remainder has been drained by dykes and drainage channels for agricultural and urban development. The biogeographic 'island' nature of both Point Pelee and Rondeau has resulted from destruction of critical wildlife habitat outside park boundaries. Many species are therefore restricted to park habitats. This has led to the forelands being virtually cut-off from other natural areas such as Hillman Marsh located north east of Point Pelee. Little genetic exchange can occur between flora and fauna on either side of park boundaries due to the lack of adjacent natural areas. Species diversity and richness are decreasing due to the loss of genetic variability. Most genetic exchange occurs via air and water so many species within these parks are cut off from related genetic stock. Pukaskwa and Lake Superior Parks have not yet reached this level of alienation so critical wildlife habitat and genetic exchange may still occur in surrounding areas.

4.4.2 Resource extraction

A number of Forest Management Agreements (FMA's) have been struck between various companies, such as Domtar Paper, to undertake forest management practices on Crown lands surrounding Pukaskwa National Park and Lake Superior Provincial Park on behalf of the Ministry of Natural Resources (OMNR 1983). In exchange, these companies obtain a continuous supply of forest raw materials on a sustained yield basis (Foy 1990). The FMA's allow cutting and forest road construction to within two kilometres of park boundaries in some areas. The White River Operating Plans adjacent to Pukaskwa include clear cutting up to the boundary where terrain permits. Rivers with headwaters located outside park boundaries may experience an increase in siltation due to erosion caused by the logging and mining activity and road development. This may negatively impact aquatic environments by reducing the clarity and dissolved oxygen content of the water (Schiefer and Lush 1986).

The Hemlo goldfield, located within the White River watershed of Pukaskwa National Park, is described as being the single largest gold deposit in North America. Gold ore reserves have been estimated at 81.5 million tons with a minimum life expectancy of 20 years (Foy 1990). It is located on highway 17 between Marathon and highway 614. Mineral exploration within the watershed has intensified due to the Hemlo development. Other mining activity in the immediate area includes the Mishibishu Lake area. It is located twenty kilometres from the Park's southeast boundary, and has become a major mining site, complete with secondary access roads, shafts and many cut lines within the East Pukaskwa River watershed. The primary land use intent for the area between Pukaskwa National Park and Mishibishu Lake is to encourage roadless Crown land recreation activities as well as resource extraction (OMNR 1983). One prospect for molybdenum has been established at Playter Harbour, just north of the White River outlet at Lake Superior (Fig.

3.5). Due to these activities, Park visitation is expected to increase in the future as local population increases.

Lake Superior Provincial Park is also surrounded by private lands on which resource extraction, cottaging and recreation are allowed. The Algoma Central Railway (ACR) owns land adjacent to the Park which is primarily used for timber harvesting. Mineral exploration activity, public recreation and cottaging also occur on ACR lands (OMNR 1983). Mineral rights, surface and subsurface and all aspects of their administration are controlled entirely by ACR except where the company has sold patented mining claims to private individuals.

Even though the current management plan for Rondeau Provincial Park specifically states that "logging for commercial purposes will not occur" in the Park (OMNR 1991a, p.8), some selective logging has occurred in recent years (Eagles, P.F.J., personal communication, April 30, 1992).

4.4.3 Road development

Logging and mining roads adjacent to both Pukaskwa and Lake Superior Parks provide public access to previously inaccessible remote areas of each park. Private roads constructed for timber extraction outside parks fall under the Public Lands Act which allows the general public access at all times. These roads around the perimeter of the parks increase access to backcountry areas increasing the likelihood of unauthorized use of park lands. An increase in violations by hunters, fishermen, as well as logging and mining companies is anticipated in Pukaskwa (Fenton interview 1991). Vehicular traffic on logging roads within Lake Superior Provincial Park requires an access pass which restricts the use of these roads by the general public (Babcock interview 1991).

The Ontario Hydro right-of-way which runs through Pukaskwa may funnel human and wildlife movement into the Park from adjacent areas. Logging roads and hydro line access roads joining the hydro line outside the Park boundary may increase the use of off-road vehicles and snowmobiles through this section of the Park. Human impacts may be felt from noise, trampling, cutting, and gathering of vegetation along the right-of-way (Lopoukhine 1991). The channelling of wildlife may alter herbivore feeding patterns as well as vegetation adjacent to the hydro line.

Lake Superior Provincial Park is bisected by highway 17 which results in serious threats to the Park's wildlife in the form of road kills. The section of highway within the Park has been one of the most serious problem areas for moose-vehicle accidents in northern Ontario (Eason 1986). Highway 17 was built through some of the Park's best moose habitat for ease of construction (Stinnissen interview 1991). This has an important impact on the moose population in the Park. The number of moose killed by vehicles in Lake Superior Provincial Park amounts to about 5% of the mid-winter population (Eason 1986). This is a very significant level of mortality amounting to about one quarter of the net productivity of the herd. Net productivity (as defined by Eason) is the number of calves alive at the end of winter, and this number must replace all adult mortality (from hunting, predation, accidents and disease) over the previous year if the population is to remain stable. The high level of road kill means that the potential growth rate of the population is reduced unless recruitment from outside the Park occurs.

The moose-vehicle accident problem seems to be caused partly by seasonal changes in the behaviour, ecology, and number of moose, and partly by the behaviour and number of drivers. About half of the moose-vehicle collisions occur in the three months from May to July (Table 4.1). This corresponds to the time when moose move out of their wintering areas and begin feeding on the new growth of aquatic plants. The winter browse that moose feed on is very low in sodium. In the spring, moose have a sodium deficiency and seek out aquatic plants which are rich in sodium (OMNR 1981, Fraser and Thomas 1982). Sodium is an important element in the nervous system and body fluids of animals.

The months of May to July corresponds to the apparent peak in sodium hunger, but not to the period of greatest vehicular traffic (Fraser and Thomas 1982). Although highway 17 was built through prime moose habitat, the moose are not just attracted to these marshes. Highway 17 itself is a major source of sodium as rock salt (sodium chloride) is used to de-ice the highway in winter. Much of the salt is removed by spring runoff, but some collects in poorly drained areas along roadsides. Over half of the moose road kills and moose-vehicle accidents in Wawa District are associated with salt pools (OMNR 1981). The volume of traffic, especially at night, and driving habits are also related to the number of moose-vehicle collisions. Speeding motorists, tired drivers, and drivers not expecting to see moose on the road are involved in most moose road kills (Eason 1986).

4.4.4 Water diversions

The highly modified landscape north of Point Pelee has contributed in altering the Park's hydrology. Up until 1892 Hillman Creek flowed into Point Pelee's marsh (Anonymous, Undated). Diversion of this creek by an agricultural dyke has resulted in a lotic system (running water)

Month	1980	1981	1982	1983	1984	1985	Total
Jan.	2	2	0	4	3	3	14
Feb.	0	0	0	1	2	1	4
Mar.	0	0	0	0	0	0	0
Apr.	1	1	0	0	1	3	6
May	3	3	4	2	2	0	14
Jun	6	7	6	6	3	2	30
Jul.	5	5	5	2	2	4	23
Aug.	2	1	1	1	4	1	10
Sep.	1	1	1	2	2	1	8
Oct.	2	2	0	0	1	2	7
Nov.	0	0	2	0	0	2	4
Dec.	5	5	1	2	1	2	16
Total	27	27	20	20	21	21	136

Table 4.1 Moose road kills in Lake Superior Provincial Park 1980-1985
Source: Eason 1986

becoming a lentic system (standing water). Before this occurred, marsh levels were supplemented during low lake levels. Impacts on the marsh ecosystem as a result of this diversion are unknown at this point.

A major concern of Pukaskwa staff is the effect future hydro-electric turbines may have on river ecology. Currently, the only site with hydro-electric potential in the vicinity of the Park is Umbata Falls on the White River (Fig. 3.5). Dams built outside park boundaries not only impact critical habitats downstream (section 2.3.3) but upstream as well (Barr 1986, Elfring 1990). The unknown effects on water levels may also threaten the wilderness experience for many canoeists.

The Michipicoten River, at the north end of Lake Superior Provincial Park, has thirteen dams along its length, while the Montreal River at the south end of the Park has two dams (OMNR 1983). These dams regulate water levels to stabilize hydroelectric power generation by the Great Lakes Power Corporation. Since both rivers are located outside the Park's boundaries, the impacts of their dams on Park resources are limited. The dams and impoundments may alter critical wildlife habitat adjacent to the Park.

4.4.5 Fire suppression

Human occupation of land is usually associated with fire suppression which is practised in and around each of the four case-studies. Fire suppression on land surrounding a park may alter natural processes of succession and disturbance within the park. For Point Pelee, however, this situation is influenced by its boundaries which act as natural firebreaks. The northern boundary is a series of agricultural dykes and drainage canals which detach the Park from the adjacent land thereby preventing fires from entering. Even though fire suppression is practised on adjacent land, an external fire would be unable to spread into the Park.

The exclusion of fire in Point Pelee and Rondeau is not a major concern since the Carolinian forest communities are not 'fire dependant' as they are associated with moist conditions. Fire suppression in and around Pukaskwa National Park and Lake Superior Provincial Park are of greater concern since their Boreal Forest communities are dependant on the periodic disturbance of fire (see 3.3.6). Without the effects of fire, the age and structure of the vegetation mosaic found in both parks may be subject to irreversible change. Large areas of early successional habitats may not be maintained. A transformation in the floral and faunal species composition may also occur. Species composition and stand structure would degenerate resulting in greater homogeneity of the forest vegetation (Canadian Parks Service 1989b). The fire dependent species, which have adapted and developed strategies to survive periodic fire, may slowly be replaced by species which are not fire dependent. Continued changes in the vegetation brought about by fire suppression are obvious threats to the ecological integrity of the boreal ecosystem in both northern parks.

4.4.6 Harbours

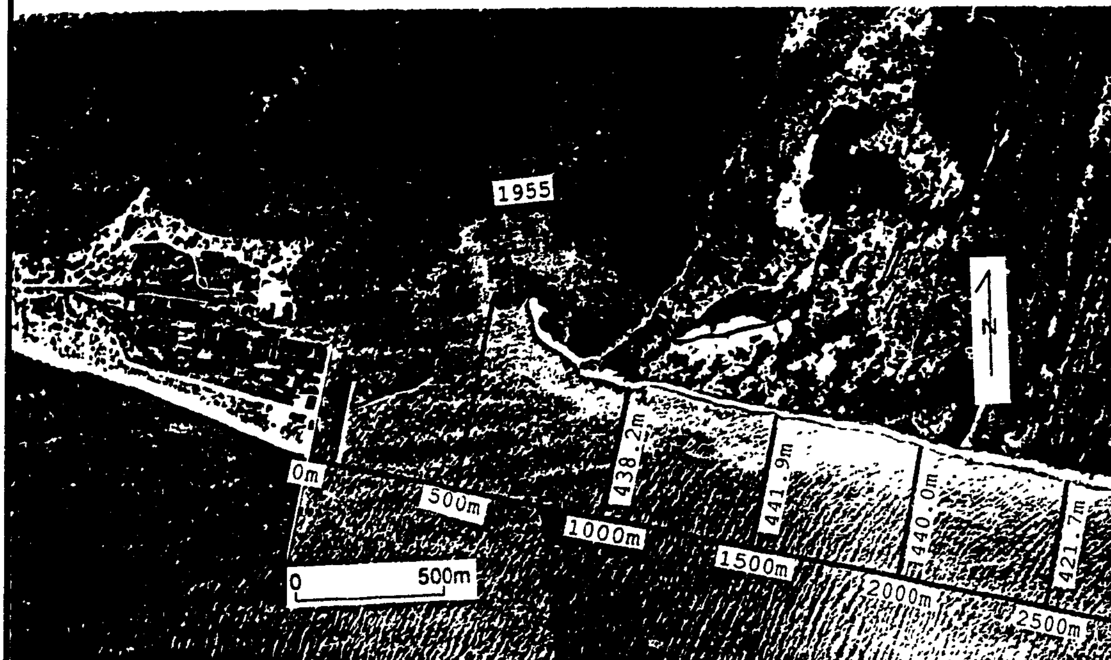
Development of harbours to the east and west of both Point Pelee and Rondeau have had profound effects on the longshore drift processes along the shoreline (section 3.2.1). The harbours are effective sediment traps contributing to the loss of longshore drift supplying these landforms. Accumulation of sediment now occurs on the updrift side of the harbours. Small bluffs located directly to the east of Rondeau supplies some sediment to its east beach as the bluffs are located between the harbour and Rondeau. Littoral drift originating from the bluffs to the west of

Rondeau Provincial Park was responsible for the formation of the sand bar which enclosed Rondeau Bay. The Erieau community was built on the western portion of this land base. Historically, this sand bar was believed to be very mobile and that incoming material was sufficient to maintain its integrity (Crysler and Lathem 1973, 1975). Upon the completion of the Erieau pier and boat channel west of the Park in 1882, sediment supply reaching Rondeau has essentially been non-existent.

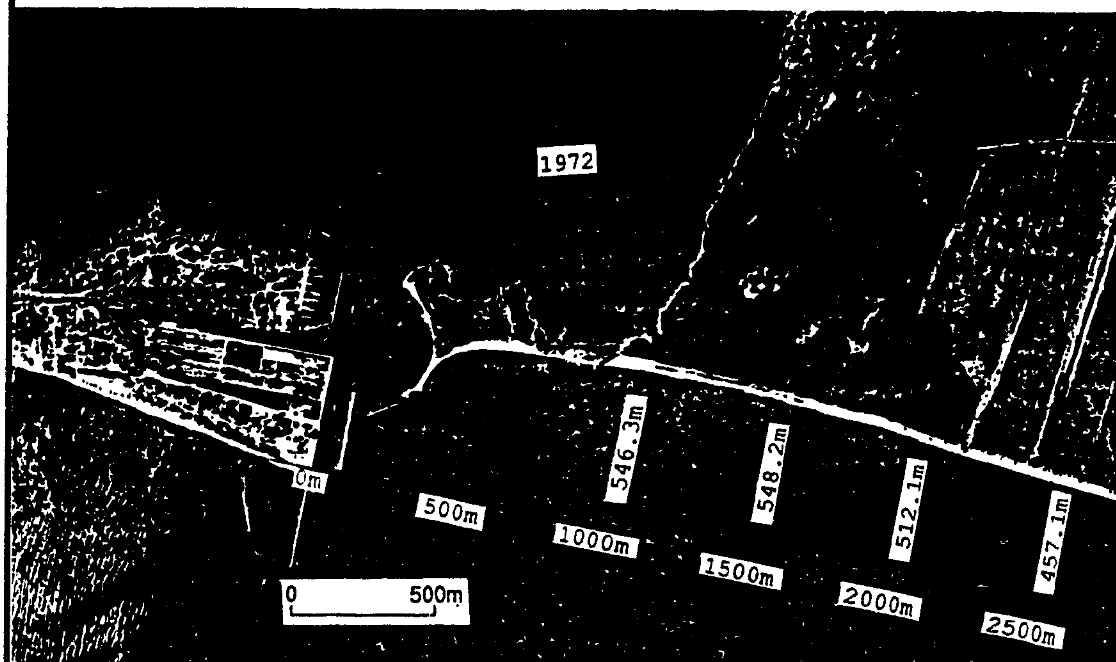
The Erieau piers have been in existence for over 100 years and during this time the continual disintegration of the sand bar between Erieau and Rondeau has been observed (Fig. 4.1). Severe erosion of the Rondeau's south-west beach has also been acknowledged. Since the west sediment supply has been essentially cut off, the sand bar itself has become the source area for littoral drift supplied to the southwest beach of the Park. This has resulted in a net reduction in the volume of material constituting the bar. Also during the past century the Erieau land base directly to the west of the piers has enjoyed a substantial accumulation in size. These changes can be directly related to the reduction in sediment supply reaching Rondeau from the west created by the piers at Erieau (Crysler and Lathem 1975).

4.5 Shore protection

Both Point Pelee and Rondeau peninsulas are unstable dynamic open systems composed of unconsolidated sediments. In recent years human use of the Lake Erie shoreline has been increasing with negative impacts on their dynamic nature. As a result, much of the shoreline adjacent to these parks, especially Pelee, have been hardened with groynes, armour stone breakwaters, gabions, and pilings (Canadian Parks Service 1991c). These have severely impaired the normal accretion-erosion and long shore drift processes along this section of shoreline (East



The 1955 sandbar alignment at Rondeau was used as a benchmark.



The 1972 shoreline has moved approximately 108m north at 1000m, 106.3m north at 1500m, 72m north at 2000m, and 35.4m north at 2500m.

Fig. 4.1 Aerial Photographs of the piers at Erieau and the sand bar located at the southwest corner of Rondeau Provincial Park.
Source. MNR Aerial Photography 1955, Flightline 4211, Roll 55, Photo 91-92, 1972, Flightline 4211, Roll 31, Photo 131.

1976, Shaw 1986, LaValle 1990). Although historical accounts indicate shore erosion and deposition are ongoing processes at Point Pelee, there has been very little recovery from severe erosion that occurred along the northeast barrier ridge during and subsequent to periods of high lake levels (Shaw 1989).

The haphazard construction of shoreline protection structures outside Point Pelee severely reduces the volume of sediment which flows into this system (LaValle 1990). The adjacent shoreline protection has increasingly contributed to the negative sand budget of the Park causing serious erosion to the East barrier beach without complete compensatory accretion on the West beach (Shaw 1989, LaValle 1990). The land base and general configuration of the Park is totally dependant upon a continuous supply of sand but because of its location it is the recipient of all upshore impacts.

The Rondeau peninsula has been nourished by substantial volumes of littoral drift originating from the bluff areas to the east and west (section 3.2.1). The shoreline east of Rondeau has very few groins and other structures designed to trap littoral drift, therefore the sediment supply moving down the east beach is adequate to maintain its integrity. The shoreline west of the Erieau piers has a variety of artificial shore protection including armour stone breakwaters and pilings. These structures adversely affect longshore drift.

4.6 Pollution

The movement of pollutants across park boundaries is one of the most difficult problems to mitigate. Park staff cannot effectively protect natural resources from threats that do not recognize boundaries. In the Great Lakes basin ecosystem, approximately 400 toxic substances have been identified, yet only 10% are regulated (International Joint Commission 1989). The ecological impacts of contaminants entering parks via air and water are very complex while the role of pollutants in long-term effects on ecosystems is not fully understood. It is becoming increasingly evident that pollution has devastating and long lasting effects on the quality and quantity of natural resources.

4.6.1 Lake pollution

Agricultural, municipal and industrial runoff has resulted in deteriorating water quality in Lake Erie (Environment Canada et al 1988). Agricultural activity dominates the landscape around Point Pelee and Rondeau and effluent from farms and communities contaminate surrounding waters. Serious problems of soil erosion and siltation of Rondeau Bay began when farms in the immediate area shifted away from small scale livestock farming to the large scale introduction of row crops and drain tiles during the late 1960's to mid 1970's (Ecologistics 1983, Wiper interview 1991). The erodability of soil materials increased due to the decline in organic matter content. The decline in organic matter can be attributable to the switch from animal and green manure to chemical fertilizers and excessive tillage. Fence rows and woodlots were cleared and cultivated, increasing field sizes and lengthening slopes, which further aggravated the problem. High levels of suspended sediments drained into Rondeau Bay during rainstorms. These levels have decreased to some degree in recent years but the problem remains.

In many areas north of Point Pelee the groundwater is no longer safe for human consumption (Canadian Parks Service 1991c). Sewage disposal is often inadequate in this low lying area, especially during periods of high water. Once the soil becomes saturated septic systems can no longer operate properly and may result in raw sewage draining directly into agricultural ditches. Due to the pattern of these ditches these contaminants along with agricultural chemicals are either channelled directly into the marsh or into Lake Erie at the north Park boundary. Effluent from the canals moves downshore along the Park's beaches and has resulted in periodic restrictions to swimming (Canadian Parks Service 1991c). Even though Lake Erie water quality has improved somewhat in recent decades it has been permanently degraded by human use. This may ultimately affect the entire resource assemblage of the whole Lake Erie basin.

4.6.2 Lead shot

As a result of duck hunting in and around both Point Pelee and Rondeau, the marsh ecosystems have received over 90 years of lead shot which has been acknowledged as a poison in many food chains. Waterfowl hunting has been discontinued in Point Pelee (Deering interview 1991) but still occurs in the Rondeau marsh for four days each week from the end of September until the end of December (OMNR 1991b).

4.6.3 Acid precipitation

Airborne pollutants often originate many kilometres away from the areas they contaminate. Since the prevailing winds for the four study areas are from the west and southwest, they receive air pollution from the United States as well as Canada. Toxic metals and organic compounds may travel long distances before reaching the earth as fallout, contaminating the soils and waters of park ecosystems. Many pollutants also return to the earth's surface in precipitation and fog. The effects of acid rain on Point Pelee and Rondeau have not yet reached the level of direct impacts. This is mainly due to the buffering capabilities of the soils and marsh waters, although some spring pH depression may occur (Canadian Parks Service 1991c).

Pukaskwa National Park and Lake Superior Provincial Park are located in the Canadian Shield Region of Ontario which is sensitive to the effects of acid deposition and heavy metal accumulation (FPRMCC 1990). Studies have indicated that acid deposition is occurring in significant quantities in both parks (Coker and Shilts 1979, Kerr 1981, Schiefer and Lush 1986). Specific effects of acid deposition on vegetation are difficult to determine because of variations in deposition, vegetation and site factors. Although specific cause-effect relationships have not been demonstrated, acid deposition and ozone are thought to be factors contributing to forest decline in Canada through indirect or contributing factors (section 2.3.4).

Since the early 1980's, scientific understanding of the effects of acid deposition on aquatic environments has increased substantially (section 2.3.4). Recent studies have indicated that many lakes in Pukaskwa and Lake Superior Parks have moderate to extreme sensitivities to further acidic input (Coker and Shilts 1979, Kerr 1981, Schiefer and Lush 1986, OMNR 1988, Babcock interview 1991, McCrae et al 1991). Some lakes have become acid stressed to the point where fish populations are either absent or exist at reduced levels of abundance. A lake is defined as acidic when its buffering capacity (acid neutralizing capacity) is less than or equal to zero (FPRMCC 1990).

The study of 59 perimeter and headwater lakes in Pukaskwa National Park by McCrae et al (1991) found that 32 lakes were extremely sensitive to acidification, of which 20 were below the biotic threshold. The biotic threshold (pH6) is the point where direct and indirect impacts on the biological structure and function of aquatic ecosystems are known to occur (see 2.3.4). Their study also determined that the main source of acidity to these lakes was atmospheric. Acidity along coastal lakes was elevated in comparison to inland lakes. This is indicative of higher deposition rates characteristic of a modest maritime effect. The lakes and rivers of the Park are also subject to acid shock effects during the spring as winter snowfall melts.

4.6.4 Toxic substances

Rain in the upper Great Lakes area has been shown to contain significant concentrations of polychlorinated biphenyels (PCB's) and several other toxic substances. Although these concentrations in Lake Superior fish are high, they are not above any health guidelines or action levels but are near enough to be of concern (Environment Canada 1984).

Tissue analysis of Pukaskwa's brook trout indicated elevated mercury levels which was considered to be a possible by product of trace element leaching and contamination brought about and augmented by the acidification process, as discussed in section 2.3.4 (Canadian Parks Service 1989b). Mercury bioaccumulation in the Park's aquatic ecosystems appears to be related to bedrock weathering and long-range atmospheric transport from industrial sources (Schiefer and Lush 1986).

McCrae et al (1991) postulated that acidic conditions also gave rise to elevated aluminum concentrations. Of the 59 lakes investigated in Pukaskwa National Park, 53 exceeded water quality guidelines of aluminum concentrations for the protection of aquatic life. The highest aluminum, manganese and zinc concentrations were found in the 32 lakes found to be extremely sensitive to acidification.

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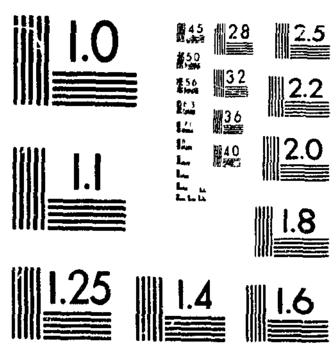
PM-1 3½"x4" PHOTOGRAPHIC MICROCOPY TARGET
NBS 1010a ANSI/ISO #2 EQUIVALENT



PRECISION℠ RESOLUTION TARGETS

4.6.5 Pollutants from resource extraction

Watersheds which drain areas external to both Pukaskwa and Lake Superior parks are of concern as they are capable of transporting pollutants into the parks. The quality of park waters may be negatively impacted by herbicides or insecticides used in adjacent logging and recreation areas. These chemicals may enter the parks in winds and water thereby damaging terrestrial and aquatic ecosystems (Canadian Parks Service 1989b, Foy 1990).

Mining and forestry activities outside Pukaskwa's boundaries are expected to have important impacts on its ecosystems. Treated effluent from the Hemlo mining operation is discharged into the White River Watershed which drains into Lake Superior through the northern most portion of the Park. The most notable contaminants associated with tailings include mercury and cyanide (Canadian Parks Service 1989b). As a result of the Hemlo operations, prospecting in the immediate area, such as Playter Harbour (Fig. 3.5), is expected to increase in the future. Other mining activities are presently occurring in the Hemlo area, as well as along the Park's eastern boundary at Mishibishu Lake. In the Hemlo district a mining feasibility study is underway for future mining of platinum, palladium and copper (Canadian Parks Service 1989b). Since the area around Mishibishu Lake is one of high mineral potential, mineral exploration will also be encouraged (OMNR 1983).

4.6.6 Chemical spills

The Algoma Central Railway (ACR) also poses a potential threat to Lake Superior Provincial Park's ecosystems. Railway accidents may result in transported chemicals being released into the Park since the railway line forms part of the Park's eastern boundary (Fig. 3.6). Highway 17 poses a similar threat since many chemicals are transported through the Park daily.

Accidents in the Park occur year-round, some of which involve transport trucks. Noise pollution from the highway and railway traffic may also negatively impact wildlife. Some species have been known to abandon critical habitats due to noise and frequent encounters with humans (Graefe 1990).

The location of Point Pelee, Rondeau and Pukaskwa protects them from similar effects since major highways and railways are located at considerable distances. Pukaskwa's White River watershed is the only one bisected by the highway and railway lines so it has the greatest potential of being affected by a chemical spill.

Point Pelee's Conservation Plan (1991) stated the greatest single source of transboundary pollutants is from chemical spills on Lake Erie. The potential for contaminants to reach the beaches of both Point Pelee and Rondeau are high as both parks are in close proximity to a major shipping route. Some of the Park personnel who have been at Point Pelee a long time remembered significant spills which have occurred in the past. They also stated that smaller ones probably occur on a frequent but irregular basis and may go unreported. The beaches surrounding Point Pelee and Rondeau provide some protection to interior ecosystems and are the easiest physical formation to clean up. Similarly Pukaskwa National Park and Lake Superior Provincial Park are protected from chemical spills on Lake Superior by the rugged shoreline. Areas affected by Lake Superior water quality include the coastline, beaches, and river mouths. Of greatest concern in Pukaskwa are the arctic-alpine flora, Woodland Caribou, Great Blue Heron and Herring Gull habitats found along the coast and offshore islands. Garbage such as plastics and other synthetics wash up onto the beaches and coastlines of the four study areas. In Point Pelee and Rondeau it was uncommon to walk along these areas and not encounter debris of this sort.

4.7 Physical removal of resources

4.7.1 Poaching

Point Pelee's Conservation Plan (1991) specifies some of the natural resources which are regularly and persistently harvested by visitors. These resources include decorative flowers and fruits such as rare cactus, burning bush, and wild edibles such as mushrooms. The unauthorized removal of plants, animals, butterflies or other insects for private collections also occur. Poaching of natural resources is also suspected to occur at Rondeau due to the constant, year-round influx of campers, cottagers and day-use visitors. The removal of plants and animals may negatively impact rare or endangered species found in these parks.

The current decline of herptiles in Point Pelee is of concern since this Park contains a significant proportion of the total herptile species found in the National Park system. It is suspected that poaching has been a direct influence on the decline of some herptile species since many are slow moving and can be caught relatively easily (Kraus 1990). Those which are attractive, such as the spotted turtle (*Clemmys quttata*) run the risk of being taken for pets. Poaching of unique species, such as turtles and fox snakes is suspected to occur for the black market pet trade in the United States and Canada (Woodliffe interview 1991).

Poaching is also a concern for the interior and backcountry areas of Pukaskwa National Park and Lake Superior Provincial Park. Poaching in the form of exceeding the fishing limits is believed to occur in backcountry areas. This may be a more serious problem in the winter when fish can easily be frozen and removed (Stinnissen interview 1991).

4.7.2 Fishing

Human-induced changes in the fish communities as a result of harvesting may seriously affect ecological relationships such as food chains and predator-prey relationships. Sport fishing is allowed in each of the four study areas while commercial fishing occurs outside their boundaries. In the northern parks, fishing may result in undue pressure to populations already stressed by acidification, low primary production, and heavy metal bioaccumulation. Other factors must also be considered such as the associations between exotic fish, non-sport fish, sport fish, their harvest, and the ecological assemblages of which they are a part (Canadian Parks Service 1991c). Fishing may negatively impact native species such that exotic species may become more competitive.

Commercial fishing in Lake Erie and Lake Superior may also adversely affect fish populations found in park waters. Fishing nets are also a threat to many aquatic birds and herptiles, particularly diving birds and turtles which may become entrapped in nets and drown. It is suspected that many birds, caught in gill nets, are killed annually in Lake Superior (Baxter 1974). Commercial and sport fishing in and around Point Pelee National Park may also adversely affect life forms other than fish. The decline of the softshell turtle (*Trionyx spiniferus*) and the mudpuppy (*Necturus maculosus*) are partially attributed to fishing nets (Kraus 1990). The mudpuppy, which is the largest salamander in Canada, may also be caught by sport fishing. Sport fishing enthusiasts may sometimes use frogs from the marsh as bait which may negatively impact rare populations over the long term.

4.7.3 Trapping and hunting

Past and present trapping and hunting, in and around each park, may also have negatively impact predator-prey relationships and indirectly, the vegetation and hydrology. Beaver harvesting may indirectly influence the present distribution or propagation of hardwoods. The Resource Description and Analysis (1989) for Pukaskwa stated that beaver do have a significant influence on vegetation patterns in areas prone to beaver flooding. Satellite imagery was used to detect changes in water bodies over ten years to evaluate the influence of beaver. A relationship between beaver and moose is thought to exist as beaver ponds play an important role in the support of moose populations by supplying aquatic plants (Gimbarzevsky et al 1978).

4.7.4 Forest harvesting

Selective logging occurred in each of the study areas during the early years of this century. This activity may have had a definite influence on the age, structure, and species composition of the vegetation since only certain species (pine, spruce and fir) were removed. The concentration of pure aspen stands in the southern portion of Pukaskwa are attributable to logging in the area (Lopoukhine 1991).

Since 1988 commercial forest harvesting in Lake Superior Provincial Park has been discontinued until completion of the new Park management plan (Babcock interview 1991). The management plan will determine whether or not logging will continue in the Park. If it is permitted to continue, a forest management plan will have to be completed to specify how and where this activity will be allowed. Prior to 1988, 98% of the Park's forested area was licensed to three Park timber harvesters, but only half of this area was zoned for actual logging (Vosper 1984).

Present logging activity outside Pukaskwa National Park and Lake Superior Provincial Park has numerous implications besides the increased access and erosion provided by logging roads and clear cutting. Improper slash disposal may result in slash accumulating in streams and rivers. Jams may form around or under which streams must scour a new channel. The violent movement of channel materials can kill fish eggs and food organisms in gravel and cause deposition of silt below the jam. These jams can also block fish migration to and from spawning grounds. The bacterial decomposition of slash and small wood debris in water often results in the removal of dissolved oxygen. This process may cause a deficiency of oxygen for fish, especially during the pre-hatching stage (Fish and Wildlife 1971).

Forest harvesting and replanting or reseeding large tracts of land with merchantable species alters the supply of diaspores, changes the vegetation mosaic, plant species diversity and wildlife habitats (OMNR 1989c, Lopoukhine 1991). A change in diaspores external to park boundaries may affect park vegetation genetically and structurally over the long term. Clear cutting affects wildlife in a number of ways. The noise of timber harvesting may cause fauna to abandon critical nesting or denning areas. For some animals, such as Woodland Caribou, a mature forest provides shelter from predators and a food supply of lichen and mosses (Parks Canada 1982c, 1986b). Other animals, such as beaver, deer, bear, and moose rely on the abundant food supply provided for by the slash, new herbaceous growth and replanted seedlings associated with logging (Telfer 1974, Eason 1989).

Baxter (1974), who discussed the effects of logging on avian distribution in Lake Superior Provincial Park, determined that both clear cutting and selective cutting tend to destroy habitats for birds relying on the denseness of the canopy for breeding. Clear cutting drives most species of birds away, some of which return following the regeneration of shrubs and herbaceous vegetation. Some populations of birds such as the Wood Thrush and Scarlet Tanager are entirely removed from selectively cut areas.

Although logging may negatively impact fauna dependant on dense, mature forests, it also increases habitat for species relying on early successional areas (Teller 1974). Eason (1989) found that areas which have been cut in roughly one square kilometre alternate cut and leave blocks provide early successional growth for food and enough standing timber as shelter for moose from hunters and predators. Moose, wolves and black bears were common in these areas. There undoubtedly exists some minimum ratio of forest cover to open fields tolerable to lynx. The lynx's dependency on snowshoe hare makes it sensitive to pronounced changes in hare abundance. Since hares mainly inhabit young forest stands, the lynx is greatly influenced by forest clearing (Canadian Wildlife Service 1977).

Since vegetation constitutes wildlife habitat, widespread changes in forest cover may be expected to affect wildlife populations. Disturbances created by forest harvesting may also facilitate the establishment of exotic species. Animals feeding outside park boundaries may also carry exotic seeds into parks and aid in their establishment. The future composition of the interior of Pukaskwa is expected to be affected by these changes (Canadian Parks Service 1989b, Lopoukhine 1991). To date, the interior of the Park has been least affected by human activities.

Logging may also modify the influence of insects on park vegetation. The Boreal Forest communities have evolved under the influence of insects through pollination, and the epidemic death of Balsam Fir and spruces caused by the Spruce Budworm (Canadian Parks Service 1989b).

The structure, composition and distribution of vegetation is greatly influenced by insects. Clear cutting often increases the regeneration of Balsam Fir thereby increasing the likelihood of future outbreaks of spruce budworm (Lopoukhine 1991). In undisturbed forests, budworm epidemics follow an irregular pattern of time and location, reducing the future compliment of fir (Canadian Parks Service 1989b). Forest harvesting and fire suppression in areas adjacent to parks may therefore have the effect of increasing the probability of budworm outbreaks and thus indirectly influencing the future vegetation in the Park. The epidemic deaths of fir and spruces also influences fuel conditions and therefore fire history. Logging may also increase the fire hazard due to poor slash disposal (Lopoukhine 1991).

4.7.5 Aggregate extraction

The high proportion of sand in the Pelee deposit (section 3.2.1) led to the physical removal of aggregate resources in and around the Park. Dredging activity has not occurred at Rondeau because of the low proportion of sand and gravel off the shores of the Park (section 3.2.1). The extraction activity at Point Pelee is assumed to have adversely affected the erosion rates of the Point (East 1976, Coakley 1977). There is believed to be a direct causal relationship between past dredging activities and the ongoing shoreline erosion. Since the late 1800's sand and gravel had been removed from the area until dredging activities were stopped in 1974 in response to public outcry (East 1976). During this period an undetermined volume of sand and gravel was not only extracted from the shoal area but also from Pelee's beaches and nearshore areas (Fig. 4.2) (Coakley 1977). The last few years of mining south of the point removed an average annual amount of 127 cubic metres (Sly 1977). As an alleged result of all mining activity the subaerial portion of the landform was reduced approximately one kilometre in length (Coakley 1977). The shoal area directly south of the point is postulated to be a storage area for sediment

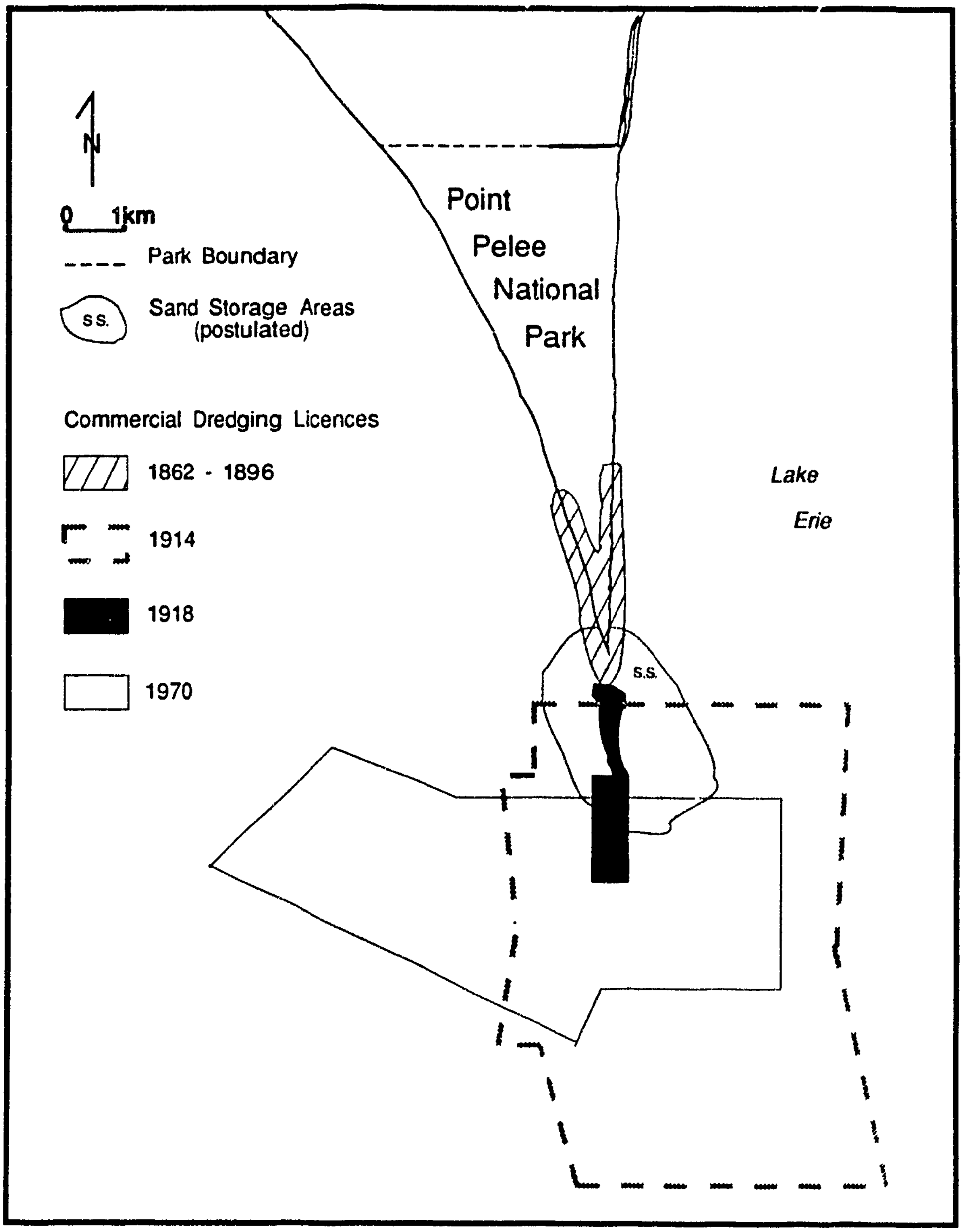


Fig. 4.2 Location of commercial dredging licences in the vicinity of Point Pelee since 1862 (taken from Coakley 1977)
Source: National Topographic Series, sheet 40G/15, 1:50000.

supply to the point. Material is periodically transported northward onto beach areas when winds are from the south (Fig. 4.3) (Coakley 1977). Dredging of the critical storage area would pose a definite risk of interference with source material for the point and is believed to have contributed to the severe erosion of sections of the east shoreline. According to Coakley (1977) such operations undoubtedly had a profound effect on the wave climate near the tip by increasing incident wave energy making the area more prone to washovers and causing a considerable lowering in elevation.

Dredging occurs at the harbours directly to the east and west of both Point Pelee and Rondeau. This contributes to the loss of longshore sediment reaching these peninsulas. Dredging at ports east of Rondeau has had minimal effects on the littoral drift since there are erodible bluffs directly east of Rondeau with very little artificial hardening of the shoreline (Rukavina and St. Jacques 1978). This allows sediment from these bluffs to reach Rondeau's east beach.

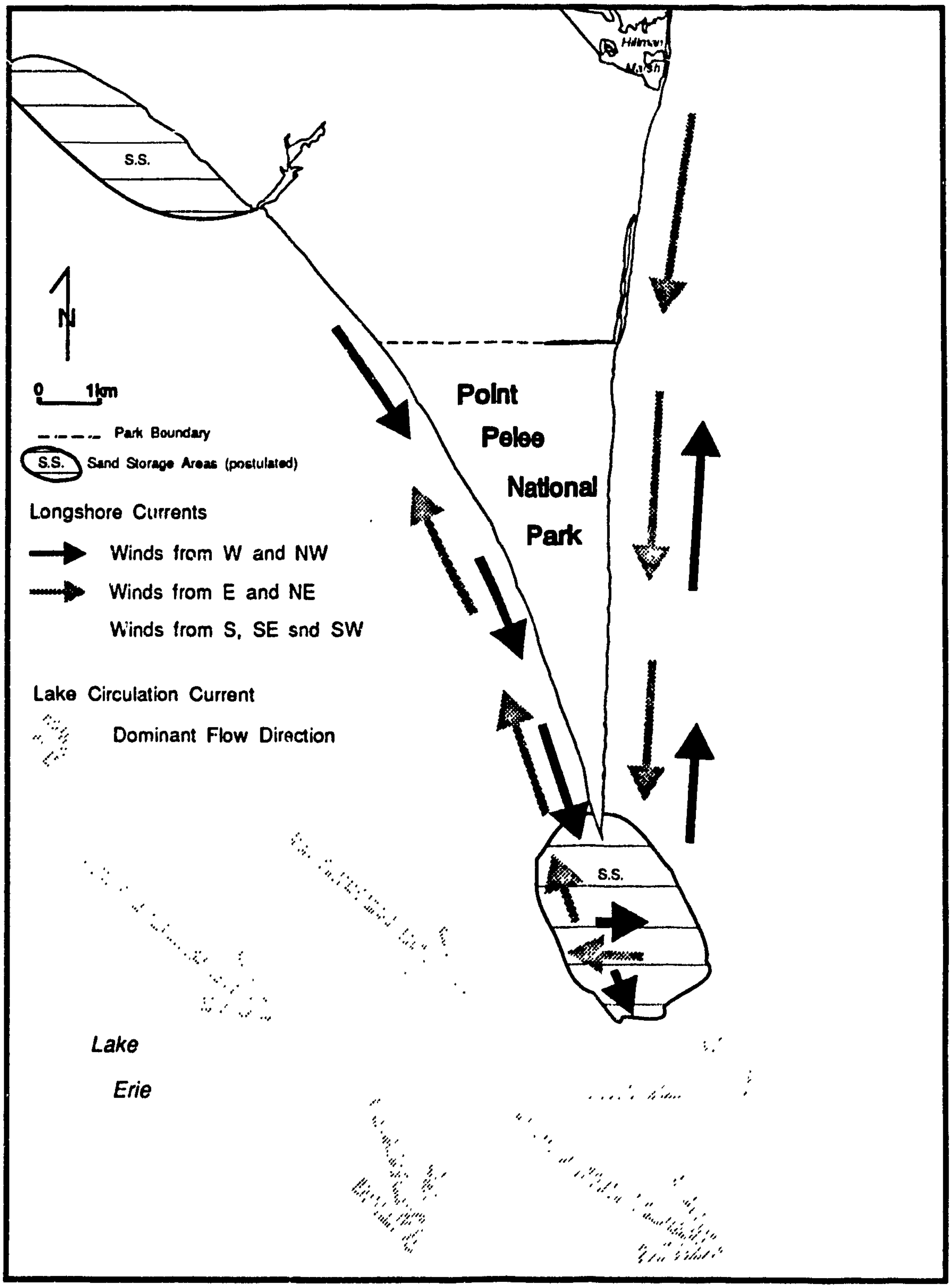


Fig. 4.3 Interpretation of the major patterns of sediment transport in the Point Pelee-Pelee Shoal area (taken from Coakley 1977)
Source: National Topographic Series, sheets 40J/1, 40J/2 & 40G/15, 1:50000

Chapter 5 Park Management Responses

5.1 Introduction

In national parks the idealistic goal is 'natural' processes directing 'natural' ecosystems. For this to be accomplished, park management must allow natural processe to operate unhindered by human activity to facilitate the natural evolution of ecosystems. Passive management which minimizes human impacts is therefore preferred. Active manipulation of the natural environment may be used as a last resort for such things as protecting neighbouring lands, park facilities, or rare and endangered species critical to representing the natural region (Parks Canada 1983). Usually both passive and active ecosystem management techniques are applied with set criteria established for justifying manipulation (Parks Canada 1986a, Canadian Parks Service 1991c).

Rondeau and Lake Superior Provincial Parks are Natural Environment Parks which incorporate outstanding recreational landscapes with representative natural features. These characteristics are to provide high quality recreational and educational experiences (OMNR 1979, OMNR 1991a). Natural Environment Parks, therefore, represent the essence of the Provincial Park idea and must incorporate all the values for which the System stands. Although Provincial Parks are not mandated to protect their ecological integrity as are National Parks, Natural Environment Provincial Parks are to protect natural areas of particular richness and diversity. Their rich and varied environments are the main reasons for park establishment and are also the foundation for outstanding recreational opportunities (OMNR 1978).

5.2 Point Pelee National Park

The Park Conservation Plan (1991) and various management plans, such as the Exotic Plant Species Management Plan (Dunster 1990), emphasize some forms of immediate, active management to minimize human-induced ecological changes where possible. Active management is required because of the Park's small size, high levels of visitor use, and its ecological isolation from other natural areas. Active management is crucial for protection of the Park's resources.

5.2.1 Exotic species

National Park policy (Parks Canada 1983) on exotic species states that they are not compatible with national parks such that their introduction is explicitly prohibited and efforts are made to remove them where they exist. Although the removal of all non-natives is an idealistic goal, natural resource management works towards the elimination of exotics whenever possible (Parks Canada 1982a). The methods employed to accomplish these tasks are not included in general park policy and must be developed by individual parks since the methods and species are usually site specific. The control of exotic species is based upon their aggressiveness, reproductive success, ability to hybridize with natives, the extent of habitat occupation, or whether they detract from the native flora and fauna which the park is supposed to represent (Dunster 1990, Canadian Parks Service 1991c). Exotic species that are not yet known to pose a threat or have become naturalized in park ecosystems may not be targeted for removal or may be removed opportunistically (Canadian Parks Service 1991c). Examples of these include the exotic fish, herptiles and birds in Point Pelee.

The invasion of exotic biota into Point Pelee's marsh is an ongoing process as these species gain access to Park waters during periods of breaching of the East barrier beach. Essentially, these species have become naturalized in the lower Great Lakes and intense, active management to remove them from the marsh would not be feasible. Point Pelee is considering a passive management approach to keep in line with national park policy once further monitoring has defined the impacts non-native fish have on endemic species (Deering interview 1991). Once completed, this information may provide management options such as the removal of exotic species opportunistically or encouraging their use as sport fish (Canadian Parks Service 1991c). Since national parks have no control over exotic species outside their boundaries the control of sea lamprey and zebra mussels are not their responsibility. Point Pelee does however, participate in assisting research efforts dealing with Lake Erie exotics, such as the zebra mussel. In such instances the Park may provide logistical support, and/or equipment to outside experts.

National parks also attempt to reduce the risk of inadvertent release of exotic species through visitor education and enforcement. The release of unwanted pets (herptiles, dogs, cats) into a national park is in violation of regulations. In Point Pelee, these species are usually removed opportunistically so they are not visible and do not significantly compete with or predate other park resources (Canadian Parks Service 1991c). Controls are implemented as necessary and include sending animals to the Humane Society or extermination by Park wardens (Deering interview 1991).

Exotic plant removal is one of the major resource management concerns for Point Pelee National Park (Reive interview 1991). Park staff have specific methods for removing non-native plants in the Exotic Plant Species Management Plan (Dunster 1990). It was unrealistic to attempt the removal of all such species, so this Plan categorized species into priority levels according to the need for their removal. The following criteria were established to determine the priority of species designated for removal. Highly visible or reproductively successful plants which were competing with native species were considered a high priority. Woody species were of concern as it was felt that the herbaceous understory would be reduced by the natural process of succession or succumb to competition with other natives. Scattered individuals, non-reproducing species, and inconspicuous plants which were not dominating the native flora were given a low priority. Other species such as grasses and clovers were ignored due to the extensive and unrealistic removal needs and the fact that they have become more or less naturalized in the region.

This Management Plan also details the most effective course of action to eradicate, reduce, or prevent the further spread of species identified on the priority lists. These methods take into consideration the importance of maintaining the scenic quality of the Park, enhancing the native flora, and minimizing the damage to the surrounding environment. Methods include hand pulling, mechanical removal and some limited chemical control. Chemical controls are not preferred by the Canadian Parks Service since many are not selective and may impact surrounding areas (Parks Canada 1983). If chemicals are the only method available then short-lived herbicides are preferred over the more persistent formulas. Biological controls are not currently recommended for use in national parks since they involve the introduction of animal and insect predators, fungi and disease. These may create new management problems since they are not solely selective.

A review of species status and effectiveness of initiatives are also undertaken to determine current needs, techniques and degrees of effort required to remove priority species. Park staff continue to implement the revised exotic removal program and monitor the effectiveness in reducing targeted species populations (Deering interview 1991). The warden service continue to remove priority species on an irregular basis due to time and personnel constraints (Canadian Parks Service 1991c).

5.2.2 Global warming

There were no specific management responses for global warming in Point Pelee National Park (Reive interview 1991).

5.2.3 Adjacent land use

National parks, by themselves, have no control over adjacent land use and therefore have no control over becoming isolated biogeographic islands. Management responses are limited to cooperative agreements and new land acquisition. The Canadian Parks Service intends to carry out preservation obligations through increased partnerships, cooperative activities and involvement in regional planning and resource management programmes (Canadian Parks Service 1991d, 1991e). National parks will not be managed in isolation but as a participant in resource management and regional tourism through public and private sector partnerships. Cooperative agreements with other agencies and land owners can be used to protect critical habitat outside park boundaries. New land acquisition may also be used to compensate for regional impacts by acting as a buffer (Canadian Parks Service 1991c). The benefits of additional lands must be identified as well as the process involved to acquire them.

The initiatives discussed below have not received much attention from the Canadian Parks Service due to public sensitivity and the Service's reluctance to devote too much effort on matters outside the Park. The possibility exists to acquire and rehabilitate a portion of the drained land to the north of Point Pelee (Canadian Parks Service 1991c). This may be accomplished with the assistance of other agencies to eventually link Point Pelee with Hillman Marsh (Fig. 3.2) (Reive interview 1991). This may become feasible when shoreline erosion becomes too costly relative to the rapidly depleting agricultural value of the land. Present cottage lots along the shoreline to the northeast and northwest of Point Pelee have the potential to become public beach areas in lieu of the costs of shore protection (Deering interview 1991).

Since Point Pelee National Park is not subject to fires entering from outside areas, fire management is based on internal fire suppression. The Conservation Plan (1991) states that a fire contingency plan will be prepared to manage fires corresponding to the natural fire regime. Presently, the natural role of fire in the marsh and terrestrial ecosystems is unknown. This must be identified along with the impacts from past fire suppression. Details on how these concerns are to be addressed were unavailable. The management response for the detrimental effects harbours have on the longshore drift processes will be managed in conjunction with shore protection in the following section.

5.2.4 Shore protection

Shore protection structures outside the Park, and their impacts on the dynamic nature of the sand spit are the most sensitive aspects of the Canadian Parks Service's relationship with adjacent landowners and local government. Point Pelee's Conservation Plan (1991c) states that any actions taken by the Park and adjacent land owners must be integrated with the implications of the negative regional sand budget. The Plan also recommends a regular forum of discussion between adjacent land owners, other levels of government, and involved agencies on the review of shoreline protection. The Canadian Parks Service believes that its participation in this discussion may assist in the analysis, design, and implementation of a project aimed at a permanent solution to the problem of severe erosion. Shoreline erosion and recession will be considered essentially as natural processes by the Park and no active management in the form of shore protection will be implemented (Deering interview 1991). Point Pelee intends to prepare contingency designs to rebuild or renourish the sand berm at the northeast corner of the Park, however, the Park Service will not purchase or place sand. These plans will be available to outside advocates if the situation becomes critical (Canadian Parks Service 1991c). A monitoring program will be established to determine the impact of structures northeast of the Park and also the success of any attempts to partially offset these impacts.

5.2.5 Pollution

Point Pelee must yet identify the potential consequences of pollutants on the Park's ecosystems. Monitoring programs must be designed and implemented to assess these effects and to assist in the development of management responses. This information may lead to active manipulation, or due to the scale of impacts, such as Lake Erie pollution, may not be feasible to manage. Water quality studies which identify impacts on the environment may allow the Canadian Parks Service to work with other agencies responsible for action on or against external sources of pollution.

The Park Conservation Plan (1991) suggests negotiating with the township regarding the north boundary, drainage canal maintenance and special disposal practices. Management responses for mitigating the effects of agricultural chemicals are presently nonexistent since impacts are virtually unknown and the canals and dykes have been in existence prior to Park establishment. Management responses for acid rain have not yet been considered since it is believed that direct impacts are moderated by the buffering capabilities of the soils and marsh waters (section 4.6.3).

Chemical spills on Lake Erie are the responsibility of the Canadian Coast Guard (Reive interview 1991). If the spill cannot be contained then the Canadian Parks Service and other agencies responsible for pollutant spills can resort to clean-up activities. The Canadian Parks Service does have manpower and equipment to deal with spills throughout the Province and these would be made available to protect Park property. Point Pelee is potentially at risk from a marine spill, especially when a breach occurs in the East beach. A priority list for shoreline protection has been developed should the Coast Guard be able to protect some portion of the Park (Canadian Parks Service 1991c). Priorities are based on breaches into the marsh, and beaches with high visitor use. The time of year is also important because if a spill occurred during the migratory phenomenon then beaches used as seasonal staging areas would have higher priorities.

5.2.6 Physical removal of resources

Poaching of natural resources is difficult to control and deter since information on these harvests are poorly documented. Collection of this type of data is limited since the identification of persons removing these resources is opportunistic. Essentially, wardens must witness the removal of artifacts in order to enforce regulations and collect this information. Presently, public education designed to dissuade potential poachers is limited to signs at the Visitor Centre and Interpretive trailheads (Canadian Parks Service 1991c).

While sport fishing is considered to be an acceptable activity in national parks, it is only allowed as long as sustainable fish populations exist. Fishing regulations and limits in Point Pelee are similar to those of the Province (Parks Canada 1983), however, enforcement and monitoring is limited. Currently, the limits are 5 Northern pike and 3 Largemouth bass, while all other species have no limit (Canadian Parks Service 1991c). Since the current population status for all species is unknown, the existence of sustainable populations is also unknown. The Park has initiated an information gathering program to identify population trends using creel census data, however, accurate biological data is also required to make informed management decisions. Point Pelee intends to finalize and implement a sport fish management plan to establish distinct management alternatives for exotic fish species, and the mechanisms by which to accomplish their commitments to sport fishing and protection of viable populations. Such a plan is needed to address these concerns as well as to outline a fish species inventory, and specific studies, such as the impacts of sport fishing on predator-prey relationships.

The only management response identified for past aggregate extraction was to prohibit further offshore dredging for commercial purposes. Replacing sediment which was removed from the beaches and shoal areas by these activities are not currently being considered.

5.3 Rondeau Provincial Park

In Rondeau Provincial Park resource management strategies are needed to recommend specific management techniques or practices for vegetation and fauna. In addition, monitoring of floral and faunal populations and their changes are also required. Rondeau's Management Plan (OMNR 1991a) identifies the need for a vegetation management strategy which would specify techniques for fulling protection objectives and guidelines for vegetation issues. This Plan also acknowledged the need for detailed botanical inventories for the Nature Reserve and Natural Environment Zones. The Plan stated that additional monitoring studies will map and quantify changes in vegetation over time throughout the Park. This monitoring is to be used to measure the effectiveness of specific management techniques such as the response of vegetation to deer population control. Monitoring floral and faunal changes can also be used to identify potential threats to the Park's ecosystems. Previous documentation of the life sciences has been done haphazardly in the Park. Since 1988 there has not been a resource manager in Rondeau

(Woodliffe interview 1991) so specific initiatives have not been undertaken. Rondeau's main concerns in the last few years have been related to visitor issues and the importance of reducing the deer herd. Since many baseline studies are lacking, ecological changes related to external threats have not been monitored in Rondeau. Staff have, therefore, been unable to identify many general management responses.

5.3.1 Exotic species

Provincial park policy states that non-native species will not be deliberately introduced unless they are of historical significance (OMNR 1978). Such species are permitted in historical zones provided they do not threaten other park values. This policy also states that a management programme may be developed for eradication of exotic species which have become established and threaten park resources. If an exotic plant is spreading and threatening indigenous populations, control or elimination will be implemented where feasible by the most environmentally sound method available (OMNR 1978). Control will also be directed as narrowly as possible to minimize effects on other environmental components. If exotics are not spreading it will not be considered a threat and will be left to die out naturally.

The level of exotic encroachment is virtually unknown in Rondeau, due to the overgrazing by deer, therefore threatening species have not been identified. Once the deer herd is culled, many exotics may proliferate throughout the Park due to the level of disturbance. This had occurred in Point Pelee but now that Pelee's deer are no longer creating disturbed conditions, it is believed that many exotics may die out naturally (Mouland interview 1991). In Rondeau removal of exotic plant and animal species is limited and opportunistic, or non-existent. Rondeau Provincial Park uses pesticides and herbicides for some exotic species (Woodliffe interview 1991).

Non-native woody species, such as barberry, are cut and treated with Roundup. Herbicides may also be used to prevent or slow the spread of garlic mustard. Insecticides are used in problem cases of exotic insects such as the gypsy moth. Feral animals in Rondeau are removed and/or destroyed opportunistically under the supervision of the Ministry.

5.3.2 Global warming

There were no management responses for global warming identified in Rondeau Provincial Park (Wiper and Woodliffe interviews 1991).

5.3.3 Adjacent land use

Similar to national parks, provincial parks have no control over adjacent land use. Provincial parks are therefore similarly limited in their management responses. These include involvement in regional planning in terms of providing recreational areas. For Rondeau Provincial Park, the main response to many serious and immediate threats related to adjacent land use has been Park shrinkage. All of Rondeau Bay (to the high water mark) had previously been included within the Park's boundaries. Presently, only part of the Bay is included. As Fig. 3.3 illustrates, the rapidly eroding sand bar located at the immediate right of the Ericau piers is also excluded from the Park.

In response to fire suppression, Provincial Policy (OMNR 1978) states that natural fires in Wilderness or Nature Reserve Zones normally will be allowed to burn undisturbed unless they threaten human life, other zones, or land outside the Park. Natural fires threatening the values for which Nature Reserve or Historical Zones have been established will be suppressed. The Policy also states that prescribed burning may be carried out in Wilderness or Nature Reserve Zones to simulate natural fire when desirable. All other fires will be suppressed. Fire suppression techniques used will minimize effects on the parks environment. Such techniques as the use of bulldozers will not be allowed. Presently all fires are suppressed in Rondeau (OMNR 1991a). The Park does not yet have a fire strategy to deal with wildfires and prescribed burning (Woodliffe interview 1991). This issue is to be resolved in Rondeau's vegetation management strategy.

The response of Park management to the detrimental effect adjacent harbours have on the longshore drift processes will be described in conjunction with shore protection.

5.3.4 Shore protection

Rondeau's Management Plan (OMNR 1991a) stated that erosion of the south beach will be monitored to document and assess the impact on the beach and ultimately on the Bay and marsh. Strategies for minimizing the lake's effect may also be necessary. Presently, Rondeau Provincial Park considers shoreline erosion as naturally occurring and does not yet monitor this phenomenon (Woodliffe interview 1991).

5.3.5 Pollution

The Ministry of the Environment does water quality monitoring in Rondeau Bay (Woodliffe interview 1991). Good water quality is important to maintain the Rondeau Bay fishery and the Ministry will encourage measures to improve the water quality and rehabilitate fish habitat (OMNR 1991a). Rondeau's Management Plan (1991) states that the impacts of lead shot will be assessed and if significant adverse impacts are observed, a ban on the use of lead shot will be recommended. Similar to Point Pelee, acid rain is not considered a serious threat because of the buffering capacities of the soils (Wiper interview 1991). Rondeau Provincial Park also relies on the Canadian Coast Guard for chemical spills on Lake Erie (Woodliffe interview 1991).

5.3.6 Physical removal of resources

Poaching of decorative and natural objects is prohibited by the Provincial Parks Act (1987). Similar to the national parks, provincial park enforcement and visitor education of poaching are very limited and opportunistic due to the lack of information on the extent, locations and impacts of these illegal harvests.

Park Policy (OMNR 1978) states that sport fishing will be encouraged in Natural Environment Parks as long as maintenance of healthy endemic populations exist. Size limits and limits of catch may be essential in zones where appropriate. Fishing is not allowed in Nature Reserve Zones but is encouraged within Park waters of Rondeau Bay. Since Rondeau does not monitor fish populations or the effects of sport fishing on predator-prey relationships (Wiper interview 1991) the existence of sustainable populations is unknown. Fish management programs will be undertaken only after studies indicate that they will benefit the existing fishery (OMNR 1991a).

5.4 Pukaskwa National Park

Presently, Pukaskwa is able to apply more passive management techniques than Point Pelee, due to its large size, low visitor use and relative remoteness. In the future, the Park may need to employ more active management if current trends on adjacent lands continue to change the regional natural environment. Pukaskwa may end up as ecologically isolated and impacted by adjacent land use as Point Pelee. Pukaskwa has not yet been gazetted as a national park so the

National Park's Act and regulations do not apply (Fenton interview 1991). This requires the use of a wide variety of both Federal and Provincial legislation to achieve its protection goals (ie. Ontario Trespass to Property Act, Ontario Fish and Game Act, Criminal Code, etc.).

5.4.1 Exotic species

The vast areal extent, rugged topography, limited human resources and fiscal restraint of Pukaskwa National Park places severe restrictions on inventories and baseline studies. Since some Park resources are lacking detailed inventories and others are ongoing, the exact impacts of such things as exotic species are difficult to determine. Of the 961 lakes in the Park only 55 have been inventoried for fish and there have been no specific fish studies carried out in the Lake Superior waters within Park boundaries (Schiefer and Lush 1986).

Pukaskwa's exotic fish, such as Yellow Perch, are self-sustaining populations and are now considered part of the natural fish communities such that their removal is unwarranted (Parks Canada 1982b, Schiefer and Lush 1986). The sea lamprey has been the focus of a large scale control program in the Great Lakes for the past twenty years. Pukaskwa National Park has participated in this control program by allowing the use of lampricides every 3-5 years in Park streams which are used for sea lamprey spawning (Schiefer and Lush 1986). Although this treatment has reportedly killed some fish species, which were not identified, there was also no mention of the impacts on native lamprey species (Schiefer and Lush 1986). The sea lamprey is considered to be under control in Lake Superior but will continue to exist in suitable Park streams (Canadian Parks Service 1989b).

Since the level of exotic plant encroachment in Pukaskwa National Park is unknown, but believed to be minimal, they have not identified specific management responses. It is understood however, that operational practices may need to be modified such that the creation of desirable habitats for non-native species is reduced (Fenton interview 1991).

5.4.2 Global warming

There were no specific management responses identified for global warming in Pukaskwa National Park (Fenton interview 1991).

5.4.3 Adjacent land use

Management responses for impacts on Pukaskwa's resources from adjacent land use are limited to cooperative agreements, new land acquisition, and being considered as a Biosphere Reserve (Fenton interview 1991). Under the United Nations Educational, Scientific and Cultural Organization's (UNESCO) Man and the Biosphere Program, protected areas known as Biosphere Reserves have been created in many countries. They are established to conserve the diversity and integrity of plant and animal communities within natural ecosystems. If accomplished, this may give the Canadian Parks Service more influence over lands adjacent to Pukaskwa (Fenton interview 1991).

Pukaskwa National Park staff intend to work closely with neighbouring land owners to ensure a complimentary approach to land management. Continued Park liaison and environmental monitoring are necessary to ensure that the companies extracting resources on adjacent lands, and Ontario Hydro are aware of potential impacts of their operations on Park lands (Couchie interview

1991). The majority of the Park will be managed as wilderness in recognition of its inherent value and continuing decline throughout North America.

Increased access via logging and mining roads, to backcountry areas of Pukaskwa required the implementation of an enforcement plan to ensure the protection of the Park's resources (Canadian Parks Service 1989b). This plan includes winter and summer patrols in backcountry areas. During the hunting season, air and ground patrols will be utilized and concentrated in areas of uncontrolled access.

Before Pukaskwa National Park could be established, agreements concerning some resource management issues had to be made between the Canadian Parks Service and the Province of Ontario. These agreements resulted in constraints placed upon management of certain Park resources. Examples of these include the Ontario Hydro right-of-way maintenance and the Ontario Ministry of Natural Resources' (OMNR's) provision of forest fire detection and suppression services (Parks Canada 1986a). Currently, all fires in Pukaskwa are suppressed where possible. Pukaskwa National Park intends to determine the natural role of fire on park lands from available data, such as forest fire history, and integrate this information with vegetation management initiatives (Canadian Parks Service 1989b). A fire management plan will also be prepared to address suppression, prescribed fires, and wildfires left to burn. Preparation and implementation of this Plan will, however, require coordination with and input from the OMNR (Parks Canada 1986a).

The Canadian Parks Service must reassess its management of fire in light of new information on the effects of fire suppression and fire dependant communities. Following the guideline of a National Fire Management Directive, fire management plans must address suppression, prescribed fires and wildfires for each park.

5.4.4 Pollution

Many pollutants are recognized and dealt with under separate resource management initiatives such as acid rain and impacts of mining activity on Park waters (Canadian Parks Service 1989b). Both Park staff and outside agencies design programs to monitor impacts of present and potential pollutants. Canadian Park Service personnel collect data for the expansion of baseline inventories but they also carry out data collection and/or analysis for some studies such as water quality in the Pukaskwa River (A. Moreland interview 1991). The Park also controls and initiates contracts to carry out specific resource studies and monitoring needs. Cooperative programs are established with other agencies, such as universities, who may have mutual goals and objectives. Some assistance in the form of human resources, logistical support, and/or equipment may be given (Couchie interview 1991). Experts from other agencies are allowed to initiate unilateral studies from which the Canadian Parks Service would benefit, but there is limited involvement from the Park Service in directing the study objective.

The Canadian Parks Service is supplied with data from outside studies to assess present and long term impacts resulting from transboundary pollutants (Canadian Parks Service 1989b). This data is made available to Park staff for the purpose of fulfilling management objectives. Senior managers in the Department of the Environment may be informed on the extent, magnitude and significance of the impacts on Park ecosystems. The Canadian Parks Service may then work with other agencies responsible for action on or against external sources of pollution.

Chemical spills on Lake Superior are the responsibility of the Canadian Coast Guard (Fenton interview 1991). Park staff will work with other agencies in clean-up activities when needed. Most of Pukaskwa's resources are protected from lake pollution and chemical spills by its rugged coastline.

5.4.5 Physical removal of resources

Poaching of decorations, natural objects, and flora and fauna is prohibited by the National Park's Act (Canadian Parks Service 1991c). Pukaskwa has the intent of the National Park's Act and is protected against poaching by various provincial regulations which require permission of the land owner for certain activities such as hunting and fishing (Reside interview 1991). Enforcement and visitor education designed to reduce poaching are very limited and opportunistic since information on the extent, locations and impacts of these harvests are poorly documented. Park wardens must witness these activities in order to enforce regulations and collect data.

Sport fishing and native hunting and trapping are acceptable activities in Pukaskwa National Park (Parks Canada 1982b). These types of resource harvesting are allowed as long as sustainable populations exist. Pukaskwa must yet identify lakes which are suitable for fishing and establish limits accordingly (Schiefer and Lush 1986). The effects of these activities on fish and wildlife populations are largely unknown, therefore, the existence of sustainable populations are also unknown. The requirement for more credible information on the current status of these populations is evident. For the most part, the relative abundance of each species and the various interrelationships (predator-prey) are only speculative. This information gap has been recognized by the Canadian Parks Service. Pukaskwa staff intend to identify the level of inventory, control and monitoring necessary to ensure the protection of these resources (Canadian Parks Service 1989b). Presently, staff are designing and initiating information gathering programs for sport fish, furbearer, moose and caribou population trends in order to make informed management decisions to protect these populations (Fenton interview 1991).

Some information may be gathered from creel census data, registered trapline data, and the number of moose harvested by the Robinson-Superior Treaty Group (RSTG)(Canadian Parks Service 1989b). To effectively maintain these populations, adequate baseline data is needed to identify the impacts of harvesting. The Canadian Parks Service realizes that it cannot rely solely on the data collected from sport fishing enthusiasts, native trappers, and hunters. Accurate biological data such as habitat requirements, reproductive success, and population dynamics are also required to make informed management decisions (Parks Canada 1986a, Canadian Parks Service 1989b). Pukaskwa staff intend to finalize and implement management plans for their respective harvesting activities. These Plans will address the mechanisms by which to accomplish their commitments to resource harvesting and their policies to protect and maintain populations.

The physical removal of resources around Pukaskwa National Park requires the monitoring of their effects on the flora and fauna of the Park. This knowledge will be collected in conjunction with adjacent land uses (section 5.4.3). Baseline information on the flora and fauna will aid in the identification of detrimental changes induced by the transformation of the regional natural environment. The resource management plans and practices will be revised and modified when necessary.

5.5 Lake Superior Provincial Park

A new management plan for Lake Superior Provincial Park is currently being developed (Babcock interview 1991). This may identify specific management strategies required for the Park's vegetation and fauna such as monitoring their population changes. Currently, the Park lacks baseline studies in many areas due in part to the large areal extent and limited human resources. Lake Superior Provincial Park's main concerns at present are visitor issues and the future of logging within the Park.

5.5.1 Exotic species

In Lake Superior Provincial Park, removal of exotic species is non-existent. The Park deliberately stocks exotic fish species to enhance sport fishing where indigenous populations have been altered by such things as acid rain or as a biological control against yellow perch (OMNR 1988). The stocking of splake is not considered to be a threat since they do not maintain their own populations. They may however, affect ecological relationships such as food chains and predator-prey relationships. Lake Superior Provincial Park has participated in the lamprey control program, similar to Pukaskwa National Park, by allowing the use of lampricides in the Gargantua River (Babcock interview 1991).

5.5.2 Global warming

There were no management responses for global warming identified in Lake Superior Provincial Park (Babcock and Stinnissen interviews 1991).

5.5.3 Adjacent land use

The use of logging roads within the park requires an access pass (Babcock interview 1991). These roads are used by forestry, railway, and power company workers, as well as trappers accessing traplines. Even though the use of snowmobiles and all-terrain vehicles is not allowed, these users are permitted to operate such vehicles on logging roads to cross through the Park to access backcountry areas and areas east of the boundary. In recent years, lodge and cottage owners have been requesting the use of Frater Road to access their properties located east of the Park. As an interim measure the use of this road by individuals who have traditionally used snowmobiles will be allowed to continue until the Park Master Plan Review is completed and the issue has been fully addressed (OMNR 1989c). OMNR wishes to establish distinct regulations for roads which could provide access to the Park since the potential exists for unauthorized public use of these roads. This may compromise the integrity of the Park boundary and the remote character of the Park. The use of logging roads may be affected by the Timber Management issue as mentioned in section 4.7.4.

In response to the level of moose mortality along highway 17, Lake Superior Provincial Park has initiated programs to reduce the number of moose-vehicle collisions (OMNR 1988). These programs include draining roadside salt pools, constructing devices to reduce moose trampling, and improved highway signs warning motorists of the potential hazard.

Lake Superior Provincial Park has not yet developed a fire strategy to deal with wildfires and prescribed burning (Babcock interview 1991). This may be addressed in the new management plan, but until that time, all fires will be extinguished.

5.5.4 Pollution

The Ministry of Natural Resources (MNR) controls and initiates contracts to carry out specific resource studies and monitoring needs similar to the Canadian Parks Service (section 5.4.4). Presently, the Ministry of the Environment does acid precipitation monitoring in Lake Superior Provincial Park (Babcock interview 1991). MNR may also work with other agencies striving for action against external sources of pollution. Since the Canadian Coast Guard is responsible for chemical spills on Lake Superior, Park staff may assist such agencies in clean-up activities when needed for such events on Lake Superior or in Park transportation corridors (Stinnissen interview 1991). Similar to Pukaskwa National Park, the majority of Lake Superior Provincial Park is protected from lake pollution and chemical spills by its rugged shoreline.

5.5.5 Physical removal of resources

Law enforcement for poaching is especially difficult in this Park since the majority of Park users have the potential to remove resources along the highway corridor without encountering a warden. Similar to the other three study areas, monitoring of this activity is opportunistic at best.

Fishing, hunting and trapping are acceptable activities in Lake Superior Provincial Park, provided that sustainable populations exist. Harvested populations are not monitored to ensure sustainability. Anglers are, however, encouraged to practice the technique of catch and release (OMNR 1988) and trapping is to be phased out of all Provincial Parks by the year 2010 except by licensed Natives enjoying treaty rights (OMNR 1989c).

Forest harvesting allowed in the Park prior to 1988 was only allowed in Recreation-utilization Zones (OMNR 1979). Logging practices of selective and clear-cutting did not allow for a sustainable timber supply (OMNR 1989c). Reseeding and natural regeneration of clear-cut areas was practised, but the rate of renewal of especially hardwoods, was inadequate to ensure a continuous longterm supply.

Chapter 6 Discussion, Conclusions and Recommendations

6.1 Discussion

Preceding chapters have documented threats, their impacts on park ecosystems, and the corresponding management responses. This section focuses on key issues that arise from this review. The discussion has been divided into the following categories: threats and management responses; management effectiveness; national and provincial park approaches to specific threats; comparison of southern and northern parks; and the relation of this study to the literature. These subdivisions were based on the objectives of this study as stated in section 1.2.

6.1.1 Threats and management responses

One of the objectives of this study was to compare procedures of national and provincial parks when dealing with human-induced ecological changes. Point Pelee National Park and Rondeau Provincial Park are very similar in the types and intensities of external threats. Their management responses, however, vary remarkably. Point Pelee has documented most threats, recognized many potential changes in Park ecosystems and has developed both general and specific management techniques to deal with many of these issues. Although some issues have not yet been addressed (for example the effects of sport fishing and agricultural chemicals on the marsh ecosystem) these information gaps have at least been recognized by the Canadian Parks Service, and Park staff work towards the collection of this information. The Park's specific management plans such as those for herptiles and exotic plant species identify much work which needs to be done. Point Pelee staff acknowledge and understand the importance of many external threats. Their work towards mitigating the associated ecological changes in Park resources is however, very opportunistic at the present time.

Rondeau is lacking in many of these areas, especially baseline studies against which to compare ecological changes. Even though the new Management Plan (1991) specifies important Park objectives, such as 'protection from direct human influences as fully and practically as possible to allow natural processes to dominate', methods to accomplish this have not been identified. This new Plan recognizes many of the weaknesses in monitoring and has outlined an implementation schedule. Phase One of the schedule includes a comprehensive inventory of flora and fauna, preparation of vegetation and wildlife management strategies, and initiating resource-related monitoring programs such as the response of vegetation to deer control. Phase Two includes establishment of a Lake Erie shoreline monitoring program and implementation of both vegetation and wildlife management strategies. Although this schedule addresses many of the pressing resource issues, it did not specify when these programs would get underway. Since the OMNR is currently undergoing internal reorganization, and all permanent positions have been frozen (Woodliffe interview 1991) it may be quite some time before this schedule is implemented.

Pukaskwa National Park and Lake Superior Provincial Park also have similar external threats and different management responses. Both parks also lack many baseline studies due in part to their large areal extent and limited human resources. Pukaskwa is, however, making a concerted effort to initiate many resource inventories. The Park has prepared, and is in the process of preparing management plans that focus on different types of data needing to be collected. This data collection sporadically includes information on external threats, an example being the Sport Fish Management Plan and information on acid precipitation and toxic metals. Lake Superior Provincial Park, however, is severely lacking baseline information on which to establish management. This Park has virtually no information regarding external threats. Even though broad surveys of plants were conducted in 1988, of the more than 600 plants known to occur in the Park, there was no mention of exotic species (White 1988).

Both Point Pelee and Pukaskwa have recognized most external threats and have addressed many of them, even if only generally. Examples are Point Pelee's involvement in the discussion of plans to rehabilitate portions of the marsh north of the Park, and Pukaskwa's liaison with logging and mining companies to ensure their awareness of potential impacts on Park lands. Public awareness of the Canadian Parks Service interests with respect to surrounding lands and their use, around both Point Pelee and Pukaskwa, may contribute to the preservation of natural resources adjacent to the parks.

Although both of the national parks have policies and management techniques for many resource issues, a fundamental problem lies in the implementation of these programs. Many of the pressing resource management issues for both national and provincial parks may never be fully addressed due to budgetary cutbacks, time and personnel constraints and the backlog of resource management projects. Identification of external threats, their impacts on park ecosystems and appropriate management to mitigate these impacts are only preliminary steps in park preservation. Management responses must be implemented and incorporated into a working schedule with some sort of time frame identified so that park staff actively work towards these goals.

The collection of data to provide baseline information is an ongoing endeavour because this data is constantly undergoing change. This data must be incorporated into management initiatives since clearly defined problems have a greater chance of being resolved. Ecosystems are not static, so management must be adaptive to incorporate new information. Monitoring must also be used to assess management. The overall effectiveness of a resource management plan is measured by a monitoring programme to supply feedback which may lead to recognition of new needs and guidelines for altered management.

Through regular monitoring, action can be identified and taken when potential problems arise. To some extent, the collection of data for increasing baseline information can be considered a management response to external threats. This information helps identify how park ecosystems change and may also help to identify effects of specific threats. For example, monitoring of the arctic-alpine vegetation and caribou populations in Pukaskwa may help to identify specific changes resulting from global warming.

6.1.2 Management effectiveness

Another objective of this study was to evaluate the effectiveness of management programs in rehabilitating and/or preventing human-induced ecological change. Since both provincial parks lack strong research and monitoring programs to provide critical information on which to base management, the effectiveness of their management cannot be assessed. Both Rondeau and Lake Superior Provincial Parks must formulate general and specific policies dealing with the impacts of external threats. Presently, both provincial parks are more concerned with internal issues. OMNR has been preoccupied with visitor issues and the importance of reducing the deer herd in Rondeau while in Lake Superior Park they have concentrated on visitors and the future of logging within the Park. General park policies and surveys have been insufficient to outline techniques to be used in response to external threats. In many instances park managers do not know the resources which are inside the boundaries or the state of those resources.

Both Rondeau and Lake Superior Provincial Parks have carried out some random resource inventories, but have made no mention of such important issues as exotic species or pollution. Since the level of exotic encroachment is virtually unknown in these parks, the effectiveness of management cannot be adequately determined. They may be combating some exotic species with chemical application but the overall effectiveness of inhibiting all exotic encroachment has been undetermined. Both Rondeau and Lake Superior Provincial Parks should give greater emphasis to preserving and protecting their environments since their natural diversity and integrity were the basis for their establishment. These Natural Environment Provincial Parks were established in areas of provincially significant natural diversity and integrity, for the purpose of providing outstanding recreational opportunities. These parks should not let their ecosystems deteriorate since the parks have been entrusted to protect these resources to provide the basis for recreation.

Generally, Point Pelee National Park's recent management programs are based on reliable research. Many of their basic resource inventories have been professionally applied to identify specific management techniques to be used to prevent detrimental ecological change. Park staff have begun the difficult task of rehabilitating the terrestrial ecosystems to their former state. The Exotic Plant Species Management Plan (Dunster 1990) deserves much of the credit since its underlying goal is to create and manage healthy plant communities. Dunster acknowledges the fact that this goal would not be achieved if all the attention was focused on controlling individual exotic species. She recognises the need for an ecosystem management approach to mitigate many of the threats posed by non-native species by directing efforts towards restoring the ecosystem to a healthy state. Much of the literature, including Dunster's work in Point Pelee, identifies that most problems with exotics are caused by anthropogenic disturbances to natural habitats. It is believed, therefore, that minimizing these disturbances would likely lead to their reduction.

Encroachment and proliferation of an exotic weed species often follows human disturbance of the landscape, which eventually leads to the degradation of a natural ecosystem. It is frequently suggested in the literature that a healthy, natural ecosystem will not experience problems with exotic species (Curry-Lindahl 1972, Lamprey 1972, Conservation Foundation 1985, and others).

In Point Pelee it is believed that most of the exotic species will be naturally replaced by native species when pre-settlement conditions are restored, or when native species are transplanted onto a site (Dunster 1990, Mouland interview 1991). Some species will undoubtedly be dropped from the exotics list because they will have been successfully eradicated. A greater challenge lies in conducting careful monitoring programmes in order to prevent the addition of new species to the list.

Presently, the Park has also launched a Restoration Study to identify procedures by which to restore presettlement conditions. Once this program has been finalized and implemented, it may prove to be a very realistic way to protect and prevent further degradation of Pelee's unique resources. Management plans and studies, such as those mentioned previously, are however useless unless fully implemented. Presently, park staff do not have the proper time to fully commit to each of these studies and plans which, in itself, is also a threat.

The prime national role for this park, as stated in the Management Plan (1982a) is the protection, management and preservation of its nationally and internationally significant geomorphological and biological resources. Even though the Park has identified new means of protecting its biological resources through greater ecosystem management approach, the Canadian Park Service (CPS) seems to be shying away from its responsibilities to protect geomorphological resources. These resources include the dynamic sand landform, which is the physiographic basis of the Park.

6.1.3 National and provincial park approaches to specific threats

Both Point Pelee and Rondeau's consideration of shoreline erosion and recession as natural processes cannot go without comment. The erosion problem has obviously been influenced by both shore protection and the development of harbours adjacent to the parks. Therefore, the resulting erosion is not natural but is human-induced. The natural erosion prior to these developments occurred during high lake levels and was essentially repaired during deposition which occurred during low lake levels. Both landforms were essentially in dynamic equilibrium with respect to longshore drift processes since they were both undergoing erosion and deposition. Had these forelands not been in some sort of equilibrium with longshore processes, Point Pelee's beach ridges would not have been aggrading to the west and similarly Rondeau would not have been extending to the east.

Shoreline development has exacerbated the erosion of park land by reducing or completely eliminating longshore drift. Hence, Point Pelee's westward aggradation seems to have been severely reduced or eliminated. The west side of the point is even experiencing some erosion during high lake levels. The east beach undergoes severe erosion during periods of high lake levels and may also experience a loss of sediment during low lake levels. Deposition occurring during low lake levels is often insufficient to repair the areas which have undergone sediment loss during high lake levels. This should not be considered as naturally occurring by the CPS. It is obviously being influenced by human developments adjacent to the Park.

Similarly, Rondeau's south beach is believed to be eroding during both high and low lake levels as the piers at Erieau trap the longshore sediment supply. Rondeau's east beach does not yet seem to experience a great deal of erosion, except at the southeast end. This may be due to the fact that some sediment is supplied from the east bluff located between the Park and Port Glasgow. Rondeau's aggradation rate may have been impaired by the Erieau Piers and the Port Glasgow Harbour. Sediment supplied to the sand spit may be sufficient to prevent severe erosion along most of the East beach but may be insufficient to facilitate further aggradation to the east. Monitoring of shoreline erosion and aggradation occurring at Rondeau would definitely clarify these possibilities. The OMNR also considers the erosion a natural phenomenon, even though it is obviously being influenced by the Erieau Piers.

It would appear that the CPS and OMNR have a non-aggressive approach to these anthropogenic impacts. This may be due to the fact that they have no control over the adjacent shoreline and therefore feel that nothing can be done to offset the erosion of parkland. It seems as if the CPS is waiting for erosion of the northeast beach to become so extensive that the agricultural dykes are exposed to direct wave action. This may ultimately lead to breakdown of the dykes and flooding of the farmland. Since the agricultural value of this land is diminishing, while the cost of repairing dykes or further shore protection is increasing, protection of this land may not be justified. Breakdown of the agricultural dykes and flooding of the farmland may be what's needed to resolve the present situation. Agencies may then proceed to purchase and reconvert the land to its former state as a marsh. The cottage lots along Marentette's Beach may then also be acquired as a public beach and present shoreline protection removed. Destruction of the dykes and flooding of the farmland may bring attention and an eventual solution to this problem but may also result in loss of life and property.

The CPS and OMNR should take the lead roles in the discussion between adjacent land owners, other levels of government, and involved agencies on the review of shoreline protection and development since the parks are presently most at risk from these developments. The adjacent land owners are presently protected and will not likely initiate any discussion since shore erosion is not their problem. The CPS and OMNR should not try to pass these problems to someone else or to the next generation of park managers. The longer these problems are allowed to proceed, the more difficult it may become to find a solution or repair the damage once a solution has been determined.

6.1.4 Comparison of southern and northern parks

A comparison of southern parks to northern parks allows one to identify many severe and immediate threats (Table 6.1). Many of the external threats to Point Pelee National Park and Rondeau Provincial Park are related to their small size, isolation from other natural areas, and the level of urban development. The northern parks, Pukaskwa National Park and Lake Superior Provincial Park, are still relatively remote with respect to urban settlement. Their external threats are generally associated with resource extraction and fragmentation of adjacent natural areas. Since the southern parks have been in existence longer than the northern parks, and are located in a highly developed region, they may be used as examples for what may occur farther north. As resource extraction and urban development encroach upon the larger parks, they may become as ecologically isolated and impacted as Point Pelee and Rondeau in the future. Both Pukaskwa and Lake Superior Parks could learn from these examples to realize the importance of natural areas and critical wildlife habitat outside park boundaries. Many of the external threats associated with habitat fragmentation and urban development may be reduced by preserving natural areas surrounding a park in the form of a buffer zone. Presently, it is still feasible to negotiate with

External Threat	Point Pelee National Park	Rondeau Provincial Park	Pukaskwa National Park	Lake Superior Provincial Park
Exotic Species	aquatic biota herptiles birds insects mammals flora	aquatic biota insects mammals flora	aquatic biota insects	aquatic biota insects
Global Warming	southern species increase, northern species decrease	southern species increase, northern species decrease	southern species increase, northern species decrease	southern species increase, northern species decrease
Adjacent Land Use	rural & urban development, water diversions, fire suppression, harbours	rural & urban development, fire suppression, harbours	resource extraction, roads, water diversions, fire suppression	resource extraction, roads, water diversions, fire suppression
Shore Protection	armour stone, groynes	armour stone, pilings		
Pollution	lake pollution, lead shot, chemical spill on Lake Erie	lake pollution, lead shot, chemical spill on Lake Erie	acid precipitation, toxic substances, pollution from resource extraction, chemical spill on Lake Superior	acid precipitation toxic substances, pollution from resource extraction, chemical spills on Hwy 17, railway, & Lake Superior
Physical Removal of Resources	poaching, fishing, past trapping & hunting, aggregate extraction	poaching, fishing, past & present trapping & hunting	poaching, fishing, trapping and hunting, forest harvesting	poaching, fishing, trapping & hunting, forest harvesting

Table 6.1 Summarized results of external threats for each of the case-studies.

adjacent landowners to create buffer zones around both northern parks. This may become a reality for Pukaskwa if it is designated as a Biosphere Reserve (see section 5.4.3). Once the adjacent lands have been drastically altered by human activity, a buffer zone would be extremely difficult to acquire. Such is the case for Point Pelee and Rondeau. Even though Point Pelee has considered the possibility of linking the Park with Hillman Marsh, or rehabilitating land north of the Park, these concepts may prove to be very costly and may take generations to accomplish.

Point Pelee and Rondeau may also set examples for what may happen when external threats are not controlled in early stages. Some threats, both internal and external, may be slow to develop, and are put off until they develop into crises. Since threats to parks are increasing in number, severity and the costs to address them, they must be anticipated and dealt with as early as possible.

One of the fundamental problems between the southern and northern parks is that it is more difficult for Pukaskwa National Park and Lake Superior Provincial Park to accomplish resource inventories. Comprehensive information on the natural resources and threats to these parks is difficult to obtain due to the large areal extent and rugged topography. It is more difficult to travel in and around these parks for the collection of data than it is in the smaller southern parks. It is also expensive to hire helicopters and airplanes which may be preferable for data collection. The northern parks also have similar numbers of resource personnel as their counterparts to the south, therefore the smaller parks have an advantage for resource management.

The northern and southern parks share certain commonalities with respect to transboundary impacts yet there is a pressing need to share information and innovative responses. Communication between national and provincial parks in each geographic location may serve to mitigate similar threats in similar areas, such as shore protection or resource extraction. Discussion may assist managers to work together for common goals. Communication between northern and southern parks is also needed to achieve common goals such as preventing exotic encroachment. It may also help Pukaskwa and Lake Superior Parks anticipate future problems which Pelee and Rondeau are currently facing. Research and response efforts should be integrated to prevent human-induced ecological change. Even though the parks share many common problems, such as exotic species, pollution, poaching and global warming, the impacts may be distinct due to geographic location. The northern parks are at great risk from acid rain and global warming because they are located on the Canadian Shield and in the transition zone between Boreal and Great Lakes-St. Lawrence Forest Communities. Pelee and Rondeau, located in a highly urbanized area, are at great risk from rural, urban and shoreline development. Communication and information exchange is needed to assist park managers in preventing irreversible ecological changes. A greater number of resource personnel working towards a common goal may develop innovative management strategies because each has his/her own expertise.

National Parks and Natural Environment Provincial Parks have many criteria for park establishment. Generally, these parks are established in areas which have had limited human activity and are relatively 'untouched'. These parks must also be representative of the particular region which they are to be located. Often these areas contain provincially or nationally significant species. Both the Canadian Parks Service and the Ministry of Natural Resources do not require such stringent criteria if they do not protect these areas from detrimental ecological changes subsequent to park establishment. Every effort must be made to maintain the biological diversity as well as the ecological relationships and processes of these areas. Since both Park Services are mandated to protect park environments, they must make these issues top priority.

6.1.5 Relation of this study to the literature

Each of the four case-studies faces some similar external threats as those found in the literature: notably air pollution, physical removal of resources, exotic species, water quality and adjacent land use. Some unique threats were also found that were dependant on park location. An example is the detrimental effect of shore protection on the southern parks. Also as in the literature, each of the case-studies suffers from chronic understaffing, underfunding and a backlog of resource management projects. Some biological and ecological research activities are also carried on by outside experts with park staff providing managerial and technical assistance. In all four case-studies, some of the basic research is not being professionally applied to park management. Each of the four study areas lacks, to varying degrees, research and monitoring programs to provide critical information on which to base management. Examples include inventories of resources with no mention of exotic species, allowing resource harvesting before the identification of sustainable populations, and consideration of increasing public recreation before adequate baseline studies have been completed. Even though the parks have not fully committed to research-based management, the management initiatives which have been identified are a good start.

The four study areas are also developing innovative means to carry out their mandates by encouraging approved scientific research by qualified individuals. There are some cooperative projects between universities and parks that facilitate data collection. This will assist each park to expand its information of natural and cultural resources and assist in their proper management.

6.2 Review of objectives

The initial objectives of this study were:

1. examine the types of external threats and their implications for ecosystems in Point Pelee and Pukaskwa National Parks and Rondeau and Lake Superior Provincial Parks.
2. examine the responses of park managers to prevent changes in ecological integrity.
3. determine whether or not the management techniques of park managers are rehabilitating and/or preventing ecological change induced by external threats.
4. make an initial comparison of national and provincial park approaches to specific threats. By focusing on both national and provincial parks, differences in management techniques and their effectiveness for similar threats in similar areas may be determined.

The first two objectives were fulfilled by interviewing park staff and reviewing specific studies in the parks. The results were summarized in chapters four and five respectively. For the third objective, a complete evaluation of management effectiveness in rehabilitation and/or prevention of detrimental ecological changes cannot be accomplished. This is due to the fact that responses to threats have not been fully identified or implemented. Where identification and implementation have been undertaken, very little monitoring has been done to determine the effectiveness of park management. Many management programs have been recently introduced and monitoring of their effectiveness must proceed over the long term. For Point Pelee National

Park, however, the numerous management plans have great potential for rehabilitating many portions of the park which have undergone detrimental ecological changes. The park has already undergone substantial improvements in many of its habitats. The success of management techniques for rehabilitating and/or preventing ecological change is directly dependant on the implementation of these plans. Completion of the Restoration Study will no doubt assist in park rehabilitation. The comparison of national and provincial park approaches to external threats described and discussed previously was based on information collected during interviews, park visits and critical reviews of specific studies and management plans.

6.3 Limitations of the study

1. Responses of park personnel during the interviews may have incorporated certain preconceived viewpoints in the identification of specific threats and their impacts on park ecosystems. Some park staff may not view certain external influences as threats or may not recognize impacts as being detrimental.

2. This thesis may understate the extent of threats and human-induced ecological changes facing the study areas. This may be due to a lack of documentation or understanding of these factors. This thesis did not elaborate on cumulative or synergistic effects but focused on individual impacts of individual threats.

3. Although the study was innovative in a comparative and broad spectrum approach, it was limited to four parks. A larger sample of parks may have resulted in the identification of a greater number of threats and management responses, however, less attention may then be available to obtain the opinions of park staff. Since the wardens and resource personnel must actively pursue the mitigation of detrimental ecological changes on a day-to-day basis, their knowledge and opinions are therefore very important. The four case-studies were chosen because of their unique

commonalities. Point Pelee National Park and Rondeau Provincial Park are very similar and are located in a highly urbanized area of southern Ontario. Pukaskwa National Park and Lake Superior Provincial Park are also comparable since they are similar in location, climate, plant and animal communities, and park sizes.

In spite of these limitations, this study has documented specific external threats and management responses for each of the four parks. This examination of the dynamics of external threats may give a greater awareness of the complexities involved in maintaining ecological integrity. This may assist managers in gaining an overall view of threats to their particular park and identifying weaknesses in natural resource management.

6.4 Conclusions

Important conclusions of this study may be summarized as follows. Management responses to human-induced ecological change have not been fully identified in the study areas. Even though Point Pelee and Pukaskwa National Parks are aware of external threats and potential impacts on park lands, they lack many management responses. Where management has been identified, often it has not been fully implemented. Rondeau and Lake Superior Provincial Parks lag far behind the national parks since most of their resource inventories have not been completed. The provincial parks also lack qualified resource personnel to complete these studies. Many important resource management concerns for both national and provincial parks may never be thoroughly addressed due to time and personnel constraints, budgetary cutbacks, and a backlog of resource management projects.

One general conclusion to emphasize is that the establishment of national and provincial parks, alone, does not protect their ecosystems from external or internal threats. It is crucial that both the National and Provincial Park Services' goals of protecting park habitats be carried out in day-to-day operations. Park goals, objectives and management cannot be accomplished without the tangible implementation of projects. This must begin by accumulating baseline information, and monitoring ecosystem changes. Monitoring of specific ecosystem components is necessary to collect baseline information and to verify management effectiveness. Threats and associated impacts must be defined as broadly as possible so that management solutions can be based on the complex inter-relationships within ecosystems. Normal ecosystem functions and behaviour must be understood in order to determine when components require management. Before human-induced ecological changes occur, management must work towards preventing these changes, or, after they occur, reducing their severity. Since these changes are not natural, they may change the natural course of biological or geomorphological evolution. Working towards mitigating the causes of these changes requires baseline information to determine which changes are normal. An underlying problem of resource management is distinguishing between naturally occurring changes and those which are human-induced. This difficulty may be part of the reason for the lack of ecological monitoring in parks. A monitoring process must also be considered as an ongoing evaluation of management initiatives. Through regular monitoring, immediate action can be taken when problems arise.

With respect to protecting park environments from human-induced ecological change, this study has indicated that both provincial parks are much worse than their national park counterparts. The provincial parks' lack of information on external threats, impacts and possible management responses, may reflect OMNR's lack of concern regarding the natural environments of their parks. Natural Environment Provincial Parks are the very essence of the Provincial Park System, yet their provincially significant landscapes and habitats receive very little if any monitoring and protection from external threats. Provincial parks are mandated to conserve provincially significant environments but both Rondeau and Lake Superior Provincial Parks have not identified any specific management practices to accomplish this.

The Canadian Park Service is slowly adopting an ecosystem management approach. Park managers are no longer limiting their management to certain plants or animals, but now realize that when one species is threatened, others are also affected. While trying to conserve habitats in parks, managers must recognize the interactions of ecosystem components. Proper management relies on an understanding of the ecological structure and function of these components (Curry-Lindahl 1972). Park management is frequently misinterpreted to be the protection and control of plant and animal species. The most important aspects of park management lie in the conservation of habitats. When anthropogenic disturbances are prevented, plant and animal populations require little or no management (Lamprey 1972). Prevention of anthropogenic disturbances may not be accomplished in practice, but park management could strive towards the standards set by this ideal. The lack of ecological considerations and research jeopardizes the values for which many parks were created. It is impossible to understand the past, present, and future of abiotic and biotic inter-relationships within habitats and ecosystems without ecological knowledge (Boyd 1972, Cain 1972). Park managers are at risk of making serious mistakes in management and policy establishment because the factors determining the prevailing situations are not understood (Curry-Lindahl 1972). Park managers cannot adequately manage what they don't understand.

Agee and Johnson (1988) stated some of the benefits of adopting an ecosystem management approach. These included regionally responsive planning that recognizes the combined abilities of public and private land to achieve goals, management which supports scientific programs, and the ability to use interpretive programs to help educate visitors about ecosystem management concepts. They explained that problem-oriented interpretive programs recognizing the complexity of resource management problems and the role of values in solving these problems could educate visitors to the real uncertainties park managers face. These aspects could be applied to each of the case-studies, especially Pukaskwa, since many visitors live and work in the immediate area. This means that many of the visitors are employed by the mining and timber companies harvesting resources adjacent to the Park. By educating these visitors on the impacts of resource harvesting to Park ecosystems, it may eventually influence the operations of these companies.

The persistence and increasing intensity of many park threats is due to lingering social and economic pressures on natural environments, and the inadequacy of many Park Service research programs. Budgetary and personnel cutbacks, as well as the overwhelming accumulation of resource management projects inhibits the collection of crucial ecological information and its incorporation into management. Both the National and Provincial Park Services lack assertiveness in their confrontation of external threats. In some cases this has resulted in compromise and negligence in the preservation of natural environments entrusted to the Park Services.

One cannot solely condemn the parks for their lack of information and management when dealing with external threats. Although there is room for improvement in their approach to these overwhelming threats, fault also lies with the public and private sector. Since external threats and resulting human-induced ecological changes arise from human activities on adjacent lands, these people must also be held accountable. The lack of concern for their actions and impacts on parks habitats cannot go without comment. Parks would not be impacted so severely if more control were employed on adjacent lands. A great advantage lies in educating visitors on the impacts human activities outside parks have on parklands. Since many visitors consider these special places to be priceless they may have more than a passive interest in the plight of parks. It is up to everyone to mitigate the impacts of external threats to parks.

6.5 Recommendations

Future research may determine interesting relationships between Canadian parks and parks in the United States, such as Point Pelee National Park and a comparable park on the south shore of Lake Erie. Innovative study may also be made between natural areas managed by federal or provincial governments to those managed by non-government organizations.

Future study should concentrate on assisting park managers in the collection of baseline data and monitoring the effectiveness of management initiatives. Each of the four parks in this study require assistance in determining precise impacts from individual threats as well as cumulative and synergistic effects on ecosystems. An indepth study on each park could determine critical information such as the effects of shrinking gene pools on limited populations, or identifying alternatives to the use of road salt to reduce moose-vehicle collisions in Lake Superior Provincial Park.

The effects of many pollutants on living organisms is not well understood, therefore studies on such topics as the impacts of heavy metal accumulation on mammals may benefit park management. It has been hypothesized that the coastal area of Pukaskwa National Park may have greater deposition of pollutants due to a modest maritime effect (section 4.6.3). Accumulation of heavy metals such as cadmium in the coastal vegetation may affect mammals in this habitat such as caribou. Since cadmium is known to accumulate in the livers and kidneys of moose and deer it may also occur in caribou which may contribute to the caribou decline in Pukaskwa National Park. Future research should also concentrate on the effects of acid precipitation and toxic elements on lower organisms at the base of food chains. Many of these organisms may be at risk from a greater variety of pollutants, even in very minute quantities. Lower organisms may be impacted by contaminants which are not of any known consequence to human health, therefore the pollutants may not be regulated. Ecosystems are often sensitive enough to be damaged before a human health standard is violated.

Research by qualified individuals may help prevent detrimental changes in ecological integrity. Adequate funding, specialized personnel and management based on scientific research is needed for parks to adequately protect their natural resources from human-induced ecological change. This type of research in the parks may also lead to a better understanding of the impact human activities have on the natural environment.

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Appendix A

Checklist Used for Reviewing Threats, Ecological Changes and Management Responses

1) inventory of park ecosystems and analysis of their condition.
2) types of external threats affecting the park.

For each specific external threat:

3) description and intensity of each threat.
4) level of knowledge; sufficient, insufficient.
5) ecological effects, what are the known and predicted impacts of the specific threat.
6) influencing factors of the park's ecology; i.e. acid buffering capacity of the soil.
7) description of monitoring that has/is being done on the specific threat or resulting ecological changes.
8) overall management response to the threat or resulting ecological changes.
9) possible solutions to reduce or eliminate the impacts.