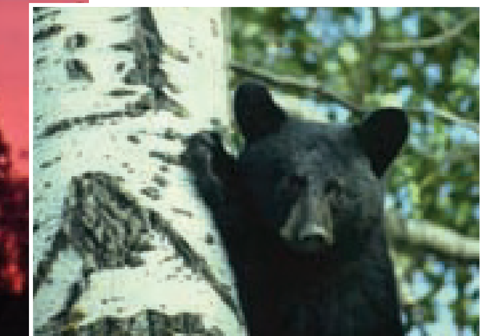

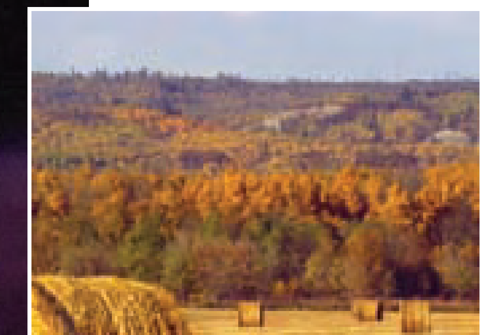

RIDING MOUNTAIN ECOSYSTEM

Community Atlas

CPAWS

CANADIAN PARKS AND WILDERNESS SOCIETY

CPAWS gratefully acknowledges the financial support of the Government of Canada's Voluntary Sector Initiative, through the Parks Canada Agency, and the in-kind support of ESRI Canada. The views expressed in this publication do not necessarily reflect those of the Government of Canada.

Canada

To view electronic versions of the four atlases produced in this project, please visit:
< www.cpaws.org/community-atlas >

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Cover photo credits: Ian Ward (Deep Lake, Riding Mountain National Park), Paul Pratt, UBC (barred owl), Parks Canada (black bear and field outside Riding Mountain boundary)

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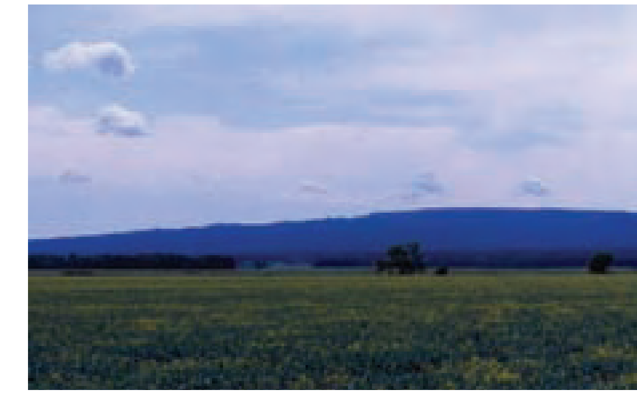
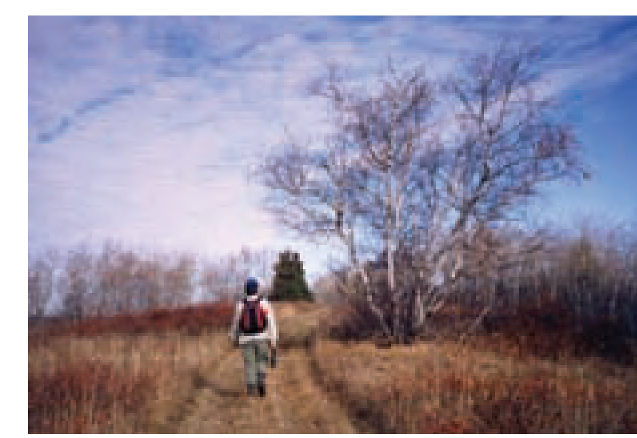


Ian Ward

Donna Danyluk



Ian Ward

MAPS & TABLES

INTRODUCTION

WHAT IS THIS ATLAS FOR?

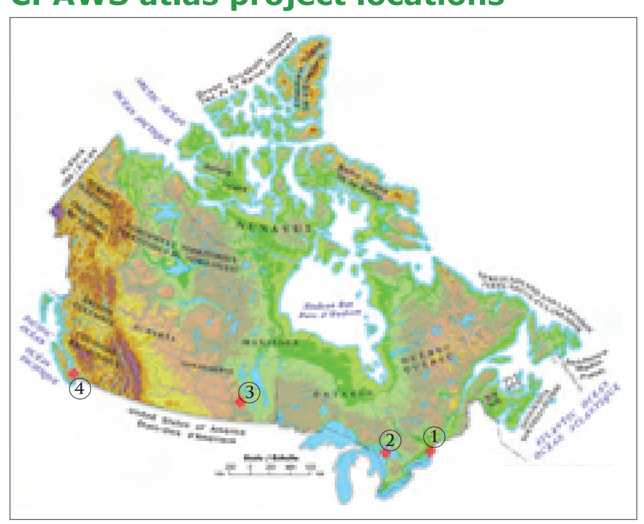
This atlas presents information about the “greater park ecosystem” of Riding Mountain National Park. A greater park ecosystem is the landscape around a park that influences the wildlife and ecological systems inside the park. The objectives of this atlas are to transform complex data into usable information, and to make this information available to everyone involved or interested in local decisions that affect the greater ecosystem. This shared information should give us some common ground and help us all make better decisions that will benefit people, wildlife and the community.

Section 1 introduces the Riding Mountain Biosphere Reserve, which represents the boundaries under study in this atlas. Section 2 discusses the physical components of the Riding Mountain Ecosystem, such as glacial history, climate, topography and geology, soils and ecologically distinct areas. Section 3 discusses the human history of this part of the province, while Section 4 looks at the changing landscape, including the impacts of habitat fragmentation, fire and climate change.

Section 5 provides an overview of water issues in the Riding Mountain ecosystem, including drainage and wetlands. Section 6 looks at the flora and fauna of the area along with a summary of the regulations concerning wildlife. Section 7 discusses the implications of and different approaches to ecosystem management. It also looks at what the future might hold for the Riding Mountain ecosystem and the choices we face.

Literature references that are cited throughout the text are provided after Section 7, followed by the all-important Maps & Tables that complement the information presented. The appendices provide additional details or explanation.

CPAWS atlas project locations



The four national parks included in the Community Atlas Project: St. Lawrence Islands National Park (1) and Bruce Peninsula National Park (2) in Ontario, Riding Mountain National Park (3) in Manitoba, and Gulf Islands National Park Reserve (4) in British Columbia. [Map source: Atlas of Canada]

THE COMMUNITY ATLAS PROJECT

From 2002 to 2004, the Canadian Parks and Wilderness Society embarked on an exciting project working with local groups, individuals and agencies involved in land management around four of Canada’s national parks: St. Lawrence Islands National Park and Bruce Peninsula National Park in Ontario, Riding Mountain National Park in Manitoba, and Gulf Islands National Park Reserve in British Columbia. Our objective was to gather information about the regions surrounding the national parks, to compile this information into community conservation atlases, and to present these atlases in a way that will contribute to local policy development and land use that supports the ecological integrity of the national parks at the core of these landscapes. This atlas is one of the four that resulted from the project.

We now know that the long-term ecological health of our national parks depends not only on how lands within park borders are managed, but also on what happens in the surrounding region, sometimes referred to as the “greater park ecosystem.” In other words, activities both inside and outside national parks impact on how well parks can protect plants, animals and ecological processes.

While we have used the technical tools of Geographic Information Systems (GIS) to analyze and present data in map forms, this project has been much more than a GIS project. It has been about working collaboratively to determine what information is needed to manage the landscape around a national park in a way that is supportive of healthy park ecosystems and healthy communities. It has been about involving people who live in the greater ecosystems of national parks and ensuring that the atlases meet the needs of the individuals, agencies and organizations who will use it in their work and their voluntary activities.

The basis of good planning and management is good information.

With this in mind, we involved local groups, agencies and individuals from the very beginning. Before we produced any maps, we talked to people, soliciting ideas about what information would be useful to include in a community conservation atlas, how it could be presented and how it might be used. We consulted on what data was available to build the atlas. The information that was generously provided by many people at many stages of the project is an absolutely essential part of the final atlas that is presented here.

We envision that this atlas could be used to inform government planning and policy development directly, and as a tool that will help citizens and groups participate in public planning processes in and around national parks. For example, national park management planning, and local and regional planning all solicit participation from the public.

The challenge now will be to keep the information in these atlases up-to-date. There will be the opportunity to do so in part with the on-line and CD versions. We welcome your continued input into the atlases, and welcome suggestions on how we can continue to update the valuable work that we have done together.

CPAWS gratefully acknowledges the financial support of the Government of Canada's Voluntary Sector Initiative, through the Parks Canada Agency, and the in-kind support of ESRI Canada.

Canada

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www.cpaws.org/community-atlas

ABOUT CPAWS

The Canadian Parks and Wilderness Society (CPAWS) is a non-profit charitable conservation organization that has been working to conserve nature since 1963. We are a grassroots organization with 13 regional chapters and a national office. The CPAWS Manitoba Chapter has been working for wilderness in this province since 1991.

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PARTNERS, COLLABORATORS AND ACKNOWLEDGEMENTS

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CPAWS Manitoba would like to thank numerous individuals and agencies for their efforts and contributions in making this document possible (titles/positions listed are current as of time of consultation):

Dwayne Blackbird (Coalition of First Nations With Interests in Riding Mountain National Park and former Chief of Keeseekoowenin Ojibway First Nation), **Jennifer Bookhout** (Important Bird Areas Coordinator, Canadian Nature Federation, Ottawa), **Ryan Brook** (PhD Candidate, Natural Resources Institute, University of Manitoba), **Andrew Couturier** (GIS Analyst, Bird Studies Canada, Winnipeg), **Wendy Creed** (Digital Information Specialist/GIS, Manitoba Conservation), **Al Dakin** (Manitoba Land Initiative Warehouse Co-ordinator, Manitoba Conservation), **Vic D'Angiolo** (GIS Specialist, Canadian Food Inspection Agency, Winnipeg), **Geraldine David** (Parks Canada, Riding Mountain National Park), **Gerry Delorme** (Resource Planner, Manitoba Conservation Districts, Gladstone), **James Duncan** (Manager, Biodiversity Conservation Section, Manitoba Conservation), **Greg Fenton** (Superintendent, Riding Mountain National Park), **Nicole Firlottee** (Assistant Biodiversity Information Manager, Manitoba Conservation), **Ray Frey** (Reeve of the Rural Municipality of Park South, Onanole), **Sean Frey** (Ecosystem Data Specialist, Parks Canada, Riding Mountain National Park), **Helen Godschalk** (Program Coordinator, Science and Stewardship, Nature Conservancy of Canada, Ontario), **Cary Hamel** (Conservation Area Planner, Nature Conservancy of Canada/Manitoba Conservation Data Centre), **Jamie Hewitt** (Land Resource Conservationist, PFRA Dauphin), **Ken Kingdon** (Communications Officer, Parks Canada, Riding Mountain National Park), **Glenn Lelyk** (GIS Specialist, Agriculture and Agri-Food Canada, Winnipeg), **Patsy Michiels** (Assistant Land Resource Conservationist, PFRA Brandon), **Karin Newman** (MSc Candidate, Dept. of Botany, University of Manitoba), **Marilyn Peckett** (Manager, Aboriginal Affairs/Senior Park Planner, Parks Canada, Winnipeg), **Maureen Peniuk** (Protected Areas Initiative, Manitoba Conservation), **James Plewak** (Chief Executive Officer, West Region Tribal Council), **Leonardo Sotomayor** (GIS Manager, The Nature Conservancy, Virginia), **Lowell Strauss** (Ecoregional Planner, Nature Conservancy of Canada, Saskatchewan), **Paul Tarleton** (Ecosystem Manager, Parks Canada, Riding Mountain National Park), **Bill Tedford** (GIS Specialist, Ducks Unlimited Canada, Winnipeg), **Bill Thompson** (MSc (graduate), Dept. of Botany, University of Manitoba), **Joanne Tuckwell** (Acting Species at Risk Coordinator, Parks Canada, Winnipeg), **Tanys Uhmann** (Habitat Stewardship Co-ordinator, Manitoba Habitat Heritage Corporation), **Sandy Walter** (Land Securement Representative, Nature Conservancy of Canada, Brandon), **John Whitaker** (Chair, Riding Mountain Biosphere Reserve Committee, Erickson), **Grand Chief Dennis White Bird** (Assembly of Manitoba Chiefs, Winnipeg), **Ian Witherspoon** (Natural Lands Retention Program Leader, Ducks Unlimited Canada, Killarney), and other dedicated contributors who may have been regrettably omitted from this list.

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SECTION 1.0 RIDING MOUNTAIN GREATER ECOSYSTEM

Given that ecological boundaries are not easily defined, this atlas focuses on a portion of the Riding Mountain greater ecosystem – the Riding Mountain Biosphere Reserve. The Biosphere Reserve consists of Riding Mountain National Park and the rural municipalities surrounding the Park, as defined by their physical boundaries. The term “Riding Mountain region” is used in the atlas to refer generally to the greater ecosystem.

A range of information relevant to land-use issues in the region has been compiled, including figures, tables, photographs and a series of maps covering items such as soil, wetlands, vegetation and key wildlife areas. This project will hopefully contribute to a broader and more complete understanding of the Riding Mountain region – its people and biological communities.

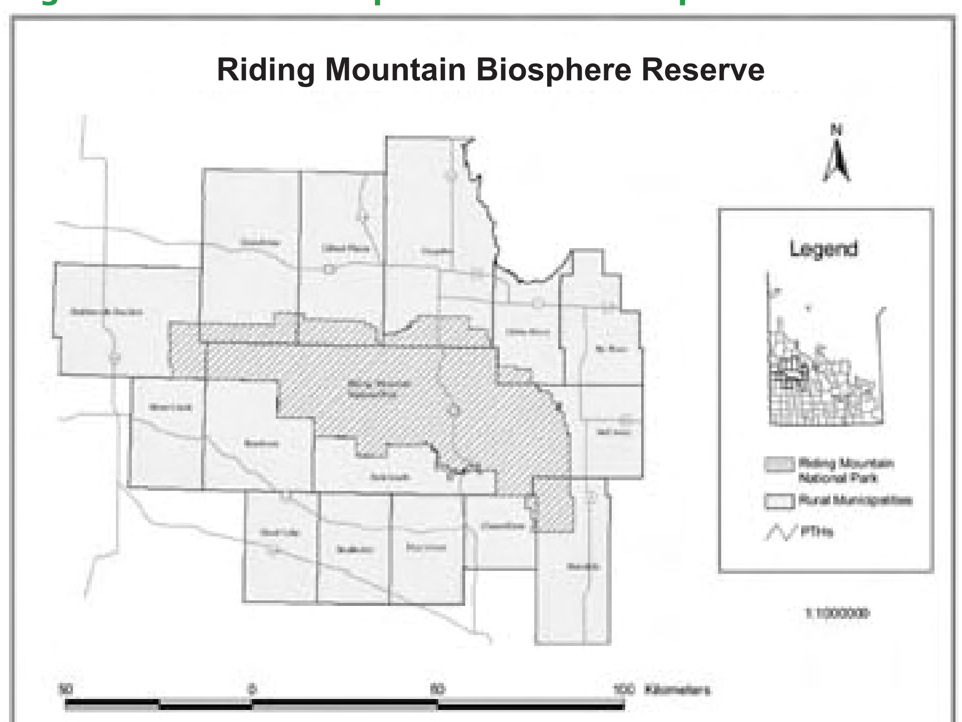
1.1 THE RIDING MOUNTAIN BIOSPHERE RESERVE

The Riding Mountain Biosphere Reserve is situated in southwestern Manitoba, approximately 250 km northwest of the city of Winnipeg. It encompasses a portion of the Manitoba Escarpment in the east, the broad valley occupied by the Wilson and Valley Rivers in the north, the Shell River valley in the west, and a plain that slopes gradually towards the Assiniboine River valley in the south.[1] The Biosphere Reserve includes several major ecosystems, including the northern boreal forest, mixed-grass and rough-fescue prairie, aspen parkland and eastern deciduous forest, and is situated in both the Boreal Plains ecozone and Prairie ecozone, as shown in **Map 1** and **Map 2** in the Maps & Tables section. (Ecozones are large areas of the landscape defined by a unique interaction of climate, vegetation, soils, geology and physical landscape features. Within ecozones, progressively smaller units of the landscape called ecoregions and ecodistricts are characterized by more refined landscape features.)

The Biosphere Reserve is about 1,381,000 hectares (13,810 square km) in size, and incorporates Riding Mountain National Park and the 15 rural municipalities that surround the Park (see **Figure 1**): Grandview, Gilbert Plains, Dauphin, Ochre River, Ste. Rose, McCreary, Rosedale, Clanwilliam, Park South, Harrison, Strathclair, Shoal Lake, Rossburn, Silver Creek and Shellmouth-Boulton. (Shellmouth and Boulton were amalgamated in 1999.)

Established in 1986 by UNESCO (the United Nations Educational, Scientific and Cultural Organization), the Riding Mountain Biosphere Reserve is one of 13 across Canada: Southwest Nova in Nova Scotia; Charlevoix, Lac Saint Pierre and Mont. St. Hillaire in Québec; Georgian Bay, Thousand Islands-Frontenac Arch, Long Point, and Niagara Escarpment in Ontario; Redberry Lake in Saskatchewan; Waterton in Alberta; and Clayoquot Sound and Mount Arrowsmith in British Columbia. The upper Bay of Fundy in New Brunswick and Nova Scotia is a candidate for inclusion in this network.[2]

Figure 1: Rural Municipalities in the Biosphere Reserve



Source: Adapted from Prairie Farm Rehabilitation Administration (2002)

There are currently 425 biosphere reserves in 95 countries around the world. Biosphere reserves are areas of terrestrial and coastal ecosystems “promoting solutions to reconcile the conservation of biodiversity with its sustainable use” and are part of the UNESCO Man and the Biosphere (MAB) program.[3] MAB had its origin at the 1968 International Biosphere Conference in Paris, where it was firmly declared for the first time that the utilization and conservation of natural resources should go hand-in-hand, and that interdisciplinary scientific approaches should be promoted to achieve this aim.[4] Biosphere reserves are designated by UNESCO following detailed nominations made by the MAB National Committee of a given country. Members of the Canadian National Committee for MAB are volunteers from a range of sectors, including research, government, First Nations and business.[4]

The Canadian government does not approve biosphere reserve nominations from the National Committee unless it is responsible for management of part of the lands involved.[4] As a general rule, the provincial government must be supportive as it is responsible for land-use issues. However, no one single government agency or private organization is responsible for biosphere reserves. Most important is local support if resource management issues are to be addressed in a cooperative manner between government agencies, landowners and different community groups.[4] Notably, the designation of Riding Mountain Biosphere Reserve was supported by all councils of the rural municipalities surrounding the Park.

What is the relationship between the Biosphere Reserve and National Park?

Riding Mountain National Park is part of a larger ecosystem on which it depends for natural processes operating at large scales. This greater ecosystem concept encourages thinking and acting beyond the political boundaries of the Park, at a scale appropriate for the conservation of ecological integrity[5] (a term used to describe the health of an ecosystem). Because the Park itself is small relative to ecosystem processes like the movement of water and wildlife, it cannot maintain its ecological integrity without support from the surrounding landscape and the people within it. In effect, the Park is only one component of a complex mix of private and public lands in southwestern Manitoba, with federal, provincial, First Nations, and municipal governments overseeing a wide variety of land uses.[5]

Since the end of the Wisconsin Ice Age approximately 12,500 years ago, this area of the province has undergone substantial changes, largely a result of the sweeping immigration and development of the region since the late 1800s. The region now supports a rural agricultural economy supplemented by tourism associated mostly with the National Park. However, the intensive economic and agricultural development has placed stresses on natural communities in the region, through habitat alteration and fragmentation, the indirect or direct removal of natural disturbance processes such as flooding and fire, and the introduction of invasive species.

Richard Caners

The mandate of Parks Canada is to "conserve, restore and maintain ecological integrity," by ensuring that parks "remain areas with whole and complete biological systems, including species, landscape elements and processes."[6] All natural processes and disturbance regimes must be intact in order for a park or region to retain its natural complement of biodiversity.[7] The *Canada National Parks Act*[8] states that "the maintenance or restoration of ecological integrity, through the protection of natural resources and natural processes, shall be the first priority of the Minister when considering all aspects of the management of parks."[5]

Biosphere reserves are living examples of conservation and sustainable development.[4]

The boundaries of the rural municipalities that comprise the Riding Mountain Biosphere Reserve encompass a significant portion of the Riding Mountain region, and were in part chosen to help protect the ecological integrity of the National Park.

The Biosphere Reserve serves three important roles:[4]

1) Conservation – protecting genetic resources, plant and animal species, and ecosystems and landscapes of value for the conservation of the world's biological diversity.

2) Development – combining conservation with sustainable use of ecosystem resources through close cooperation with local communities, building upon traditional knowledge and appropriate land management.

3) Logistic – linking with a global network, and providing research facilities, monitoring, education and training.

Biosphere reserves comprise three interrelated zones, known as the core area, the area of cooperation, and the transition area; only the core area requires legal protection.[3] Waterton Lakes and Riding Mountain are examples of Canadian Biosphere Reserves in which the central core protected area is a National Park. Riding Mountain National Park can provide baseline data for comparison with areas outside the Park that have more intensive human activity, and the Biosphere Reserve can provide a basis for cooperation in ecosystem management across different jurisdictions and land uses.[4]

Just a label? Unlike World Heritage Sites, which are established under an international convention, biosphere reserves do not have formal legal or political status.[4] The Riding Mountain Biosphere Reserve is managed by a committee of area residents appointed by member municipalities, and supported by National Park and provincial government staff along with professionals who provide advice and scientific information. Activities undertaken by the Management Committee largely depend upon the energy and interests of volunteers, and are mostly educational in nature, such as hosting meetings and seminars and providing financial support for graduate students.[9]

While there is no systematic way to assess the success of biosphere reserves, it is likely that many exist in name only, while others are partially functional, and a small number are actively pursuing the full range of objectives.[4] There is a danger that the term biosphere reserve can become merely a label applied to an existing park without any effective involvement of local communities. The designation of biosphere reserve is not only a recognition of significant natural or cultural values, but represents a commitment on the part of government agencies at all levels and all local interests to create living examples of conservation and sustainable development.[4]

For example, the Riding Mountain Biosphere Reserve has been involved in finding solutions to cooperatively address beaver dam flooding (see Section 6.2), creating a landscape view of the Biosphere Reserve as it existed in 1948 (see Section 7.2), and most recently, chairing the bovine TB Stakeholder Advisory Committee (see Section 4.1).

While the first priority for land use outside of Riding Mountain National Park is often to generate economic and social benefits, landowners and land management agencies have an interest in the conservation of natural features and sustaining the health of their land.[5] By managing for ecosystem integrity, the Park helps these individuals and agencies meet their land-use goals of stewardship, sustainability or conservation. In turn, the ecological integrity objectives of the Park are supported by those involved in conserving aspects of native biodiversity and natural processes outside its boundaries.[5]

2.1 GLACIAL HISTORY

The landscape of the Riding Mountain region that we see today is the cumulative result of changes over many thousands of years. Pollen studies in sediments recovered from three small lakes in Riding Mountain National Park have helped reveal changes in vegetation patterns of the region since glaciers retreated at the end of the Wisconsin Ice Age.[10]

The vegetation of Manitoba was entirely eliminated during this last glacial period (see **Figure 2**). The last remnants of this ice sheet retreated from northern Manitoba about 3,000-4,000 years ago[11] and from the Riding Mountain region about 12,500 years ago.[1] A treeless phase likely existed immediately after the ice disappeared, followed by a spruce-dominated forest that moved into the region from the south.[10] This early spruce forest was present before 11,500 years ago in southern Manitoba and Saskatchewan, as well as adjacent regions of northwestern Minnesota and the Dakotas. Pollen records indicate that this forest was dominated by spruce in association with wormwood, buffaloberry, sedges, and to a lesser extent juniper, ash, tamarack, trembling aspen and balsam poplar, jack pine, birch and alder.[12] These plants indicate that the climate during this time was comparatively dry.

By about 10,000 years ago, the climate became even warmer and drier.[10] The amount of spruce declined sharply, and forests were replaced by grasses, herbs and shrubs (willows, juniper and buffaloberry).

Figure 2: Glacial ice in Canada

Glacial ice in Canada in the late Wisconsin Ice Age, approximately 20,000 years ago. The minimum and maximum limits depict the range of opinions held by experts on the amount of ice existing at that time. (Adapted from Trenhaile, A.S. 1990.)[126]

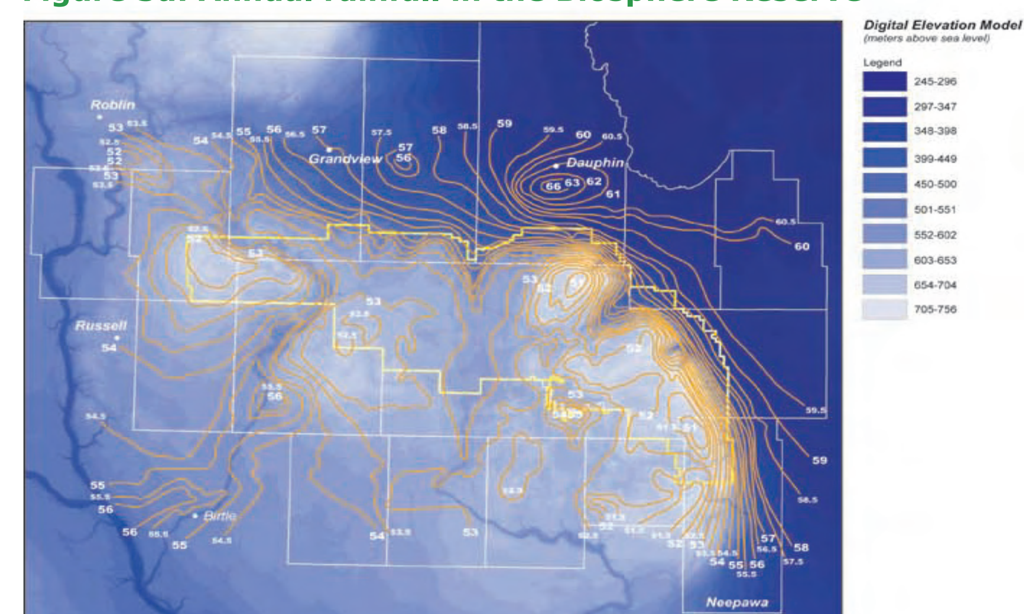
This change took place during the Hypsithermal period or "long drought."[11] By about 6,500 years ago, there was an increase in the amount of bur oak and the shrub beaked hazelnut had appeared.[12] After this time, the amount of dry grassland species began to decrease, indicating cooler and moister conditions. The vegetation in the region changed dramatically about 2,500 years ago, with the immigration of boreal trees and shrubs and a further decline in grassland species. These changes in vegetation likely resulted from a marked deterioration in regional climate.[10] The forests of the Riding Mountain region took their present form about this time, with increasing amounts of spruce, pine, tamarack, alder and fir. Although small amounts of jack pine pollen were present in the area before 2,500 years ago, its presence was most likely the result of long-distance dispersal.[10] Jack pine itself first arrived in the area as recently as 2,500 years ago, likely from a non-glaciated western refuge.[13]

2.2 CLIMATE

The climate of the Riding Mountain region is influenced by topography but is generally characteristic of the continental climate of the Canadian prairies, with cold winters and warm summers.[5,14] However, climatic conditions can vary within the Park.[15] Turbulence generated by the Manitoba Escarpment, combined with the abundance of lakes and other wetlands, contributes to increased cloud and shower activity along the Escarpment in warmer months.[5] In general, maximum monthly temperature decreases and total precipitation increases with increasing elevation. **Figures 3a & 3b** show how the number of days per year with measurable rainfall and the number of frost-free days change across the region.

Annual rainfall in the Park ranges from 40.6-50.8 cm, with approximately 80% falling between April and October.[15] June is the wettest month, with an average rainfall of 9.8 cm.[16] Mean winter snowfall is 127.0 cm at elevations of 731.5 m, dropping to 25.4 cm at 335.3 m.[17]

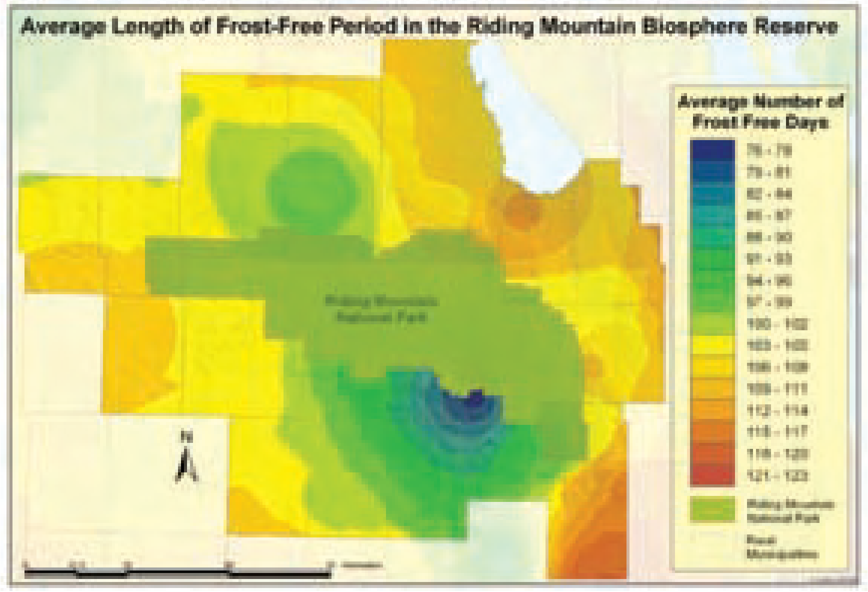
Figure 3a: Annual rainfall in the Biosphere Reserve



Yearly days with measurable rainfall in the Riding Mountain Biosphere Reserve. Rural Municipalities are outlined in white. Rainfall and digital elevation data provided by Parks Canada.

Wasagaming (elevation 622 m) has a temperature range of -19.7°C (average January temperature) to 16.5°C (average July temperature), with an average daily temperature of 0.0°C.[16] The mean annual growing season is between 160-180 days,[14] with an average of 105 frost-free days from May 25-30 to September 10-15.[15] (Readers are also referred to Section 4.2 on climate change.)

Figure 3b: Frost-free days in the Biosphere Reserve



Frosts occur whenever the temperature reaches 0°C or colder for any amount of time. The frost-free period is the number of days between the last occurrence of frost in spring and the first occurrence in fall. Since plant tissue is sensitive to freezing, the frost-free period is a rough indicator of the potential duration of the growing season. Areas with shorter growing seasons experience a higher risk of crops not reaching maturity prior to frost damage. Therefore, the choice of which crop to grow would largely be based on the length of the growing season in a particular area in addition to other considerations such as the amount of available heat, soil properties and moisture supply. [Source: Manitoba Agriculture, Food and Rural Initiatives. December, 2004.]

2.3 TOPOGRAPHY AND GEOLOGY

The Riding Mountain region has been shaped by numerous geological processes, including sedimentation, continental glaciation and water erosion, producing a landscape that is distinct from the surrounding area. This complex landscape includes a portion of the Manitoba Escarpment (also referred to as the Cretaceous Escarpment), notches or gorges formed from pre-glacial erosion of the Escarpment, outcrops of shale bedrock (intermixed with Cretaceous fossils and time-altered volcanic ash), stream-cut gorges, hummocky knob and kettle terrain, glacial till plains, meltwater channels, moraines, beach ridges, potholes, and numerous lake and stream systems.[5]

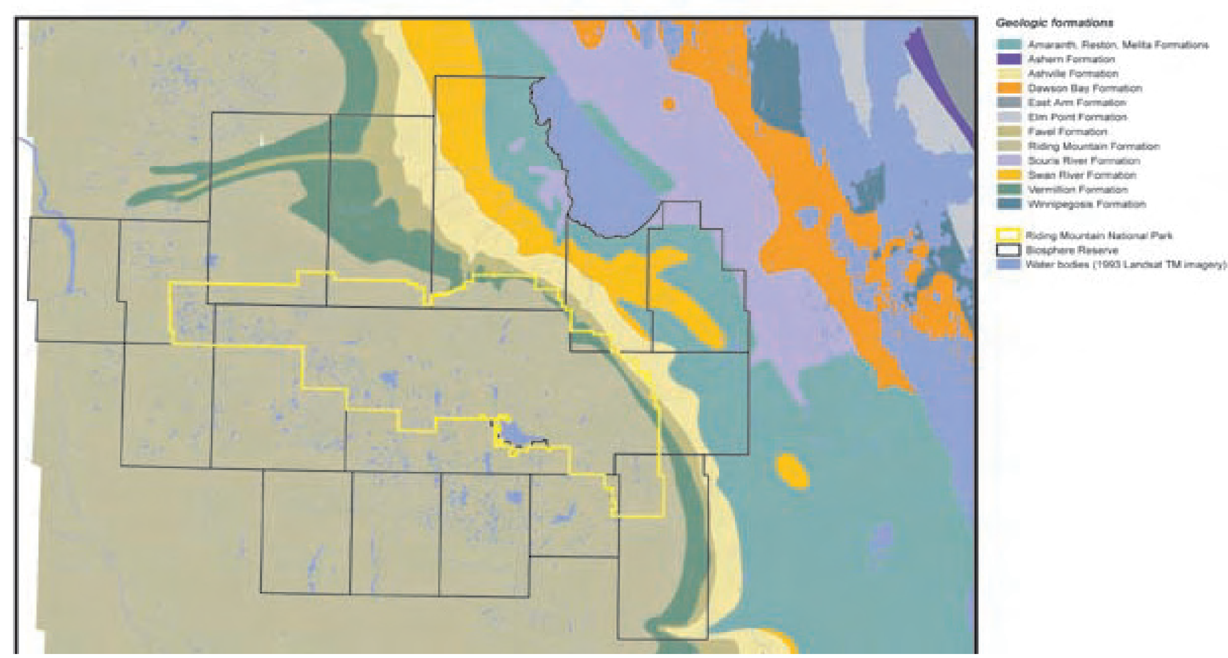
The Biosphere Reserve is located mainly on the rolling uplands of the Saskatchewan Plain, but also includes portions of the Manitoba Escarpment and the Manitoba Plain. The Riding Mountain upland and Escarpment developed from the pre-glacial erosion of the underlying soft Cretaceous shales, followed by the effects of continental glaciation and subsequent erosion, movement and deposition.[1,18] The Escarpment has the greatest relief in the area, with a change in elevation of approximately 365 m over a 6 km distance. The Birdtail Valley in the northwest and McFadden Valley in the southeast were cut by large channels of meltwater from retreating glaciers.[17] The major river systems of the Riding Mountain greater ecosystem include the Vermillion and Wilson Rivers, which are the largest of the north-flowing rivers; the upper reaches of the Little Saskatchewan River, which drains the southeastern portion of the Park; and Birdtail Creek, which drains the western portion of the Park southward towards the Assiniboine River.[1] **Map 3** shows the detailed topography of the region.

The bedrock of the Riding Mountain region originated from silt deposits laid down in shallow Cretaceous seas between 136 and 165 million years ago,[1] and has been divided into several geologic formations. From the northeast to the southwest (oldest to youngest) lie the Souris, Amaranth, Reston and Melita, Swan River, Ashville, Favel, Vermillion River, Riding Mountain and Boissevain Formations[5] (see **Figure 4**). The Riding Mountain formation is the largest and deepest, covering most of southwestern Manitoba including the Porcupine Hills, as well as Duck and

The name Riding Mountain was first used in the early 1800s, according to local history books. From the mid-1700s, fur traders referred to the area as Dauphin Hill, due to its proximity to Fort Dauphin. In reports submitted between 1817 and 1823, Peter Fidler, a geographer and surveyor for the Hudson's Bay Company, used the name Riding Mountain instead.[119] Purportedly it related to the fact that horses were the best means to cross the ridges. By the time Henry Hind identified Riding Mountain on maps accompanying his official reports to the Canadian government in the mid-1800s, the name had already become part of the local vernacular.[121]

McFadden Valley, Riding Mountain National Park

Figure 4: Geologic formations of the Biosphere Reserve



Geologic formations of the Riding Mountain Biosphere Reserve (NAD 83, UTM Zone 14). Data provided by Manitoba Conservation, 2003.

Riding Mountains. This formation has a width of up to 200 km and a maximum depth of 310 m, and is composed of non-calcareous gray shale.

The upland region of the Biosphere Reserve has a rolling topography, with widespread glacial till deposits.[18] Glacial till can be defined as poorly sorted, fine clay to boulder-size sediment deposited directly by glacial ice. There are extensive deposits of moraines and till plains, and local deposits of gravels and alluvium. Alluvium is clay, silt, sand and gravel that has been deposited in layers by streams or other bodies of running water. Sand and gravel beach ridges formed by glacial Lake Agassiz occur near the base of the Manitoba Escarpment.

2.4 SOILS

Soils of the Riding Mountain Biosphere Reserve vary considerably in their drainage, texture and calcareousness (amount of calcium carbonate they contain). The predominant soils on the Riding Mountain upland are Luvisols, as described in the Canadian System of Soil Classification.[19] Other major soils in the Biosphere Reserve include Brunisols, Chernozems, Gleysols, Organics and Regosols.

Agriculture and Agri-Food Canada has provided various soil data for the region which have been compiled and presented in **Maps 4-12**. These maps describe various features of the landscape including:

- **Map 4:** Agricultural capability
- **Map 5**: Different soil associations
- **Map 6**: Soil drainage
- **Map 7**: Surficial texture
- **Map 8**: Slope
- **Map 9**: Irrigation suitability
- **Map 10**: Potential impacts under irrigation
- **Map 11**: Water erosion risk
- **Map 12**: Attributes of soil landscapes that a land manager must consider for any land use

Richard Caners

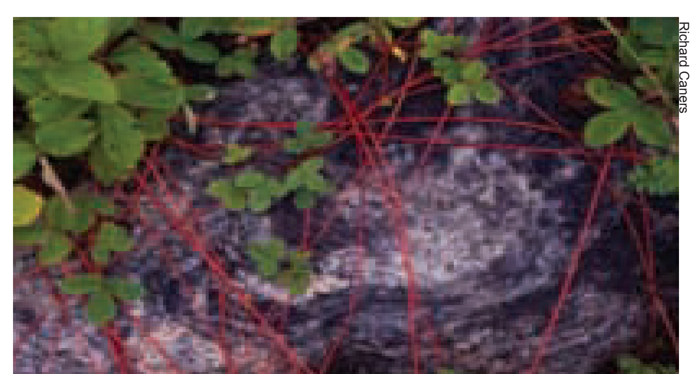
Deciduous forest at the base of the Manitoba Escarpment

Table 1 in the Map & Tables section contains detailed soil information for each of the Rural Municipalities in the Biosphere Reserve. Appendix 1 contains more detailed information, including descriptions of the different soil classes found in the maps and table.

2.5 ECOLOGICALLY DISTINCT AREAS OF THE BIOSPHERE RESERVE

Parks Canada describes four ecologically distinct areas within the National Park and Riding Mountain region.[5]

Lowlands. This area of low relief extends along the base of the Manitoba Escarpment, and includes ancient beach ridges that were formed along the shores of glacial Lake Agassiz approximately 10,000 years ago. This area is characterized by silty and clayey soils, deposited by the glacial lake and more recent flooding events of streams along the base of the Escarpment. The frost-free period of this area is approximately 30 days longer than any other area of the National Park. Eastern deciduous forests dominate the lowland area, with balsam poplar, Manitoba maple, green ash and American elm as characteristic tree species. Cottonwood is also present, but uncommon. Many tree and shrub species are tolerant of both shade and the frequent flooding in these areas, and are not adapted to fire, which does not frequently occur in these protected locations. Oak-woodland and oak-grassland vegetation associations are localized in more well-drained to extremely well-drained habitats along the Escarpment, and have evolved with fire. Bur oak trees can live to be several hundred years old in the driest portions of their habitat in the Park.[20] The acorns produced by bur oak trees, along with the nuts from beaked hazelnut and the many berries produced by other shrubs, attract black bears from around the region each fall. Reports written during the fur trade era portray the area east of the Escarpment as a swampy, thickly forested flatland. Since that time, the area which flanks the Park to the east has largely been converted to farmland.



Richard Caners

Wild strawberry

Although the lowlands occupy only a small percentage of the total Park area, the climate and vegetation support numerous species distinct to the region, such as the eastern gray squirrel, eastern chipmunk, indigo bunting and scarlet tanager. Few areas outside the National Park protect this type of habitat, making it an important candidate for conservation. Major conservation challenges include the alteration of natural habitat by agriculture (in particular, the alteration of the alluvial fans along the base of the Escarpment), and the potential problems for farmers and Rural Municipalities caused by natural water flow off the Escarpment.

Escarpment. The steep slopes along the eastern edge of Riding Mountain National Park are part of the Manitoba Escarpment, a dramatic rise in the prairie landscape that extends 675 km from North Dakota to Saskatchewan. Numerous streams flow down the Escarpment from higher elevations, and over time have cut deep gorges in the soft shales. Luvisolic or poorly developed Regosolic soils predominate. Regosols are characteristic of recent alluvial deposits and erosion. Forest cover is primarily deciduous, dominated by

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Aerial view of eastern escarpment


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Scorpionweed

aspen with some localized stands of balsam fir.

Along the deep ravines, slope and aspect play an important role in determining soil moisture, vegetation cover and amount of erosion. Stands of bur oak commonly occur on warm, dry south-facing slopes, while stands of paper birch predominate on the cooler, moister north-facing slopes. There are also steep slopes of exposed shale that do not support much vegetation, although some plants such as scorpionweed are able to grow in these extreme habitats. In other areas, the shale contains bands of bentonite clay formed from altered volcanic ash. Unconsolidated shale provides suitable habitat for red-sided garter snake hibernacula.

Much of this habitat type is either protected or inaccessible due to the nature of the terrain. However, there is the potential for change in habitat structure and function caused by extensive forestry practices, particularly in the Duck Mountain area.


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Clearcut, Duck Mountain Provincial Park

Upland Plateau. This comprises the largest area of Riding Mountain National Park. The uneven deposits of glacial till give the landscape a hummocky or undulating topography. Poorly drained areas are common, although two areas of slightly higher elevation are centred on Gunn and Clear Lakes. The upland plateau is an area where boreal


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Trembling aspen in fall

forest grades into aspen parkland, with open prairies largely restricted to southern and western areas. Stands of jack pine occur on lighter, well-drained soils in the central and eastern portions of the Park. Soils are typically Gray Luvisols, having developed under forest canopies. However, rich fertile Chernozemic soil (characteristic of relatively dry grassland or grassland-forest communities) lie beneath the open mixed-grass and rough-fescue prairie communities. The prairie, boreal forest and aspen parkland evolved with varying frequency and intensity of fire, which removes woody vegetation and maintains open grassland areas.

This upland area receives 25% more precipitation than the surrounding area, most of which falls during the winter months. The undulating topography, slow drainage and aspen forest provides an abundance of habitat for beaver. In turn, the natural disturbance created by beavers provides habitat for moose and other species. Wetlands including lakes, ponds, streams, bogs, and wet sedge meadows are common throughout the area. There are numerous small lakes and pools that are nutrient-rich (eutrophic). The one exception is Clear Lake, which is deep-spring fed and nutrient-poor (oligotrophic).


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Beaver harvest

A large portion of this area is presently protected from human development, in Riding Mountain National Park and portions of Duck Mountain Provincial Park. Major conservation challenges in non-protected portions of the upland plateau include potential habitat loss and disturbance caused by forestry, tourism and Park infrastructure, and the suppression of natural disturbances such as fire.

Knob and Kettle. This land, also referred to as the "prairie pothole region," was shaped by glacial deposits that date to the Wisconsin Ice Age. White spruce, trembling aspen and balsam poplar forests are common in this area, occasionally grading into black spruce bogs. Open prairies occur infrequently throughout this relatively moist landscape. Beavers are active in the area, while moose and elk frequent wetlands and prairies, respectively. This area, which extends from Minnedosa, Manitoba, to Edmonton, Alberta, was known to contain many more marshes and ponds during the fur trade, but has since been reshaped to a large extent through agriculture.

Knob and kettle topography is represented in areas to the south, southwest and northwest of the Park, and the relief provided by the small hills and potholes is readily visible on **Map 3**. This habitat covers the largest area within the region, stretching from Spruce Woods Provincial Park in the southeast to Roblin and the Duck Mountains in the northwest. It is currently represented in several protected areas, including portions of Spruce Woods, Asessippi and Duck Mountain Provincial Parks.

Much of the natural biodiversity outside of these parks has been reduced through the conversion of native prairie to agricultural farmland. Major conservation challenges are habitat loss (drainage and conversion of land for agricultural purposes) and suppression of fire in naturally occurring prairies.

3.1 HISTORY OF THE INDIGENOUS NATIONS OF RIDING MOUNTAIN

Sections 3.1 and 3.3 rely greatly on information provided by Dwayne Blackbird of the Coalition of First Nations With Interests in Riding Mountain National Park.[26]

Each culture has its own way of thinking about history, science and spiritual matters. Anishnabe people have lived for centuries in the areas surrounding Riding Mountain. The indigenous name for Riding Mountain is *Wowwaswajicus*, "The Hill of the Buffalo Chase," but of course, it was much more than the name implies. Riding Mountain is also called *Wagiiwing* – a vision of a mountainous landscape that holds everything that the many creatures who depend upon it require for survival and sanctuary. It provided physical and spiritual health to the Anishnabe people.[26]

"The indigenous people of what today is known as 'Riding Mountain' accept the area around the mountain as 'the place the Creator placed us.' The Earth became their Mother. The gifts of the Creator – buffalo, moose, elk, fish and fur – are seen as having been placed there as part of their extended family, working together for mutual survival." - Coalition of First Nations With Interests in Riding Mountain National Park[26]

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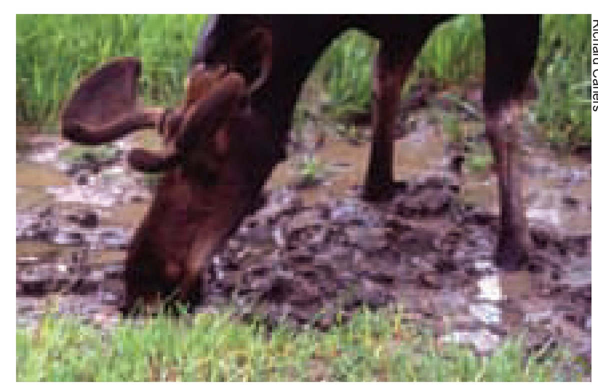
Birdtail Valley

The Anishnabe recognize there were other indigenous people in the area before them, including the Assiniboine and the Cree, who are known to have jointly inhabited the region for a period.[22, 23, 24] Anishnabe people moved into the area in the 1700s from what today is Northwestern Ontario. Others arrived with fur traders from the Sault Ste. Marie area. Still others came north from the area that is Wisconsin and Minnesota today.[26]

Between 1763 and 1821, the Assiniboine and Cree gradually abandoned the Red River Valley, the lower Assiniboine River and the Manitoba Interlake.[22] The Anishnabe took up the region left by the Assiniboine and the Cree,[22,23] and by the early 1800s were established as the dominant society of the Riding Mountain region.[21,26]

The Hudson's Bay Company traded with the Anishnabe people for fur and provisions (meat and pemmican made from buffalo), establishing outposts adjacent to Riding Mountain, including Fort Ellice and Riding Mountain House.[5] As early as 1820, the fur trade had virtually eliminated beaver, muskrat, marten and fisher from the middle and upper portions of the Assiniboine valley. The Birdtail Creek and Riding Mountain regions were relied upon as favoured hunting grounds to maintain the supply of elk, deer and moose. By about 1869, scarcity of larger game began to affect the fur trade.[25]



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Keeseekoowenin Ojibway First Nation

The Anishnabe communities relying upon the rich resources of the Riding Mountain region embraced it as part of their culture and identity. To harvest and use the resources, people travelled to special places to pick berries, make maple syrup, garden, trap, fish and hunt. If animals became scarce in one area, the people would stay away to let the wildlife replenish their numbers. There were places for ceremony, places of beauty for pure enjoyment, places to swim and play, places to spend the summer and places for winter protection. All around them was good water, wood and pasture, all linked together by an intricate system of trails.[26]

When traders came into the area, they were welcomed and provided with assistance. Later, as a few settlers drifted in, they too were welcomed. A solid foundation was built for good relationships. Later in the 19th century, when missions were established, the settlers' children were welcomed in the "Indian schools" and families came to worship in the "Indian churches."[26]

In 1871, Queen Victoria sent Commissioners to Manitoba House on Lake Manitoba to negotiate Treaty No. 2, which

Keeseekoowenin Ojibway First Nation

Burns brothers

would cover most of western Manitoba. While some indigenous communities were settled around Lake Manitoba, one group in particular was known as "The Riding Mountain Band." In the Treaty, the First Nations agreed to open their lands for immigration and settlement, and were given the assurance that they would be able to continue their usual pursuits on all unoccupied lands. The Anishnabe people had seen from settlement around the Red River that the settlers would be interested in farming, but recognized that very little of the land on Riding Mountain and its immediate area would be suitable for that occupation. A very small part of the land was set aside for the exclusive use and benefit of the Anishnabe people.[26]

3.2 EUROPEAN SETTLEMENT AND EXPANSION

As noted in Section 3.1, contact between Europeans and First Nations resulted from continued westward expansion of the fur trade. Henry Kelsey is believed to be the first to travel into the area before 1700 on behalf of the Hudson's Bay Company.[120] Pierre de la Verendrye and his sons traded in the area on behalf of the French in the 1730s and 1740s.[122]

Reports to the British and Canadian governments in the late 1850s by John Palliser and Henry Youle Hind recommended the Riding Mountain region for agriculture and settlement.[120] A survey of the land eventually led to settlers from eastern Canada, United

Parks Canada

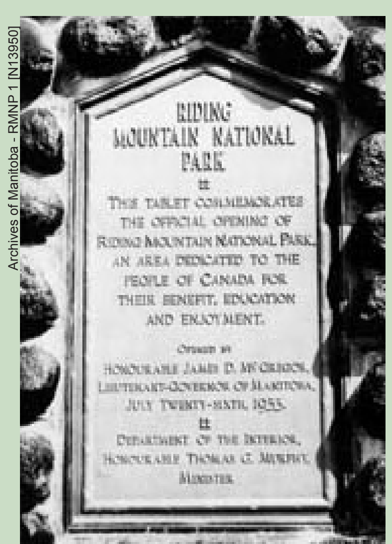
Parks Canada

States and Europe (particularly Sweden, Ukraine and Hungary) moving into the area in the 1880s.[121,122] Settlement began with a rush in the aspen parkland region to the south of Riding Mountain, which was regarded as more desirable for agriculture than the dry prairie land further to the south. Speculators also thought that the Canadian Pacific Railroad would pass through the parkland.[5]

James Watson reportedly became the first homesteader in the immediate vicinity of Riding Mountain in 1885.[120] Most settlers had mixed farms with up to 1/2 section of land.[119] Part of the attraction for settlers in and around the Riding Mountain region was easy access to a source of timber for building and firewood, and wild game for food.[122]

Forestry and milling operations began in the Riding Mountain region in the 1870s, and were concentrated near settlement activity along the Escarpment. Peak logging activity in the area that was to become the National Park coincided with settlement and railway construction near the end of the 19th century,[15] when "…railways required large quantities of timber for bridges, culverts, cross-ties, station houses, etc., and the settlers required even larger quantities to erect houses and barns."[28] White spruce was the most heavily utilized tree species, but jack pine, balsam fir, aspen, bur oak, green ash and black spruce were also taken for everything from fuelwood and fence posts to railway ties.[15] The Canadian Pacific rail line through Minnedosa was built in 1883 and 1884, the Canadian National (CN) rail line through Dauphin was officially opened in 1897, and the Rossburn subdivision of the CN line was completed to Russell in 1908.[28]

Establishment of Riding Mountain National Park took place many years after the land designation was changed from Timber Reserve to Forest Reserve. The idea of a national park was initially proposed in 1927 by the Riding Mountain Association, consisting of 80 organizations and numerous individuals.[119] The Riding Mountain Association was in competition with merchants in the Whiteshell district, who had submitted their own national park proposal in 1919.[122] The Riding Mountain bid won out and in 1930, the Forest Reserve became Riding Mountain National Park. The official opening was held on July 26, 1933. In its first year, over 12,000 people visited the Park.[121]



Archives of Manitoba - RMNP 1 [N13950]

Commemorative tablet c.1933

Archives of Manitoba RMNP 8 [N13953]

Riding Mountain National Park c.1933

As many as ten large harvest and milling operations were established on the Riding Mountain plateau in the early 1880s, operating with little or no regulation.[5] Fires often accompanied timber harvesting, and were also set by settlers burning hay meadows or clearing land.[29] Two major fires occurred in close succession around 1890, burning over 70% of the area west of the Strathclair trail, "…not leaving even a spruce seed-tree over large tracts."[30]

In response to this extensive exploitation, the Riding Mountain Timber Reserve was officially established on July 13, 1895. Designation of the Timber Reserve withdrew lands for settlement from the region, but logging practices remained essentially unchanged. In 1906, the land designation was changed to Forest Reserve, moving it from the Lands Branch to the Forestry Branch of the Department of the Interior.[28,122] Cutting regulations were established for the Reserve, although illegal timber cutting continued.[29] By this time, reports indicated that timber resources were becoming scarce, including white spruce.

The resource extraction policy was modified in 1930 when the area was given National Park status. Resource inventory, reforestation, fire suppression and conservation became priorities, but intensive logging continued on Park land until 1936, and one mill continued to operate in the Park until 1949.[5] The ecological impact of logging was considerable. Most merchantable white spruce, jack pine, and balsam fir were removed from the Park, undoubtedly altering the natural structure of forests.

The effects of settlement on wildlife was dramatic, including the extirpation of plains bison and greater prairie chicken, severe reductions in cougar, wolverine and mule deer, and an increase in white-tailed deer.[31] Surviving game populations in the Riding Mountain region, including ruffed grouse, moose and elk, were also depleted.[5]

A moratorium on hunting was imposed in 1895 with the establishment of the Riding Mountain Timber Reserve, but this ban was lifted in the early 1900s when the provincial government opened the area to regulated hunting with the exception of a 500 square km game preserve.[32] In combination with periodic severe winters, the lifting of the hunting ban resulted in major declines in ungulate populations. Photographs depict railway flatcars, loaded with carcasses of elk and moose from the Riding Mountain region, awaiting shipment from Dauphin to Winnipeg.[5] By 1914, the elk population in the Reserve was roughly estimated at 500 individuals.[32] In 1917, a legislative decree closing the Forest Reserve to hunting facilitated a recovery of ungulate populations. Predators were also subject to intense hunting pressure, and wolves and lynx were extirpated from the Riding Mountain ecosystem during the 1920s and 1930s.[27,33]

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Riding Mountain park boundary

Haying and grazing were taking place in the Forest Reserve as early as 1909. By 1919-1920, approximately 4,700 cattle were concentrated on suitable grazing areas in the Reserve (the native grasslands).[128] Haying and grazing resulted in the local depletion of forage for wildlife, and dramatically changed the species composition of some fescue prairies.[5] Other effects included the near-extirpation of beaver through efforts to maintain hay meadows,[128] and the introduction of bovine tuberculosis to wildlife populations likely by cattle that grazed in the Forest Reserve (see Section 4.1).[5]

By about 1920, virtually all of the available land released for settlement in the region had been claimed.[25] The efficiency of agricultural practices increased as oxen and horses were replaced with steam and gasoline or diesel tractors.[5] Agricultural policies focused on increasing cultivated acreage, producing grain for export, and diversifying to mixed farming in order to enhance stability.[5,35] Farms, roads, railways and towns quickly occupied the majority of the landscape around the Forest Reserve. Clearing of agricultural lands up to the boundary of the Forest Reserve was common practice, the legacy of which is clearly visible today (see photo bottom left).

3.3 IMPACTS ON FIRST NATIONS

It was not until the end of the 19th century that access by the Riding Mountain Anishnabe to the lands that today are the National Park began to diminish.

"Land is absolutely fundamental to Aboriginal identity ... Land is reflected in the language, culture and spiritual values of all Aboriginal peoples." - Royal Commission on Aboriginal Peoples [115]

As the arrival of settlers offered opportunities to trade, the economy and culture of the Anishnabe people also changed and evolved, as had happened before throughout Anishnabe history. However, there were negative impacts when their access to lands was reduced by law. European education and religious practices coupled with paternalistic officials and failure to observe the terms of the treaties also took their toll on the culture. While *Wagiiwing* continued to be as it had been for centuries, external pressures caused the Anishnabe to become increasingly disconnected from it.[26]

Reproduced from "The Riding Mountain Forest Reserve." Dickson, J.R. 1909.[30]

Surveyors along the Strathclair trail in the late 1880s. The trails established by the Riding Mountain Anishnabe were used by settlers making their way to their new destinations. Barely wide enough for a wagon, two trails were widened after 1891 to facilitate settlement and became known as the Birdtail and Strathclair trails.[25]

Treaty No. 2, which includes all of the Riding Mountain region and most of central and southwestern Manitoba, stipulated a reserve for "The Riding Mountain Band" of the Anishnabe Nation. Subsequently, a reserve today known as "Keeseekoowenin" was set out near Elphinstone. Notably, not all of the communities in the Treaty No. 2 area initially signed on to this treaty. When the leaders of these indigenous communities decided to sign on, they met with the Treaty Commissioners at Fort Ellice in 1874. The Commissioners had just signed Treaty No. 4 in the Qu'Appelle Valley. When the leaders indicated they wished to join the other Anishnabe communities as signatories to the treaty, the Commissioners prepared an adhesion to Treaty No. 4 rather than Treaty No. 2. Also, they grouped four distinct communities into one, that of Chief Waywayseecappo at Lizard's Point. Later, the other communities had their own reserves recognized: Rolling River near Erickson, Gambler's near Rossburn, and Tootinaowaziibeeng near Grandview.[26] In 1896, a fishing

Chief Baptiste Bone and wife Kakaki of the reserve at west end of Clear Lake

Archives of Manitoba - Crawley, Pax E. Coll. 6 [N14814]

reserve of 756 acres, known as the Clear Lake Reserve, was established adjacent to that lake for the Keeseekoowenin band.[21,26]

Settlers started to come into the area after Treaty No. 2 was signed. Surveyors marked off lands in sections and quarter-sections. Access for settlement was made easier by the Anishnabe trail system, as well as Hudson's Bay Company trails and via steamboat on the Assiniboine River, and later supplemented by the railways. Between 1870 and 1901, the areas to the south of Riding Mountain became quickly occupied, but generally speaking, Riding Mountain itself was left unsettled. Nonetheless, legal restrictions kept the Anishnabe people from fully using their traditional resources, and the benefits that accrued to others using these resources were not shared with the Anishnabe. Some communities, particularly Rolling River, had difficulties in having their reserves set aside because of claims made by settlers.[26]

Chiefs circa 1920

Keeseekoowenin Ojibway First Nation

After the signing of the treaties and establishment of Indian Reserve lands, pressure on the Aboriginal peoples increased. The once dynamic geographic expression of traditional land use and occupancy by the Anishnabe was ended,[21] despite explicit guarantees in the Treaty that access to lands not required for settlement would continue. Nonetheless, the Anishnabe continued to use the Riding Mountain area as best they could.[26]

"From Riding Mountain and the area around it, the indigenous people sustained their lives and created a future for the great-grandchildren of their great-grandchildren, the First Nations who are alive today." - Coalition of First Nations With Interests in Riding Mountain National Park[26]

The designation of the Timber Reserve in 1895 did not alter the status of Riding Mountain as an area for hunting and trapping. A game preserve was established after 1907, which covered about nine townships in the south-central portion of the Forest Reserve.[25] Hunting and trapping were prohibited in the game reserve.

For many years after the Treaty, the relationship envisioned both by the Queen and the First Nations was healthy. Later, however, when the federal government began to make unilateral decisions regarding the Riding Mountain lands, First Nations became concerned that the arrangement set out in the Treaty was not working as it should. When a National Park was established by Parliament in 1930 without consultation with the First Nations, the relationship soured and became contentious, a source of bad feelings on both sides.

One reserve at Clear Lake, belonging to the Keeseekoowenin Ojibway First Nation, fell within the boundaries of the National Park, and in 1936, the people living there were evicted by Park staff and their homes burned.[21,26]

The Anishnabe increasingly had to rely on their reserve lands, which generally were too small or not sufficiently productive to meet the needs of the people. They lost the ability to access their centres of traditional and cultural learning.[26]

The relationship between the Anishnabe and Park wardens remained adversarial in the decades after the Park was designated. It was not until the 1990s when the Keeseekoowenin First Nation began to press its claim that the federal government began to address this injustice. A settlement was reached in 2004.[26]

Batishe's home, Waywayseecappo Reserve (Lizard Point) 1912

Archives of Manitoba [N12155]

3.4 POPULATION CHANGE

As settlement increased with the construction of the railway during the late 1800s and early 1900s, the population of the Riding Mountain Biosphere Reserve increased dramatically over a relatively short period of time (see **Figures 5a & 5b**). Population increased rapidly until about 1921, and peaked at approximately 47,000 in 1941. Since then, the total population of the Biosphere Reserve has decreased substantially. While rural population has declined rapidly since 1941, the populations of the largest towns in the Biosphere Reserve increased until about 1981. After 1981, both rural and urban populations decreased, resulting in a total population of approximately 29,000 people in 2001. **Table 2** in the Maps & Tables section contains 2001 census summary statistics for rural, non-Aboriginal populations in each of the Rural Municipalities in the Riding Mountain Biosphere Reserve. Population estimates of First Nation communities in the Biosphere Reserve appear to have been relatively stable over time, with a possible recent increase.

Figure 5a: Population estimates for the Riding Mountain Biosphere Reserve (1871-2001) by Rural Municipality

Year	1871	1881	1891	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
Rural Municipality														
McCreary	432[a]	1,083[a]	298	445	1,160	2,395	2,265	2,268	1,997	1,678	1,412	1,369	1,224	1,047
Rosedale			1,400	2,388	3,085	3,504	3,674	3,781	3,237	2,662	2,347	1,886	1,614	1,598
Clanwilliam	2,800[b]	3,200[b]	400	588	979	1,393	1,361	1,631	1,460	1,366	1,194	1,130	1,046	915
Harrison			437	619	1,489	2,147	2,482	2,446	2,005	1,697	1,327	1,093	900	837
Shoal Lake			800	1,221	1,739	2,276	2,444	2,384	2,234	2,101	1,943	1,711	1,535	1,379
Strathclair			737	1,083	1,549	2,325	2,313	2,338	2,211	2,012	1,569	1,224	1,055	892
Dauphin	0[c]	500[c]	665[c]	4,374	6,863	9,944	9,593	10,731	10,540	11,323	12,057	12,097	11,544	10,358
Ochre River				712	1,093	1,764	1,585	1,731	1,706	1,391	1,152	1,110	991	952
Ste. Rose				866	1,621	2,731	1,850	2,170	2,381	2,311	2,043	2,206	2,038	1,942
Boulton	521[d]	975[d]	2,708[d]	260	507	970	1,546	1,735	1,267	979	688	509	378	946
Gilbert Plains				2,241	3,738	4,700	4,203	4,243	3,698	3,148	2,623	2,224	1,887	1,619
Grandview				1,258	2,150	2,850	2,943	3,493	3,279	2,943	2,471	2,280	1,944	1,653
Park South[e]				-	-	-	-	-	1,694	1,390	1,075	951	935	889
Rossburn				1,352	2,716	3,443	3,742	3,419	2,640	2,090	1,715	1,418	1,322	1,092
Shellmouth				451	1,114	1,567	1,884	1,645	1,572	1,460	1,033	886	760	(see Boulton RM)
Silver Creek				855	1,321	1,797	1,837	1,728	1,391	1,188	957	696	594	532
Reservations[f]	-	-	-	633	729	750	842	1,026	1,260	1,125	995	1,088	992	2,207
Total individuals	3,753	5,758	7,445	19,346	31,853	44,556	44,564	46,769	44,572	40,864	36,601	33,878	30,759	28,858

- Data not provided by Statistics Canada.

a Equals total population for the former Census Division 10, which included Langford, Lansdowne, McCreary, Rosedale, Westbourne, RMNP and Reservations.

b Equals total population for the former Census Division 11, which included Archie, Birtle, Blanshard, Clanwilliam, Ellice, Hamiota, Harrison, Miniota, Minto, Odanah, Saskatchewan, Shoal Lake, Strathclair, RMNP and Reservations.

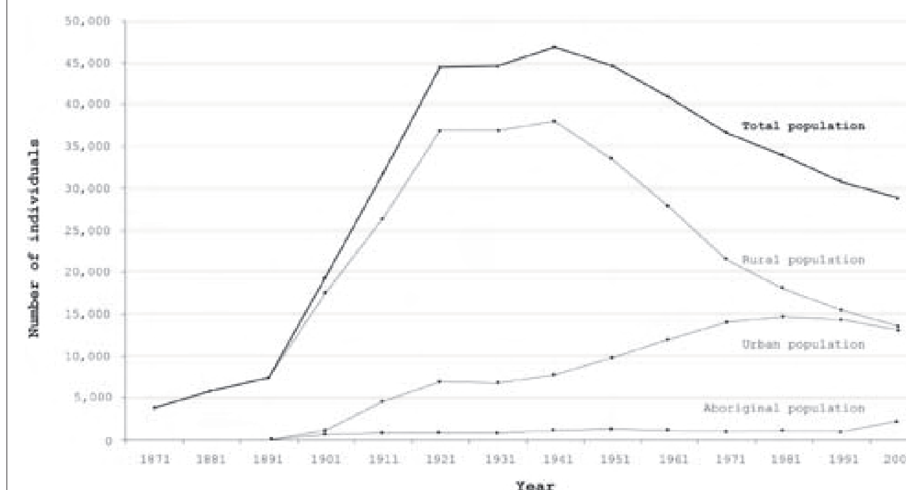
c Equals total population for the former Census Division 13, which included Alonsa, Dauphin, Ethelbert, Lawrence, Mossey River, Ochre River, Ste. Rose, RMNP and Reservations.

d Equals total population for the former Census Division 14, which included Boulton, Gilbert Plains, Grandview, Hillsburg, Park South, Rossburn, Russell, Shellmouth, Shell River, Silver Creek, RMNP and Reservations.

e Population estimates are not available for Park South until 1951 as it was a L.G.D., or Local Government District until this time.

f Population estimates for 1871-1891 have been included by Statistics Canada in the large Census Divisions for that time (see notes a-d). Although every attempt has been made to ensure accurate data representation, some values obtained from Statistics Canada may be subject to error.

Figure 5b: Population estimates for the Biosphere Reserve 1871-2001



Population estimates for all Rural Municipalities and Indian Reserves in the Riding Mountain Biosphere Reserve, 1871-2001. Estimates for 1871-1891 represent the number of individuals in the larger Census Divisions (see footnotes in Figure 5a). Urban population estimates have been included in the estimates for each Rural Municipality. Indian Reserves with available data include Rolling River, Keeseekoowenin, Waywayseecappo and Tootinaowaziibeeng (Valley River) First Nations. Although every attempt has been made to ensure accurate data, some values may be subject to error. Data obtained from Statistics Canada, 2003.

Changes in population size also coincide with, or result in changes to, population age structure. **Figure 6** illustrates the age structure of the Biosphere Reserve population over the 50-year period from 1951 to 2001. (The Aboriginal component of the population is not included in this figure, as this is examined separately in Figure 7.) During this period, the total non-Aboriginal population of the Biosphere Reserve, both rural and urban, decreased from approximately 43,000 to 27,000 individuals. This dramatic change was accompanied by a shift in age structure to a generally older-aged population. Specifically, the proportion of individuals younger than 24 decreased from about 46 to 30 percent, with the largest decreases in the under-14 age classes. Conversely, significant increases occurred in the number of people 45 and older, with the most noticeable increase in the 65+ age class, which rose from about 9 to 23 percent of the population.

Changes in the size and age structure of the Aboriginal population in the Riding Mountain Biosphere Reserve are comparatively different from the non-Aboriginal population. In both the 1951 and 2001 censuses, the Aboriginal population had a greater proportion of individuals under the age of 14 than the non-Aboriginal population (see **Figure 7**). The largest changes in the Aboriginal population age structure between 1951 and 2001 are a decrease in the proportion of individuals in the 0-4 age class, and an increase in the 25-44 age class. Compared to the non-Aboriginal population, there is a much smaller proportion of the Aboriginal population over the age of 45 in both the 1951 and 2001 censuses, with the most dramatic difference seen in the 65+ age class. In contrast with the marked increase in the non-Aboriginal population in this group as noted above, the Aboriginal population decreased from 5.6 to 2.5 percent. The shrinking number of Aboriginal Elders in the Riding Mountain region may have profound impacts on Aboriginal culture, diminishing the ability to sustain the oral history associated with the traditional territorial landscape.[41]

Figure 6: Non-Aboriginal Population Age Structure 1951-2001

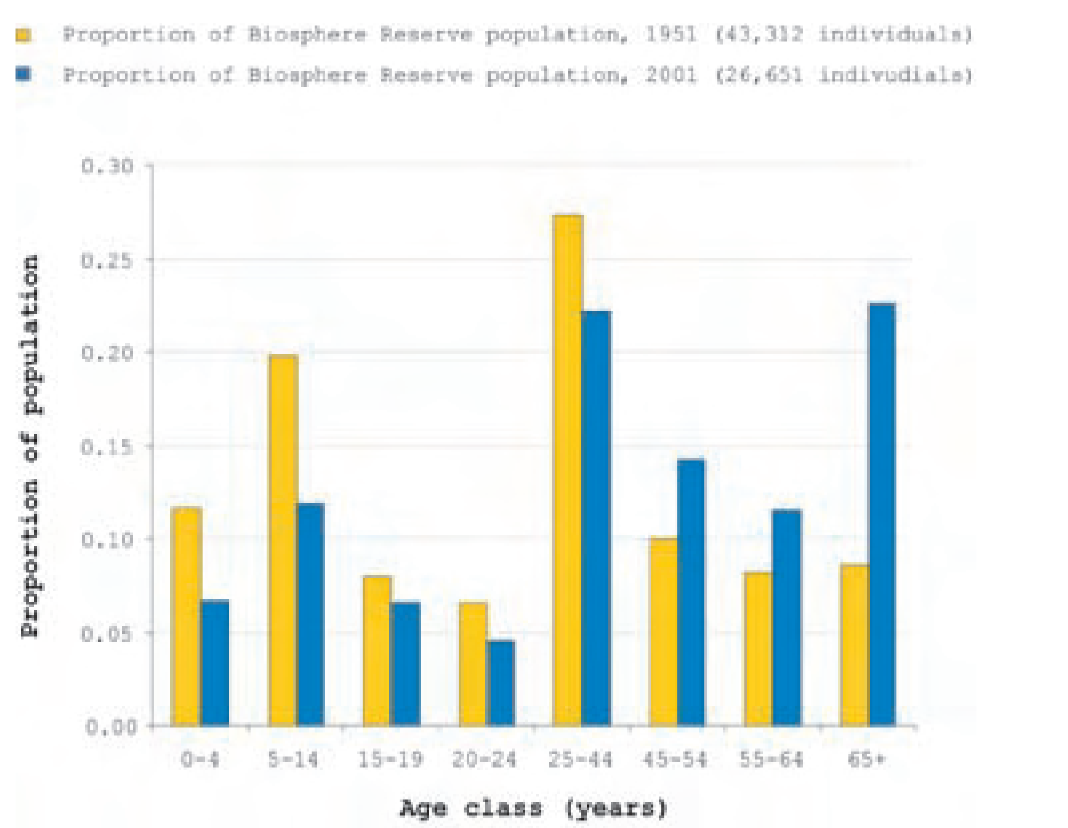


Figure 7: Aboriginal Population Age Structure 1951-2001

The Riding Mountain region has been in a state of change, both since and before the Wisconsin Ice Age. Some types of change are natural and necessary, but it remains to be seen how new and evolving changes will impact the ecology of the Riding Mountain region.

4.1 THE PRESENT-DAY BIOSPHERE RESERVE: PEOPLE, LAND MANAGEMENT AND ECONOMICS

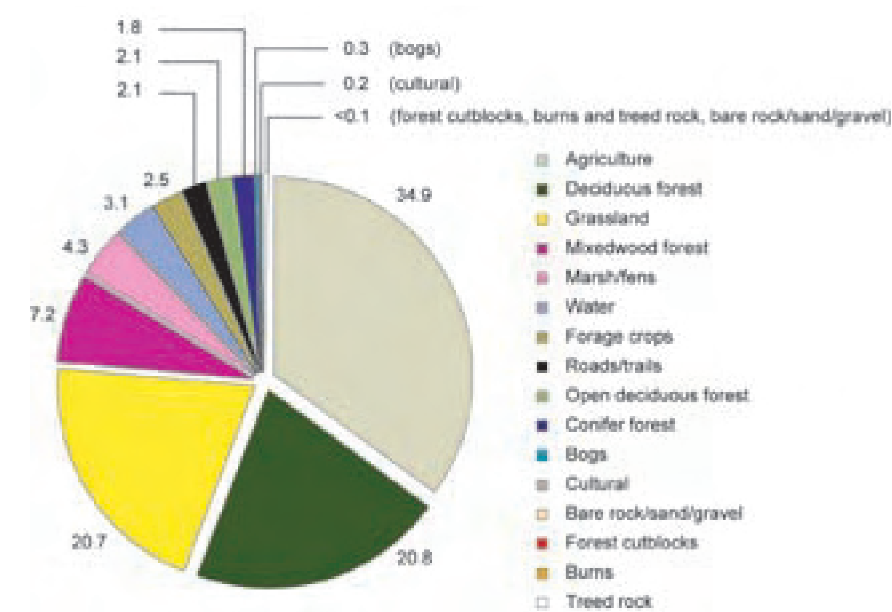
Approximately 40 distinct governments are affected by decisions made in Riding Mountain National Park. **Map 13** shows the various jurisdictional boundaries in the Biosphere Reserve. Eleven Rural Municipalities, each with an elected council, directly border the Park. Approximately 20 incorporated towns or villages are within 30 km of the Park boundary, ranging in population from less than 500 to over 8,000. The First Nations of Keeseekoowenin, Waywayseecappo, Tootinaowaziibeeng Treaty Reserve (Valley River) and Rolling River are located close to the Park. They are members of the "Coalition of First Nations With Interests in Riding Mountain National Park" along with Sandy Bay, and Ebb and Flow. Other nearby First Nations include Birdtail Sioux (Birdtail Creek) and Gamblers. (The First Nations of Ebb and Flow, Gamblers, Keeseekowenin and Rolling River are affiliated with West Region Tribal Council, along with Pine Creek, O-Chi-Chak-Ko-Sipi (Crane River), and Skownan. Birdtail Sioux and Sandy Bay First Nations are part of Dakota Ojibway Tribal Council, and Tootinawowaziibeeng and Waywayseecappo are independent.)

Map 14 depicts a 1993 landscape classification of the Riding Mountain Biosphere Reserve, and **Figures 8a & 8b** shows the amount of land in each classification. (Refer to Appendix 1 for descriptions of the classes.)

Parks Canada's Ecological Integrity Statement summarizes the major types of land and resource use in the Biosphere Reserve as follows.[5]

Agriculture is the dominant type of land use in the Biosphere Reserve, occupying 34.9% of the land area (with forage crops an additional 2.5%), and it continues to evolve with economic and technological developments. While region-specific information is unfortunately not available, the trends for the province as a whole appear to be reflected within the Riding Mountain region. For example, the practice of leaving land as fallow during the growing season in the prairie ecozone has declined markedly since the early 1980s. In 1986, 98% of farms were family-operated, but by 1996, sole proprietorships had dropped to about 60% of farms.[36] There is speculation that low commodity prices in the 1980s, reduced support for transportation (loss of the Crow rate), and relatively high cattle prices have driven farmers to increase forage production and reduce grain production.[5] For information on the various crops grown, please refer to the Manitoba Agriculture, Food and Rural Initiatives web site: <http://www.gov.mb.ca/agriculture/statistics/aac01s00.html>

Figure 8a: Amount of Land in Landscape Classifications



Percent of the total land area of the 16 land-use/land-cover classes from the 1993 Landsat landscape classification of the Riding Mountain Biosphere Reserve shown in Map 1. Values refer to the land area within the boundaries of the Biosphere Reserve, including the National Park.

Manitoba Agriculture, Food and Rural Initiatives, and Agriculture and Agri-Food Canada play important roles within the region in delivering programs and providing information to agricultural producers.

Cattle producers were hard hit when a diseased cow that traced back to an Alberta farm was diagnosed in May 2003 with bovine spongiform encephalopathy (BSE). This diagnosis led to the U.S. closing its border to Canadian cattle. Although the border was reopened in August 2003 for some Canadian beef, the confirmed diagnosis later that year of another diseased cow in Washington state that traced back to a Canadian producer meant the U.S. continued to keep its border closed to live Canadian cattle. In late December 2004, the U.S. announced a March 7, 2005, reopening of the border to live Canadian cattle under 30 months, but this became uncertain when three more cases were found in Canada shortly afterwards. The closed U.S. border has had a devastating impact on cattle producers in Manitoba and across Canada. (See also the next section on the impact of bovine TB.)

Figure 8b: Landscape Classifications in the Riding Mountain Biosphere Reserve (1993)

	Class	Percent of RMBR	Hectares in the RMBR
1	Agriculture	34.9	482,804.7
2	Deciduous forest	20.8	287,584.6
3	Water	3.1	43,358.2
4	Grassland	20.7	285,929.5
5	Mixedwood forest	7.2	99,370.8
6	Marsh/fens	4.3	58,859.5
7	Bogs	0.3	4,083.3
8	Treed rock	0.0	0.0
9	Conifer forest	1.8	24,358.2
10	Burns	0.0 (< 0.1)	0.2
11	Open deciduous forest	2.1	29,400.8
12	Forage crops	2.5	33,976.2
13	Cultural	0.2	2,254.1
14	Forest cutblocks	0.0 (< 0.1)	12.0
15	Bare rock/sand/gravel	0.0 (< 0.1)	278.3
16	Roads/trails	2.1	29,473.1
	Total	100.0	1,381,743.5

The negative economic effects of BSE on cattle producers have been so severe that some have considered a switch to grain production. This would have ecological implications given that the size of modern grain farming machinery requires large, square fields in which all of the sloughs are drained, and the bush is bulldozed and cultivated. Should this sort of land conversion take place in the Riding Mountain region, it would have a serious impact on regional ecological integrity and on the National Park mandate.[125]

Forestry employs fewer people in the region than agriculture yet its effect on the land is significant. Almost 32% of the Riding Mountain Biosphere Reserve is forested. Aspen is harvested on provincial crown and private land for firewood and to supply the Louisiana-Pacific Canada Limited (LP) oriented strand-board mill in Minitonas. The Government of Manitoba entered into Forest Management License (FML) No. 3 (shown on **Map 13**) with LP in September 1994. In October 1994, LP submitted a proposal to Manitoba Environment regarding a Ten Year Forest Management Plan (1996-2005) for FML No. 3. The Clean Environment Commission held public hearings and issued Environmental Act License No. 2191E to the company in May 1996, after concluding that LP's plan would be consistent with the principles of sustainable development.

Tourism and recreation are growing aspects of the Riding Mountain regional economy. In the Rural Municipalities immediately surrounding the Park, land is being subdivided and developed for seasonal recreation, and farmland is being purchased for hunting. Properties adjacent to the Park cost substantially more than properties a few kilometres away from its boundary. This type of development is expected to continue over the long term, subject to land-use plans in adjacent municipalities and planning districts. **Map 15** depicts the recreational capability of the Riding Mountain Biosphere Reserve.

Water management is an important consideration for people living and working in the Biosphere Reserve. During the early history of the Park, there was a focus on the impact of the water resources of the Escarpment area on the surrounding lands. Although forested areas reduce the amount and velocity of runoff, the once-forested alluvial fans at the base of the Escarpment have been converted to

Wilson Creek Project

– The "Wilson Creek Experimental Watershed Study" was a federal-provincial initiative launched in 1957 in response to concerns about flooding of agricultural lands at the base of the Riding Mountain escarpment. This extensive hydrological study, which ran from 1957-1982, investigated the cause of the periodic flooding and clogging of natural and man-made drainage systems with shale deposits, and possible controls for the flooding and erosion.[124]

The Wilson Creek Watershed was selected as the study site as it was identified as a source of the flooding and sediment deposits, which are carried below the escarpment and distributed in a fan-shaped area.[124]

Turtle River Watershed Conservation District

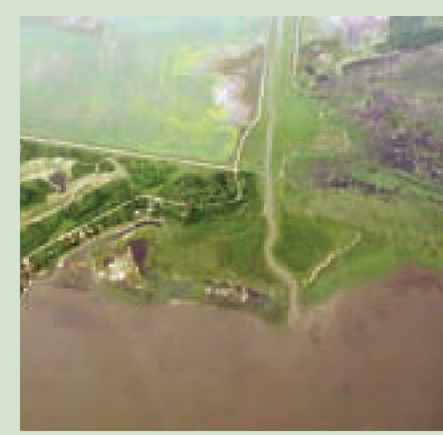
Wilson Creek shale build-up

Regarding the source, the study concluded that while the "majority of the flood runoff originates in the escarpment area of the watershed...a very significant amount of the sediment that periodically clogs downstream waterways originates in the alluvial fan immediately below the escarpment." As a control measure, it was determined that detention basins could be used to store floodwaters.[124]

A review in 1980 led to the discontinuation of the project's monitoring program except for measuring rainfall and flood flows, and concluded that "the experimental remedial work beyond the watershed area would alleviate sedimentation and flooding of downstream and adjacent farmlands."[124]

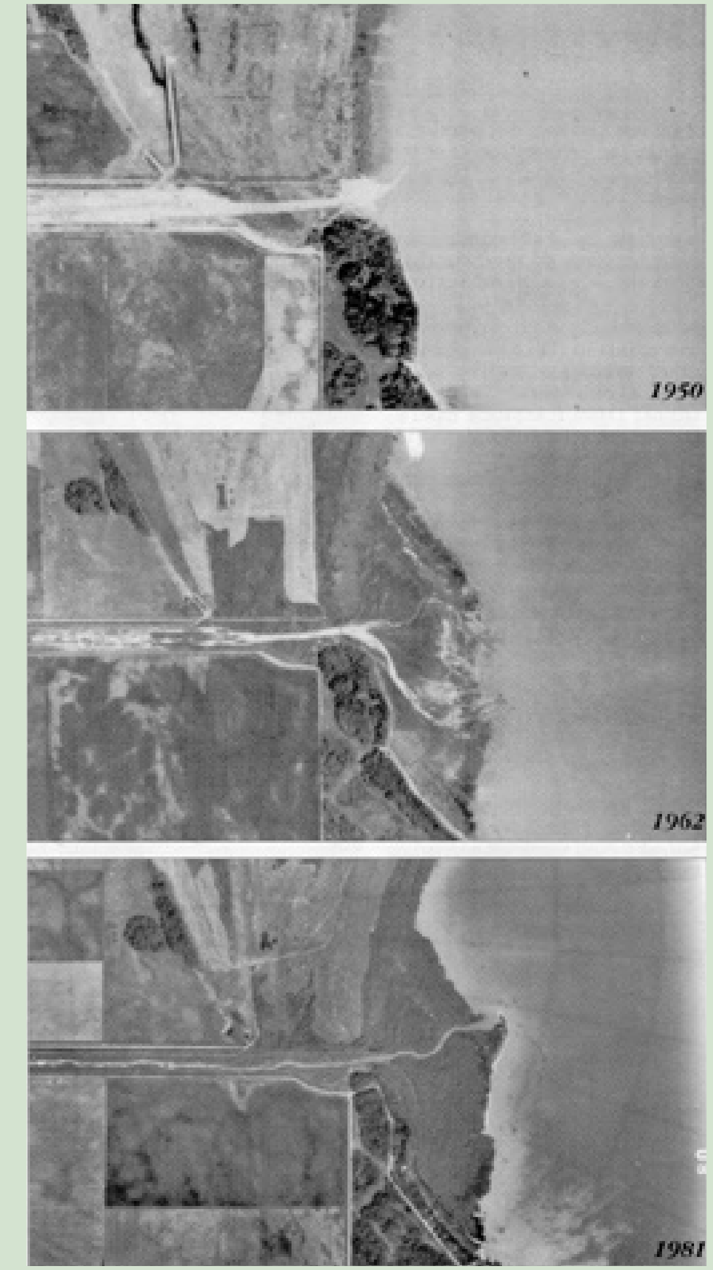
One of the recommendations of the review included installation of experimental drop structures in the lower reaches of the channel to reduce further erosion of fan deposits.[124]

Since the study ended, numerous erosion control systems consisting of a series of field stone dams (shale traps) have been installed in various streams along the Riding Mountain escarpment by local Conservation Districts.[125]



Barry Oswald, Manitoba Water Stewardship

Edwards Creek delta in 1995



The photos above, reproduced from the Government of Manitoba publication "Dauphin Lake: Opportunities for Restoration" (1989), show the dramatic formation of a delta at the outlet of Edwards Creek on Dauphin Lake from 1950 to 1962 and covered with vegetation by 1981. As noted in the report, the alluvial fans at the base of the escarpment provided water storage capability and acted as silt traps. Drainage and other stream development activities increased runoff through the fans and the silt that formerly settled in these fans was carried further downstream and much of it settled in Dauphin Lake.

agricultural fields with extensive drainage systems. Water flowing off the Escarpment can cause erosion, and loose shale carried by runoff can result in blocked drainage channels and flooding. Water control structures and the Wilson Creek Experimental Watershed Project (see inset box) were established in cooperation with agricultural and community agencies. The water quality of Clear Lake is affected by a variety of potential sources, including runoff from agricultural lands adjacent to the Park, and sewage disposal from housing and commercial developments both inside and adjacent to the Park.

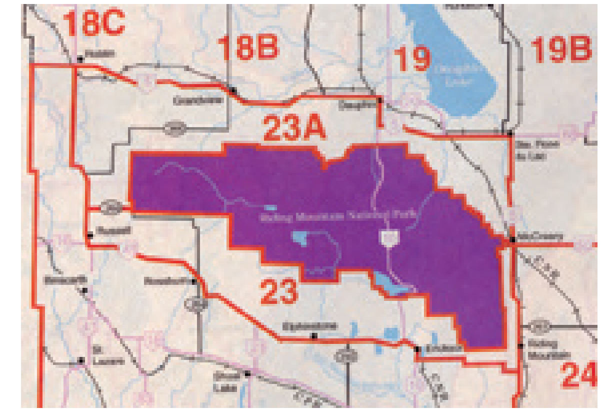
Wildlife management in the Riding Mountain Biosphere Reserve poses numerous challenges, as wildlife travels freely between federal and provincial jurisdictions. The National Park has jurisdiction of wildlife management within its boundaries, while Manitoba Conservation manages wildlife outside of the Park through provincial acts and regulations (see Section 6.3). While there is no formal agreement for wildlife management between agencies, consultation and cooperation occur around season and limit setting, population objectives, etc. Hunting, outfitting and guiding are important sources of revenue for local residents in the area. Water and fish outside of the Park are managed by a complex mix of agencies, including Manitoba Conservation and the Federal Department of Fisheries and Oceans.

Private landowners in the Biosphere Reserve are sometimes caught between conflicting management objectives of the Federal Department of Fisheries and Oceans, Manitoba Conservation, Parks Canada, and Manitoba Water Stewardship. Some landowners believe their contribution is not valued or recognized and that they are not consulted prior to action being initiated.

The impact of bovine tuberculosis and other transmittable diseases

Bovine tuberculosis (TB) is a contagious and communicable disease caused by bacteria, which affects cattle, bison, deer, elk, goats, and other species, including humans. It is believed to have been imported into North America in domestic cattle during the early stages of European settlement. Bovine TB was relatively common in livestock in Canada, including the Riding Mountain region, until the 1980s but has since become rare. Historically, bovine TB has been a very rare disease in wild cervids (elk, deer and moose); prior to 1994, only nine wild cervids had been reported with the disease in North America.[37]

There are approximately 50,000 cattle in the Rural Municipalities immediately adjacent to Riding Mountain National Park, representing approximately 10% of cattle in Manitoba and approximately 1% of cattle in Canada. Six outbreaks of bovine TB in 1991, 1997, 2001, and 2003 have threatened the livestock industry and have resulted in considerable hardship to local cattle producers. During the initial outbreaks, approximately 1,600 infected or exposed cattle were ordered destroyed and compensation was paid.[38] **Map 16** shows the confirmed cases of bovine TB in the Riding Mountain Biosphere Reserve to September 2004.



General Hunting Areas [Source: Manitoba Conservation Hunting Guide]

At some point in the past, wild elk and deer in the Riding Mountain region likely acquired bovine TB from nearby infected cattle herds, and now appear to be maintaining the infection, potentially allowing for its spread back to livestock.[38] It is believed that cattle and elk can contract bovine TB when infected bodily material (saliva, urine, manure) is transferred directly from one animal to another, or indirectly when an animal burrows its nose into infected feed, such as a hay bale.[37] It is also believed that the disease does not normally sustain itself in populations of elk and deer at densities found in the Riding Mountain region. However, the winter distribution of elk inside the Park has changed over the past two decades, with more elk now found along the Park boundary. This may be a result of changes in regional farming practices, such as an increase in forage production, changes in wildlife feeding and illegal elk-baiting practices, as well as changes in Park habitat.


Parks Canada


Parks Canada

Fencing around cattle feeding areas is a key part of the bovine TB management program to reduce contact between cattle and elk.

Following the 1997 outbreak of bovine TB in cattle, concern that wildlife might be a potential reservoir of bovine TB led to the creation of the Manitoba Bovine Tuberculosis Management Plan. This plan was developed by members of Manitoba Conservation, Manitoba Agriculture, Food and Rural Initiatives, Parks Canada, and the Canadian Food Inspection Agency, along with input from the Manitoba Cattle Producers Association and the Manitoba Wildlife Federation. This group, known as the TB Task Group, is responsible for the TB management program that includes disease surveillance, prevention, research and control.[37]

Because the infections were isolated to the Riding Mountain region, the Canadian Food Inspection Agency split the province into two – the Riding Mountain Eradication Area and the rest of Manitoba – to avoid losing bovine TB-free status across the entire province. The Riding Mountain Eradication Area consists of General Hunting Areas 23 and 23A, and its designation affects about 700 ranches and farms and approximately 50,000 head of cattle.

Several multi-stakeholder working groups and committees are working on this complex issue. This includes a TB Stakeholder Advisory Committee, chaired by the Riding Mountain Biosphere Reserve, which allows the views and observations of local people to be heard. The bovine TB issue affects both the National Park and the people who live around it, and the need for the two parties to come together to address the issue clearly demonstrates the purpose of the Biosphere Reserve and the role it can play.

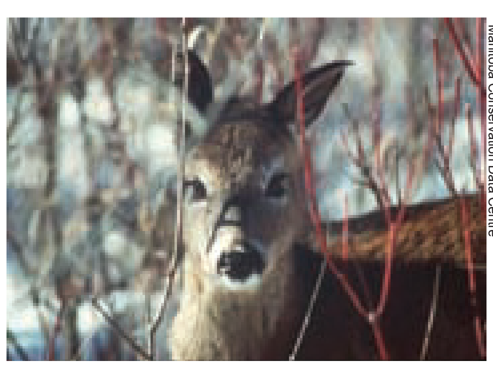
The provincial government and Parks Canada have the mandate to deal with diseased elk and deer outside and within the boundaries of the National Park, respectively. These agencies will likely continue to play the dominant role in the development and establishment of strategies to deal with the disease in the wild populations, where the traditional methods of TB eradication in livestock using quarantine, testing and slaughter are not practicable.[38]

Along with the challenge of managing the disease within the Park, the TB Task Group is working with local residents and farmers to mitigate the impacts of the disease across the larger landscape. The Canadian Food Inspection Agency is responsible for responding to the impact that this reservoir of disease may have on Canadian livestock.[38]

Research and monitoring is presently being conducted by the TB Task Group and university researchers on the prevalence of TB in the regional elk and deer populations, and on disease transmission and its role in regional wildlife populations. Ecological issues are more difficult to measure than economic trade, and must not be underestimated. A solution must be found that maintains both the ecological integrity of the Biosphere Reserve and the economy of the local communities.[39]

Information and updates on the bovine TB situation in the Riding Mountain region can be found at <www.thegreenpages.ca/tb/>.

Chronic wasting disease (CWD) is a fatal disease of the central nervous system of deer and elk, and belongs to a group of diseases called transmissible spongiform encephalopathies (TSEs). TSEs tend to be species specific; i.e., are not naturally transmissible between different species. Besides CWD, other animal TSEs include: scrapie of domestic sheep; bovine spongiform encephalopathy (BSE) or mad cow disease in cattle; and Creutzfeldt-Jakob Disease, a human disease found worldwide.[40] CWD is caused by an accumulation of abnormal proteins called prions, which causes degeneration of the brain cells. Infected deer and elk show abnormal behaviour accompanied by progressive weight loss. In later stages of the disease, affected animals show signs of extreme weight loss, repetitive behaviour, drowsiness, lack of coordination, drooping head and ears, drooling, and increased drinking and urination.[40]



Manitoba Conservation Data Centre

To date there has been no evidence of CWD in Manitoba in either farmed elk, or wild deer or elk, but it has been detected in captive and free-ranging deer and elk populations in Saskatchewan and Alberta, and several states including Colorado, Wyoming, Montana, South Dakota and Wisconsin. Over 1,170 elk and 1,150 deer from the Riding Mountain region and the southern part of the province have been tested for CWD, all producing negative results.[40]

4.2 ECOLOGICAL CHANGE

Habitat fragmentation and development

The extent and rate of ecological change that has taken place in the Riding Mountain region over the past 100 years is dramatic. **Map 17** shows a 6-category landscape classification of the Riding Mountain region, as it existed in 1948. When compared to the 16-category landscape classification from 1993 (**Map 14**), the extent of forest removal and conversion to agriculture over this 45-year period is readily apparent.

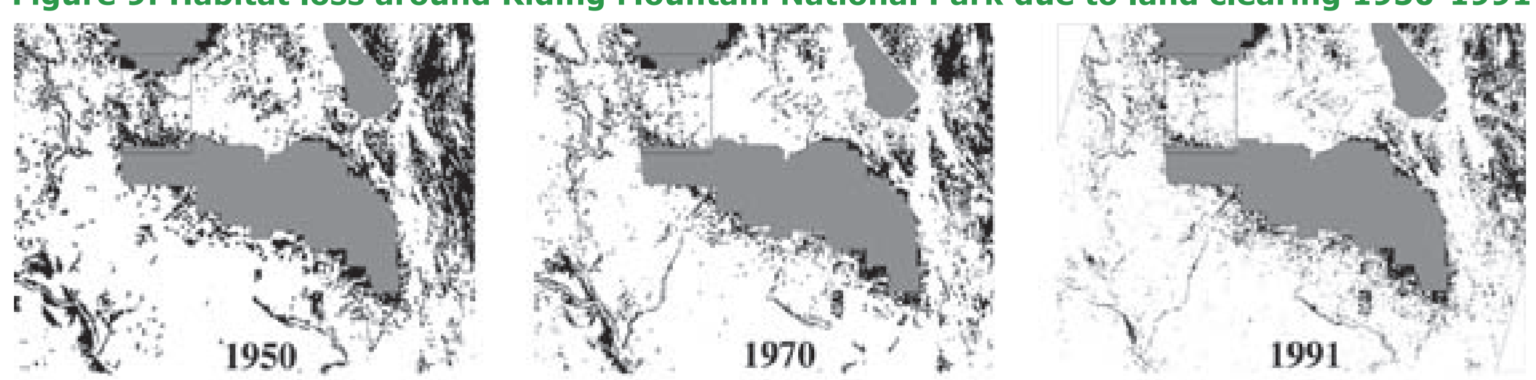
Roads make most other human disturbances possible and have cumulative effects that persist as long as the road bed is in place.[43]

Donna Danyluk

Before European settlement, the landscape along the Escarpment was continuous with the boreal forest to the north, and aspen parkland and grasslands to the south.[31] As mentioned in Section 3.2, encroachment of farmland to the edge of the Park is so pronounced that much of the Park boundary is visible from space, and connectivity with other large areas of habitat has been severed.[42]

Although the total population of the Biosphere Reserve has been decreasing since 1941, land clearance has continued at a rapid rate, with some areas being transformed at a more rapid rate than others. David Walker describes the trends of habitat loss in the Riding Mountain region between 1950 and 1991,[42] shown in **Figure 9**. Even in 1950, much of the land had already been cleared for agriculture, with 25% of the total area still forested. However, the amount of forest remaining in the 1950s varied across the region. To the north of the Park, almost half (43%) of the original forest remained, while to the south, 92% of the land base was already cleared except for small areas adjacent to the Assiniboine River valley.[42]

Figure 9: Habitat loss around Riding Mountain National Park due to land clearing 1950-1991

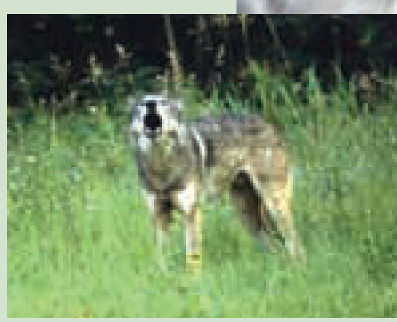


Habitat loss in the area surrounding Riding Mountain National Park, between 1950 and 1991 (adapted from Walker 2001).[42] Total forested area for the region (all areas in black; excludes Riding Mountain National Park and Duck Mountain Provincial Park): 1950 = 25%; 1970 = 19%; 1991 = 13%. Total forested area for the Grandview Corridor (boxed area): 1950 = 44%; 1970 = 23%; 1991 = 14%.

Wolves in the Riding Mountain Biosphere Reserve

The network of roads and decreasing amount of continuous forest cover in the Biosphere Reserve have severe implications for the reproduction, survival and success of wolf populations in the Riding Mountain region.[48] Given the small size of Riding Mountain National Park and the large dispersing pattern of wolves, it is unlikely that any wolf packs reside exclusively in the Park.[48] Even though they are part of a larger regional population, their dispersal from the Park may be restricted by roads and highways, and extensive deforestation.[48] Compounding this problem is a negative perception of wolves by some area residents. In a recent survey of farms within a 50 km radius of the National Park, 51% of 1,338 respondents stated that although damage by wolves on their farms was "never serious," 44% "disagreed" when asked if they enjoyed seeing wolves on their land.[49]

Parks Canada



Intensive annual tracking and aerial surveys undertaken by Parks Canada show an abrupt decrease in wolf population in the mid-1990s, with an estimated drop to 30-50 animals[5,50] (see **Figure 10**). There is little evidence to suggest the exact causes of declines in the region,[50] but it is known that wolf populations rise and fall with changes in food supply.[51]

Elk are the main prey species for wolves in Riding Mountain National Park, while moose, white-tailed deer, beaver and snowshoe hare are alternate food sources.[52] The abundance of prey in the National Park, however, should support twice as many wolves than are presently seen.[48] It has been suggested that other factors such as disease, habitat fragmentation and human-caused mortality may be contributing to declines in the wolf population.[50,51]

Dr. Charles Krebs, UBC, from his book "Great Canadian Scientists" (Raincoast Books)

Snowshoe hare

Figure 10: Wolf population trends

Estimated wolf population in Riding Mountain National Park, 1975-2001 (ground survey data). Data provided by Parks Canada, Riding Mountain National Park.

In agro-Manitoba, segregated wolf populations are found in islands of habitat including Riding Mountain National Park, Duck Mountain Provincial Forest, and reportedly in the Spruce Woods Provincial Park/Shilo Military Base Forest.[53] However, recent studies have shown that what today is considered a single population of gray wolves in Manitoba may be a hybrid of two sympatric species, namely eastern Canadian wolf (Canis lycaon) and gray wolf (Canis lupis).[48] The term sympatric is often used for populations of closely related species that occupy the same or overlapping geographic areas without interbreeding. The amount of interbreeding between the gray wolf and eastern Canadian wolf is presently unknown, but the identification of clearly defined species may have large implications on wolf conservation efforts in North America.[48,54]

The conversion of forested areas to agricultural land continued well after the 1950s, especially along the fertile river valleys to the north and southwest of the Park, where farming consists primarily of cereal crops.[42,117]

Most of the forest lost from the 1950s through 1970s occurred around edges of existing forested patches, although large forest blocks were also removed north of the Park.[42] The loss of habitat continued into the 1990s with the clearance of several large areas, the most noticeable being along the Assiniboine River valley to the west and south of the Park following completion of the Shellmouth Dam. In addition, clearance of land for pastures to the north and east of the Park resulted in large losses of forest in areas where crop productivity was traditionally low.[42] By 1991 only half of the area forested in the 1950s remained (13% of the area outside of the Park), limited to woodlots and along rivers and streams.[42] The only area where reforestation took place during this period was along the Birdtail River, south of the Park.

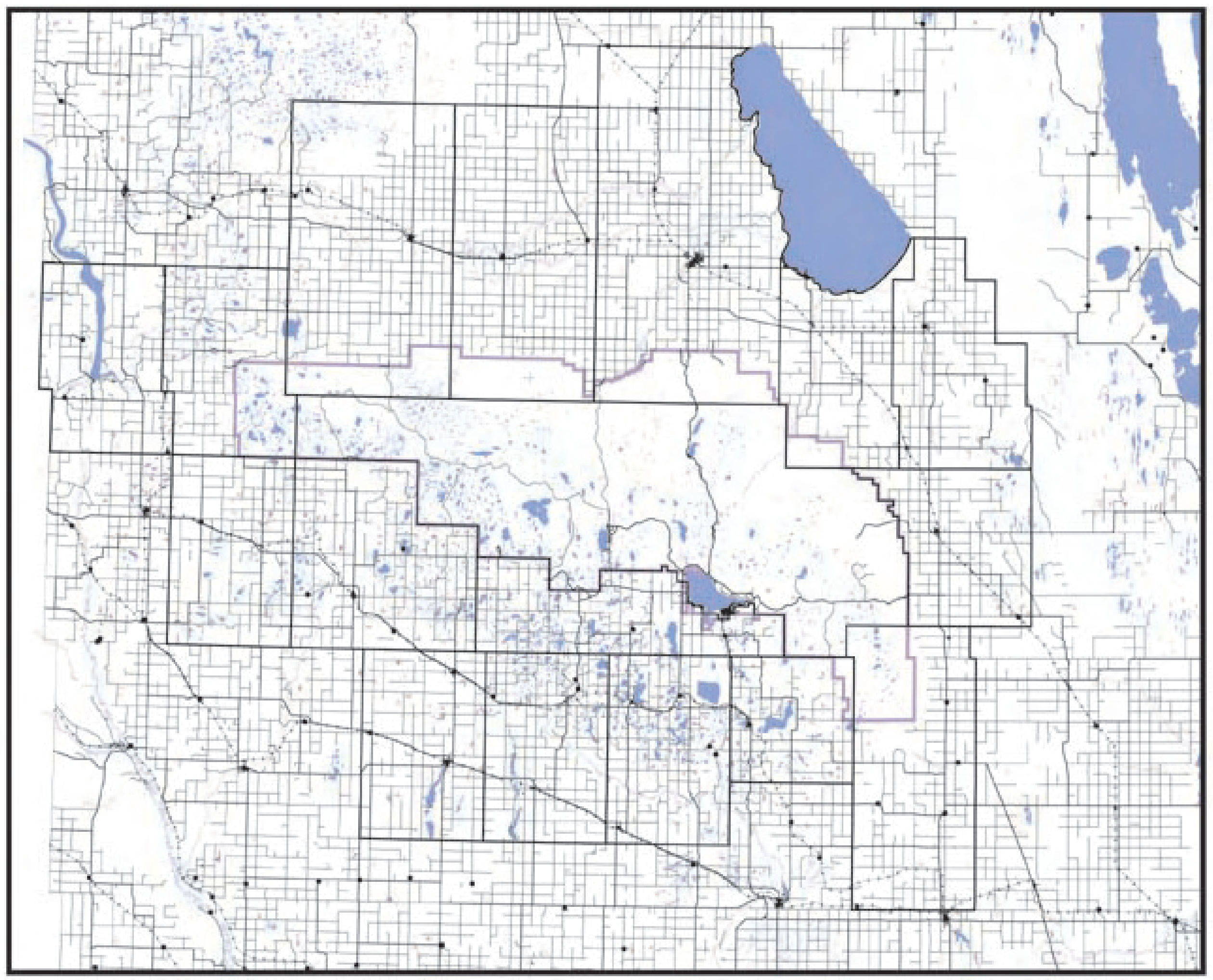
Walker found similar trends in the Grandview Corridor, the area of land which connects Riding Mountain National Park with Duck Mountain Provincial Park. In the 1950s, the corridor was nearly continuous between the two parks, with 44% forest cover. By the 1970s, forest cover had declined to 23% largely as a result of land clearance adjacent to the main highway and railway lines. By 1991 only 14% of the corridor remained forested, mostly along the Valley River. Generally, forested land closest to the two parks and land along rivers was most likely to be retained over time.[42] Woodlands along rivers are often associated with poorly drained soils where agricultural development is not possible, and floodplains are protected from development by seasonal flooding. As a result, less forest clearance has taken place along larger floodplains and steep embankments of the upper Assiniboine, Shell and Valley Rivers, where some of the largest and most complex forest patches remain today.[42] The continued loss of habitat in the Grandview Corridor is particularly critical due to the area's important role in maintaining connectivity and regional biodiversity.[42]

Roads and other forms of human access are one measure to determine a region's ecological integrity.[43] (See **Figure 11**.) Road construction results in physical destruction of natural habitat, and the increased access provided by roads results in the spread of invasive species, over-exploitation of large carnivores, increased fire ignitions, loss of tree snags through firewood collection, alterations to drainage, and other impacts. Once roads or railway lines bisect the natural landscape, connectivity is almost immediately lost, and the remaining habitat becomes fragmented. As described above, this has been especially evident in the Grandview Corridor, where nearly all of the habitat next to the main highways and railway lines have been developed for agriculture.[42]

The term landscape connectivity refers to the degree to which a landscape facilitates or impedes the movement of organisms among patches of resources.[44] Large carnivores such as wolves, black bear, coyotes and lynx have very large home ranges that are not confined to Riding Mountain National Park. For these species, survival depends on landscape connectivity, which allows for movement around barriers such as highways or developed areas, and minimizes human-caused mortality (vehicles, hunting, trapping).[45]

Perhaps the greatest challenge in conservation is the loss of connectivity between remaining patches of habitat and protected areas at regional scales.[42] Loss of connectivity at this scale can dramatically change the movements and behaviour of native species. The enhancement and creation of corridors has been suggested as a means to maintain populations of species,[46] however, research on the effective use of corridors by wildlife has produced conflicting results and requires more research. Although some species will avoid leaving their preferred habitat within a corridor, most can cope with some degree of fragmentation and will cross small gaps. An optimal level of fragmentation should exist that provides a necessary degree of connectivity for wildlife without compromising agricultural productivity.[42,47]

Figure 11: Roads in the Riding Mountain Biosphere Reserve

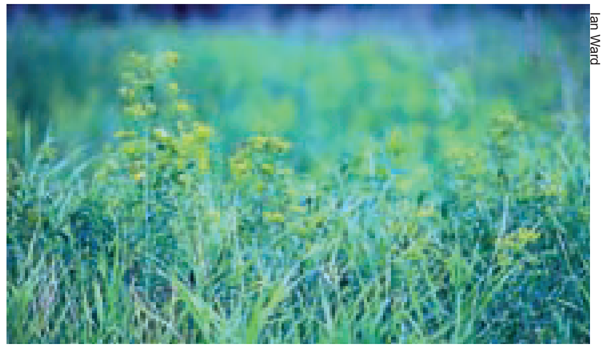


Road development in the Riding Mountain region is extensive and has facilitated the development of the landscape. In 2001, there was an estimated 10,690 km of road within and along the boundaries of the Riding Mountain Biosphere Reserve. This is about a 2% increase from 1948, suggesting that the majority of roads in the Biosphere Reserve had already been constructed by that time. Roads are variously managed by federal, provincial and municipal governments. Within the Park there are 80 km of asphalt road (most of which is Provincial Highway No. 10, bisecting the Park from north to south), as well as 98 km of gravel public roads and 417 km of backcountry trails. Roads outside the Park provide at least one point of access per mile of the Park boundary.[5]

Parks Canada

Historical photo of Highway 10 through Riding Mountain National Park

Next to habitat loss, non-native invasive species present the greatest threat to biodiversity and natural ecosystems,[97] and also have a large impact on agricultural productivity. Some species have been introduced accidentally, such as leafy spurge, which is believed to have come to North America with contaminated seed brought by early settlers from Eastern Europe. Leafy spurge is probably the most noxious weed to control in Manitoba, and infestations displace native species from natural grasslands and render pastures useless for cattle grazing. Other Eurasian species were introduced to North America intentionally, to increase grassland productivity and improve forage quality. These species have also invaded grasslands, displacing native species,[62] but fire may play a role in their control (see next section).



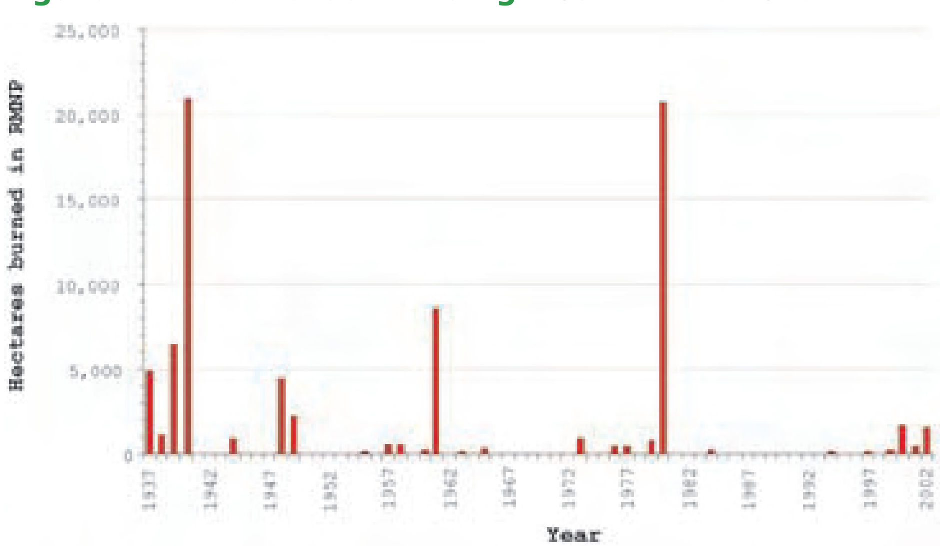
Ian Ward

Leafy spurge

Fire as a natural disturbance

Fire events have had a critical role in the development of forests and grasslands in Riding Mountain National Park. Fires were quite common before and during European settlement, particularly during the years 1822, 1853-1855, 1889-1891 and 1918-1919, as indicated by fire scars on old white spruce, and ages of aspen and balsam poplar stands.[55] Used as a tool to help clear land, fire occurrences increased during settlement, and were particularly frequent between 1885 and 1889, burning several hundred thousand acres.[28]

Figure 12: Fire trends in Riding Mountain National Park



Hectares burned by fire (resulting from lightning, humans or prescribed burns) in Riding Mountain National Park, 1937-2002. Data provided by Parks Canada, Riding Mountain National Park.

Figure 12 shows recent major fires that have occurred in the region: Whitewater Lake (1940), Gunn Lake (1961) and Rolling River (1980).[5] Small fires do not play a large role in determining forest age, as they affect only a small part of the landscape.[56] Landscapes are shaped by large fires, such as those that nearly completely burned the west side of the National Park in the late 1800s. The western region of the Park is drier and hotter, and apart from large wetlands and bodies of water, the relatively flat terrain provides few barriers against the spread of fire. The result is a much greater dominance of species that are well adapted to frequent fire, such as trembling aspen, balsam poplar and beaked hazelnut. These species spread clonally by suckering, have rapid growth, are intolerant of shade and have short lifespans.

Richard Caners

Prescribed grasslands fire

As compared to western regions, the eastern uplands of the Park are cooler and moister, resulting in fewer and less extensive fires. Also, the dramatic relief and presence of stream valleys along the Escarpment impedes the movement of fire (which typically spread from the south and west with prevailing winds), resulting in protected areas that burn infrequently. Mature stands of white spruce are more common at higher elevations throughout eastern regions of the Park. Balsam fir is also widespread throughout this area, but tends to be most common in forests which burn infrequently, such as in stream valleys cutting through the Escarpment and along the leeward side of large bodies of water which block the spread of fire. Eastern deciduous species that are poorly adapted to recurring fire such as green ash, Manitoba maple, American elm and the shrub mountain maple, are more common along the mid to lower slopes of the Escarpment. These species have a thin bark, which does not offer protection from fire compared to another eastern deciduous species, bur oak, which has a thick fire-resistant bark at maturity, allowing large trees to survive low-intensity fires. In fact, stands of oak require fire to eliminate disease and reduce competition from understory shrubs that limit oak regeneration.[20]

Fire is a pivotal ecosystem process in the North American boreal forest.[116]

Jack pine is largely found in the southeastern portion of the Park; an area which has burned repeatedly.[29] Jack pine has a lifespan of approximately 200 years, and is dependent on fire for the opening of its cones, which are produced as early as 7 years of age. Standing dead boles of jack pine, characteristic of burnt-over areas, serve as aerial seedbanks – the opened cones remain on the upper branches of the standing dead stems and release their seeds to the wind to germinate on the exposed mineral soil after fire. It is possible for jack pine to be effectively extirpated from areas in the absence of fire for long periods.

Richard Caners

Jack pine regeneration in 1980 burn, Rolling River, Riding Mountain

The boreal forest is a complex assortment of forest stands of differing ages,

Prairie crocus

and burn frequently enough so that virtually all areas will have burned within 300 to 400 years.[56] As a result, old-growth stands will be limited, with rarely more than 5-10% of the landscape reaching 200 years of age.[56] In fact, studies show that old-growth forests did not dominate most of the western boreal forest landscape before European settlement because of the frequency of fire.[56] In northern regions of the boreal forest, fires are regulated by natural factors such as the weather. However, in the southern boreal forest and aspen parkland, the agricultural development and fragmentation of the landscape that has taken place since initial settlement times has reduced the number and extent of fires in the Riding Mountain region. Fire has essentially been removed from the landscape as a meaningful natural disturbance.

In the absence of fire, a larger proportion of the forested landscape becomes old-growth.[56] Old-growth forests are characterized by large trees, large differences in tree size and spacing, accumulation of large, dead standing and fallen trees, broken and deformed treetops, rotting stems and roots, different canopy layers, canopy openings, and patchy understories. In these forests, openings or 'gaps' resulting from the death of one or more large trees break the continuity of the forest canopy and drive forest development or succession.[57] These canopy openings increase light and facilitate the growth of understory species. The greater number of habitats found in older forest stands, including logs on the forest floor in different stages of decay, standing dead trees and uprooted trees, often results in a greater diversity of species than in younger forest stands.[58]

Mixed-grass prairie at Asessippi Provincial Park

Although species diversity is important at the stand level, regional species biodiversity is greatest when there is a range of forest stands of different age on the landscape. This can only be achieved by maintaining natural disturbance processes.

Fire and grasslands

Fire is also extremely important for maintaining the integrity of native mixed-grass and plains rough-fescue prairie in the region. Plains rough-fescue grasslands occur most frequently as prairie openings in the aspen parkland ecoregion (see **Map 1**), which stretches from west-central Alberta to southwestern Manitoba. Pockets of plains rough-fescue grassland also exist in south-central British Columbia, in southwestern Alberta along the eastern slopes of the Rocky Mountains, and as islands on benches and upper slopes of areas such as the Cypress Hills and Wood Mountains in Saskatchewan, the Milk River Ridge in Alberta, the Duck and Riding Mountains in Manitoba, and in North Dakota, Montana and Oregon.[34] The Riding Mountain region represents the easternmost occurrence of this grassland type.

Grassland habitats in the aspen parkland ecoregion are threatened by cultivation and suppression of fire.[59] Before European settlement, fire was essential for maintaining grassland openings of the northern Great Plains, with a long record of fire use by First Nations to encourage new plant growth to attract buffalo.[60] Grasslands were the first to be cultivated during early settlement in the Riding Mountain region.[34] More than 70% of the ecoregion has been cultivated, and less than 5% remains as natural grassland, largely where rocky soils and rugged terrain prevail.[59]

Without recurrent fire, mixed and fescue grasslands are compromised by the encroachment of aspen, white spruce and other woody vegetation such as hawthorn, snowberry, saskatoon and chokecherry. Current theory suggests that densely populated areas result in increased deposition of atmospheric nitrogen, which may contribute to forest expansion into grasslands at the northern edge of the northern Great Plains.[61] In Riding Mountain National Park, increased nitrogen deposition may be caused by prevailing westerly and north-westerly winds carrying particles from Edmonton and Calgary, and oil refineries on the Alberta-Saskatchewan border west of Prince Albert.[61] Forest expansion in the Park was found to be 10 times faster than forests in the less densely-populated areas of Wood Buffalo and Grasslands National Parks, with an average expansion rate of approximately 1% per year.[61]

As mentioned earlier, fire may also play a role in the control of invasive species. For example, smooth brome is a long-lived perennial grass that was introduced through agricultural practices to Canada around 1886, and is currently one of the most widely planted forage grasses in western Canada.[63] Aggressive and highly competitive,

Invasive smooth brome

smooth brome spreads by underground rhizomes and prolific seed production.[64] It alters species composition and production in native prairie ecosystems, particularly where disturbance by livestock grazing or regular mowing has occurred.[65,66] Smooth brome is invading much of the remnant fescue grasslands in Riding Mountain National Park, displacing native species.[67] Studies have examined the use of prescribed fire as a means of controlling the spread of smooth brome, however the response of the species to fire is variable.[63,64,66] Fire may also be a tool to control the spread of Kentucky blue grass, another introduced perennial, which has displaced native species in formerly heavily grazed sites in the Park.[34,68] Even with the removal of grazing from the National Park, there is little evidence that these sites have recovered.


Richard Caners

Fireweed

Fire helps maintain the biodiversity of the Riding Mountain region by maintaining a balance of different forest and grassland communities in different stages of succession. Fire essentially creates a patchy landscape which increases biodiversity.[69]

After a lengthy fire exclusion policy,[70] Parks Canada has recently begun a program of ecosystem restoration through the careful reintroduction of fire.[5] Fire is now being used in forests and grasslands to stimulate new plant growth, eliminate weeds, reduce accumulated dead vegetation, reduce the abundance of woody species, and improve feeding habitat within the Park for wildlife.

Climate change

Global temperatures have clearly been increasing since the end of the Little Ice Age (about 1550-1850 AD). Since 1890, temperatures in Canada have increased by 1.7°C,[71] peaking in the 1940s, followed by a cooling in the mid-1960s, and a warming trend since 1970.[72] General climate models predict a rise in global temperature of 1.5 to 4.5°C within the next 100 years, with increased temperatures at higher latitudes and decreased summer precipitation and soil moisture at mid-latitudes of the northern hemisphere.[73] **Maps 18-23** illustrate the expected changes in temperature and precipitation from present to 2040-2060 for the Riding Mountain region and the rest of Canada.

Changes in fire frequency as a result of climatic warming will have a major impact on the boreal forest ecosystem. The western Canadian landscape is particularly vulnerable. Models suggest that as global warming continues, the prairie landscape may move significantly further north.[71] Increasing temperature alone does not necessarily mean that fire events will increase, as changes in precipitation do not always occur with changing temperature.[71,72] Whereas some regions of Canada will experience decreased precipitation with increasing global temperatures, other regions will experience higher precipitation and a corresponding decrease in the frequency of fire.[71]

The Earth's temperature is determined in part by a naturally occurring process known as the greenhouse effect. Naturally occurring greenhouse gases (GHGs) include water vapour, carbon dioxide (CO_2), methane, nitrous oxide, and ozone. Certain human activities produce more of these gases, while other activities can create GHGs that do not naturally occur.[74] Trees and other plants store CO_2 from the atmosphere as they grow; i.e., they act as carbon sinks. A single tree can absorb many tonnes of CO_2 in the course of its lifespan, and a healthy forest can absorb thousands of tonnes. Similarly, agricultural soils can be managed to store more CO_2 from the atmosphere when farmers adopt practices that increase yields and reduce soil disturbance due to tillage. More of the CO_2 that the crop plants absorbed from the atmosphere during the growing season is converted in the soil to organic carbon where it is stored, and does not return to the atmosphere.[75]


Richard Caners

With the ratification of the Kyoto Protocol, Canada needs to reduce its greenhouse gas emissions for the first commitment period of 2008-2012 to 94% of 1990 emission levels.[76] While agricultural activities are presently responsible for about 10% of Canada's GHG emissions, farmers and governments have worked together to improve farming methods and reduce soil erosion (through low tillage, less summer fallow, growing hay in crop rotations, etc.), thereby increasing retention of CO_2 in soils.[74] Assuming that these practices continue, agriculture is predicted to generate a carbon sink of 10 megatonnes in the first commitment period. There is no upper limit on Canada's agricultural sinks under the Kyoto Protocol. By providing an accounting framework that recognizes sinks and gives credits when farmers are successful in reducing agricultural sources of GHGs, farmers have an incentive to take a whole-farm approach to managing GHGs and to adopt sustainable land-management practices.[75]

Climate change will undoubtedly have major impacts on agricultural producers and forestry, but adopting different agricultural and forestry practices will help ameliorate the effects. The management of forests and farms to increase carbon stores has other significant environmental benefits, such as conservation of biodiversity, promoting clean air, protecting streams, lakes and rivers, and improving the quality of soils, which in turn helps produce quality agricultural products over the long term.[75]

4.3 THE CHALLENGE OF MAINTAINING ECOLOGICAL INTEGRITY

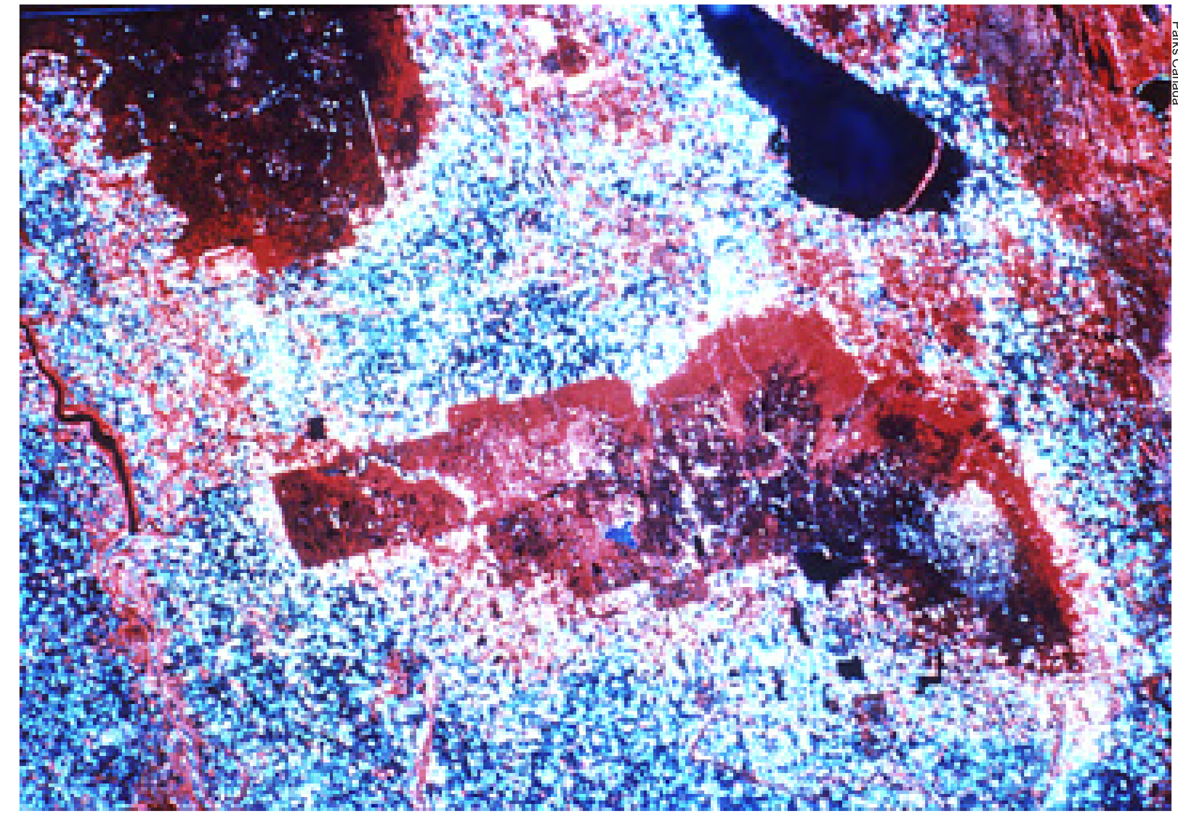
The extensive development and transformation of the Riding Mountain greater ecosystem has consequences for the maintenance of regional biodiversity and natural processes. Effective land management and conservation measures are needed to protect the remaining natural habitat in the region, and preserve for future generations the species, processes and functions of these ecosystems. The large number of government departments, management agencies and private landowners within the Riding Mountain greater ecosystem requires good communication and strong partnerships for conservation (see Conservation Initiatives in Section 7.2).

"Biological diversity – 'biodiversity' in the new parlance – is the key to the maintenance of the world as we know it. Life in a local site struck down by a passing storm springs back quickly because enough diversity still exists ... this is the assembly of life that took a billion years to evolve." - E.O. Wilson[118]

Many areas outside of the National Park are managed at least in part to protect aspects of regional biodiversity, including private land, provincial Crown land, ecological reserves, wildlife management areas, community pastures, and provincial parks (see **Map 13**). These areas are important for preserving biodiversity and facilitating wildlife movement throughout the region. However, finding solutions to problems such as wildlife depredation of crops, transmission of disease between domestic and wild animals, and the flooding of land and roads by beaver requires cooperation among land managers and private landowners.[5]

Maintaining ecological integrity in the Riding Mountain greater ecosystem is challenged by the size of the National Park and by its regional context. Managing the cross-boundary movement of wildlife, disease and non-native species, and pollutants including chemicals and waste products, poses a challenge to both the maintenance of ecological integrity of Riding Mountain National Park and the economic viability of agriculture in the region.[5] Wildlife can move freely across the Park boundary, which is necessary to maintain long-term population viability. However, once they leave the Park they can damage crops or interact with livestock, and are susceptible to hunting and trapping. Addressing this conflict requires cooperation and open communication among all parties.

Large yellow lady's-slippers



Satellite photos clearly show how Riding Mountain National Park is an "ecological island." The effects of agriculture, forestry and recreational development around the park have left almost the entire boundary sharply defined.[129] According to the Park's Ecosystem Conservation Plan: "The Park itself is too small to be a self-regulating system. In the long-term, preserving all of the life forms and ecological processes currently found here will require cooperative management of the whole region." [51]

5.1 DRAINAGE

Map 24 shows the three continental drainage systems in the Prairie Provinces: the Arctic Ocean, Hudson Bay and Missouri River systems, which together comprise 14 smaller basins of major rivers or lakes. The Riding Mountain Biosphere Reserve is situated in the Hudson Bay drainage system, which encompasses the broad area from northeastern South Dakota and northern Michigan, to northwestern Montana, southwestern Alberta and southern Nunavut Territory and is a collection of 9 subcontinental basins that drain into Hudson Bay.

The Riding Mountain Biosphere Reserve is situated on the divide between two of these subcontinental drainage basins: the Lake Winnipeg basin, which drains eastward towards Lake Winnipeg, and the Assiniboine River basin, which drains southward towards the Assiniboine River. These major drainage basins, in turn, are comprised of smaller gross drainage units, which are the areas that contribute runoff in extremely wet conditions. The boundary of a gross drainage unit is the height of land between adjoining units, and in theory is a definite line as it is based solely on topography. However, in areas of poor drainage, gross drainage boundaries become less distinct as other physiographic factors such as slope, drainage patterns, and depressional storage come into play.

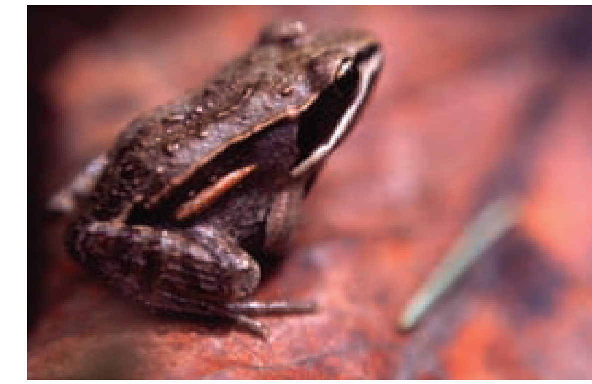
The drainage of the Riding Mountain Biosphere Reserve is illustrated in **Map 25**. Drainage systems depicted on this map are an inter-connected network of channels that convey surface water from the landscape to major river and lakes. Some of these drains are natural waterways while others are human-made. Most drains in hummocky (hilly) or high relief areas are in their natural location. However, where there is less relief (to the north and east of Riding Mountain National Park), and particularly in areas intensively developed for agriculture, most drains are human-made and have largely been relocated to road allowances. Some drains convey their water to wetlands or small lakes, which are in turn connected to the network by channels.

Hydrography can be defined as the description and analysis of the physical conditions, boundaries, flow, and related characteristics of surface waters, and the mapping of water bodies. **Map 26** depicts hydrographic information for the gross watershed units that come into contact with the Riding Mountain Biosphere Reserve. Both the hydrography and drainage of the Biosphere Reserve reflect the complex topography (elevation and relief) and human development of the region. It should be noted that the actual number of beaver dams in the National Park and the greater ecosystem is greater than that shown on the map.[77]

5.2 WETLANDS OF THE BIOSPHERE RESERVE

The Riding Mountain Biosphere Reserve has a wide variety of wetland types and sizes that support a large diversity of waterfowl, animals and other species of birds and invertebrates. Prairie wetlands also function as groundwater recharge sites, flow-through systems, or groundwater discharge sites, depending on their position on the landscape, the location of the associated water table, the type of underlying geological substrate, and changes in climate. **Table 3** in the Maps & Tables section contains wetland data collected in 1989 by Ducks Unlimited Canada for each of the Rural Municipalities of the Biosphere Reserve.

Ground spring



Wood frog

Wetlands are defined as areas of land where the water table is at or above the level of the mineral soil for the entire year.[78] Mineral wetlands are areas of mineral soil influenced by excess water but which produce little or no peat, while organic wetlands or peatlands have accumulations of more than 40 cm of peat above the mineral soil. Major wetland types include bogs, fens, swamps, marshes, and shallow open water less than two metres deep, which have differing amounts of water level fluctuation, water flow, nutrient availability, and rates of growth and decay.[78] The following definitions of different wetlands types have been summarized from Johnson et al. 1995.[78]

Bogs are treed or non-treed peat-covered wetlands, and are relatively acidic (low pH), although alkaline (higher pH) bogs are known in the region. Treed bogs are comprised mainly of black spruce and (less commonly) tamarack, and have open or closed canopies depending on prevailing conditions and age of the forest.[79] Bogs tend to be nutrient-poor, receiving nutrients from rainwater instead of mineral-enriched groundwater. Mosses of the genus *Sphagnum* are the main peat producers.

Fens are peatlands with a high water table and slow internal drainage through seepage down gradual slopes. The slow-moving groundwater is enriched by nutrients from upslope materials, making fens more rich in minerals than bogs. Fens can be dominated by grasses, shrubs or trees, depending on the amount of available water. Mosses of the genus *Sphagnum* are the main peat producers.

Richard Caners

Swamps are wetlands where standing or gently moving water occurs seasonally or persists for long periods, leaving the subsurface continually waterlogged. The amount of nutrients available in swamps is between that of fens and bogs, and their substrates consist of mixtures of mineral and organic materials, or woody, well-decomposed peat. Vegetation may be dense coniferous (such as balsam fir), deciduous forest (such as balsam poplar, green ash, American elm), or tall shrub thickets (such as willow, alder). In many swamps, peat formation is minimal, and is primarily from woody species.

Marshes are wetlands that are periodically inundated by standing or slow-moving water and are rich in nutrients. They are typically on mineral soil, with vegetation dominated by emergent reeds, rushes, sedges and grasses. Marshes are subject to water draw-down, but water usually remains in the rooting zone for most of the growing season. Water is usually neutral to slightly alkaline, and peat formation is often minimal.

The prairie pothole region

The prairie pothole region of North America covers approximately 715,000 square km, extending from north-central Iowa to central Alberta. The landscape of the region is largely the result of glaciation during the Wisconsin Ice Age (see Section 2.1), which created a rolling landscape dotted with many small depressional wetlands.[80] In the Riding Mountain region, the prairie pothole region is found within the moist mixed grassland and aspen parkland ecoregions of the prairies ecozone, and parts of the boreal plains ecozone **(Map 1)**. The undulating topography and depressional wetlands are clearly visible on the map of elevation for the region **(Map 3)**. Depending on weather, the prairies ecozone as a whole can contain between 2 and 7 million individual wetlands, most of which are in the moist mixed grassland and adjacent aspen parkland ecoregions, where 25-50% of the land surface is wetland.[81]

Despite its harsh climate, the prairie pothole region of North America is an extremely productive area for both agriculture and wildlife.[80] This landscape has been substantially altered since settlement; the economic incentives to convert natural lands to agriculture have resulted in the loss of over half of the original 8 million hectares of wetlands.[80] Land-use impacts on wetland ecosystems include increased rates of siltation, contamination from agricultural chemicals, altered hydrology, and the spread of non-native plants, while wetland drainage and accompanying conversion of native prairie grasslands to agriculture results in habitat fragmentation.

The prairie pothole region of the northern Great Plains is one of the most important areas for duck reproduction in North America.[82] (As an example, Proven Lake Marsh is described in greater detail in Section 6.2.) Twelve of the 34 species of North American ducks are common breeders in the region. For seven species (mallard, gadwall, blue-winged teal, northern shoveler, northern pintail, redhead, and canvasback), the prairie pothole region accounts for more than 60% of the breeding population. The region is also a major migration corridor for other species of duck, geese and birds. During fall migration, mallards, widgeon, gadwall and lesser scaup use potholes heavily. Freshwater shrimp found in these potholes provide an excellent food source. **Map 27** shows a waterfowl habitat classification for the Riding Mountain region.

The changing water conditions of the prairie pothole region have a direct impact on duck populations. Breeding population sizes and reproduction rates increase with the number of wetland basins holding water in May and July.[82] During periods of widespread drought in the grassland portion of the region, many ducks move into the parkland, and when both regions are dry, ducks may be displaced to more northern regions of the boreal forest or tundra, delaying breeding efforts until wetland conditions improve.[83] Species such as pintail and blue-winged teal tend to be more affected by drought conditions because of their preference for temporary and seasonal wetlands, whereas canvasbacks and lesser scaup, which use more stable semi-permanent and permanent wetlands, are less likely to be displaced unless drought is severe.[82] For all species, however, productivity is generally reduced during drought conditions because of reduced nesting success and low survival rates of young.[82]

The ability of duck populations to recover from naturally occurring droughts is further reduced by continued loss of nesting habitat to agricultural development, primarily grain production and intensive grazing,[82] and impacts on nesting success by chemicals washed by rain, wind drift and gravity into potholes. The success of waterfowl populations, in turn, affects the success of their predators. Before settlement, at least 19 species of carnivorous mammal were known to occur in the prairie pothole region of North America.[84] Now, only eight are common throughout the region: coyote, red fox, raccoon, American badger, striped skunk, mink, ermine, and long-tailed weasel. The survival of these and other species, including lynx, bobcat, gray wolf and least weasel, is dependent in part on wetland habitat.

Gene Collins

Parks Canada

Red fox

Stewardship and conservation of riparian areas

A riparian zone can be defined as the strip of land that borders a stream, river, lake, pond or any other body of water.[85] Although riparian areas occupy a relatively small proportion of the prairie landscape, they are an extremely important component, supporting complex groups of plants, mammals, birds and other organisms. Dead and dying trees, or snags, provide nesting areas for woodpeckers, wood ducks, mergansers, owls, and other cavity nesters. Migrating birds use riparian habitats for staging, nesting and stopovers. Deer, elk and moose prefer these areas as travel corridors and use them for shelter in extreme temperatures, and mink, weasel, river otter and muskrat live in, or near, riparian areas.[86] Maintaining the benefits (listed below) of a healthy riparian zone requires careful management of these fragile areas. These management suggestions have been provided by Manitoba Agriculture, Food and Rural Initiatives.[86]

Water quality. The riparian zone acts as a protective shield between the water and surrounding landscape, trapping sediments, nutrients such as phosphorous and nitrogen, chemicals and animal wastes from adjacent fields. This helps to reduce algal blooms that lower water quality, suffocate fish and create problems in recreational areas. Some species of blue-green algae can produce toxins which affect the liver and nervous system if ingested.

Fish and Wildlife. Trees, shrubs and other vegetation along streambanks and lakeshores provide shade and cooler water for fish and other aquatic life during the summer months. Even small changes in water temperature may negatively affect some fish and aquatic organisms. Branches and trees that fall in the water become places for fish to hide and feed, and leaf litter supports aquatic food webs. Riparian zones, such as riverbottom forests, are diverse ecosystems that contribute to regional biodiversity, and provide excellent wildlife habitat.

Water management. A well-vegetated riparian zone can slow flood waters, decreasing erosion and reducing flash flooding downstream. It also provides an area of groundwater recharge and helps maintain reliable stream flows throughout the year.

Sediment reduction. Proper riparian management minimizes streambank and shoreline erosion, and reduces downstream sedimentation that can negatively impact fish spawning habitat.

Financial. Protecting, rather than restoring, riparian areas makes economic sense, as the cost of stabilizing even a short stretch of streambank can be very high.

Donna Danyluk

Whirlpool Lake

Riparian areas can be managed to allow livestock use while maintaining the integrity of the water, soils and vegetation in the riparian zone. With unrestricted access, trampling by livestock increases erosion, sedimentation and the destruction of vegetation. In addition, cattle have an increased susceptibility to foot rot and mastitis, and water can become contaminated with waste, facilitating the transfer of other livestock diseases. A system of rotational grazing can be useful in managing these areas. Areas can be divided into paddocks and the herd moved from one paddock to another to avoid overuse. Ideally, a 30 foot wide strip along the water's edge should be completely fenced to exclude livestock, as this area is most critical for protecting water and vegetation. Detailed information on alternative watering systems is available from suppliers, Manitoba Agriculture, Food and Rural Initiatives, and Prairie Farm Rehabilitation Administration (PFRA) offices.

Planting forage (preferably native species) on marginal lands that have been cultivated, or lands that have deteriorated from erosion or salinity, will help prevent erosion. Zero-tillage or minimum tillage crop production will reduce the transport of agrochemicals and sediment. These practices will help reduce the impacts on riparian areas and associated wetland habitat, and will help sustain the diversity and stability of these ecosystems for the benefit of future generations. Water is dynamic – maintaining healthy wetlands and riparian areas locally will be a benefit to people, wildlife and vegetation over a much larger area.

Provincial Water-related Legislation [113]

The Crown Lands Act

The Dangerous Goods Handling and Transportation Act

The Endangered Species Act

The Environment Act

The Ground Water and Water Well Act

The Manitoba Habitat Heritage Act

The Provincial Parks Act

The Sustainable Development Act

The Water Commission Act

The Water Protection Act

The Water Power Act

The Water Resources Administration Act

The Water Resources Conservation and Protection and Consequential Amendments Act

The Water Rights Act

The Water Supply Commissions Act

The Wildlife Act

Federal Water-related Legislation [114]

The Arctic Waters Pollution Prevention Act

The Canada Shipping Act

The Canada Water Act

The Canadian Environmental Protection Act

The Dominion Water Power Act

The Fisheries Act

The Government Organization Act

The International Boundary Waters Treaty Act

The International River Improvements Act

The Navigable Waters Protection Act

The Northwest Territories Waters Act

The Yukon Waters Act

Nutrient loading to water bodies is an important water quality issue that concerns everyone. South Lake (pictured above in 2003), on the south side of Clear Lake in Riding Mountain National Park, is a shallow lake that has experienced intense algal growth due to elevated concentrations of nutrients, particularly nitrogen. The sources of the nutrients are unknown but likely originate from both inside and outside the Park, highlighting the need to work cooperatively on cross-boundary issues such as water quality and waste management.

SECTION 6.0 NATURAL HISTORY: FLORA AND FAUNA

The Riding Mountain region is situated at the confluence of several ecosystems: aspen parkland, mixed-grass and rough-fescue prairie, boreal forest and eastern deciduous forest. The complex physical geography of the region (see Section 2), in combination with natural disturbances, has resulted in a biologically diverse landscape, with habitats of differing age, structure and plant and animal composition. Natural disturbances include fire, flooding, blowdowns and the uprooting of trees, insect diseases and fungal pathogens, shifting surface materials along steep portions of the Escarpment, browsing of trees and shrubs (herbivory) by ungulates such as deer, elk and moose, and consumption of seeds (granivory) and overturning of prairie soils by small mammals.

Aspen blowdown

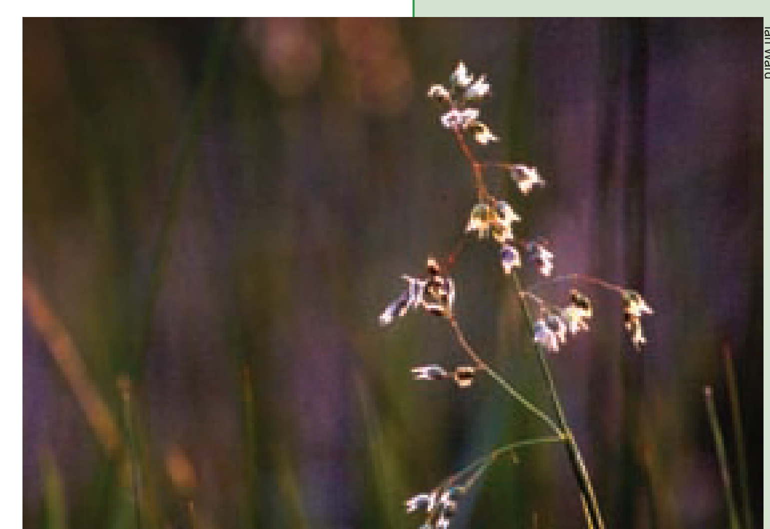
Granivory by red squirrel

Within the complex arrangement of these different communities, plants and animals have their own preferred niches, with conditions that sustain their reproduction, development and growth. The alteration of the landscape through the drainage of wetlands, habitat fragmentation and removal of natural disturbances, directly affects the ability of ecosystems to respond to large-scale changes such as climate change.

This chapter describes some of the biological diversity and some current species trends of the Riding Mountain region. The next chapter focuses on the conservation efforts that are being made to help protect this biological diversity.

6.1 THE FLORA

Approximately 669 plant species are known to occur in Riding Mountain National Park, in 88 taxonomic families and 300 genera.[87] In addition, several hundred species of mosses, liverworts, lichens, fungi and algae are found throughout the Park and the greater ecosystem. The distribution of different plant species and the communities they comprise is determined by soil type and texture, and the direction and steepness of slopes. These features determine local insolation (amount of sunlight received) and microclimate, moisture and nutrient availability, and the propensity for disturbance (flooding, fire, pathogen outbreaks). In addition, different species and communities are at different stages of succession (development over time since disturbance). The combination of plant species and the communities in which they belong is known as ecosystem diversity, and is an expression of the diversity of the terrain under the influence of different disturbance regimes.[7]



Sweet grass

Historically, the Anishnabe of the Riding Mountain region used plants in virtually every aspect of their life. Trees were used for birchbark canoes, maple syrup, willow baskets and traps, firewood, lumber and poles, and even for navigation (using iridescent fungi in decomposing poplar).[21] Vegetables provided a varied diet, and were supplemented by wild rice, and fruits and nuts, which were also used in dyes, teas and beverages, and for preserved foods. Medicinal plants were an important way of keeping traditional knowledge with the people, and elders that worked as medicinal healers were well-respected.[21] Some of the plants they used included seneca root, cattails, jack pine, yarrow, sweet grass, wild sarsaparilla, and tobacco made from the leaves of various species. Exposed soft shales along the Escarpment were used to make clay pipes, bowls and cutting tools. The landscape, in essence, was the provider of all that was necessary for mental, physical, spiritual and cultural persistence.

Using forest cover data for the province compiled by Manitoba Conservation, **Map 28** provides a general idea of forest distribution in the Riding Mountain Biosphere Reserve. The classification of natural systems (biological or geological) into discrete units is always an oversimplification of reality, and should be interpreted carefully. The different forest types shown on the map represent the most dominant canopy species of these forests. On the ground, forests are much more complicated, changing in structure and composition with changes in local conditions. This map, along with the accompanying data in **Figure 13** below, shows some important trends.

Approximately 32% of the entire area of the Biosphere Reserve is forested, with aspen-dominated forests comprising nearly 68% of the forested land. Bur oak stands occur along steep, south-facing slopes of the Escarpment and river valleys, on gravely or sandy beach ridges, and in other well-drained habitats (e.g. benches along the Escarpment and Birdtail Valley). Many of these habitats were historically subject to low intensity ground fires, and were rarely, if ever, flooded. Stands dominated by paper birch, in contrast, are found on cooler and moister, north-facing seepage slopes of the Escarpment.


Richard Caners

Gorge slope, Riding Mountain National Park

Eastern deciduous forests, dominated by green ash, American elm, Manitoba maple and mountain maple, are found at the base of the Escarpment, and along streams and watercourses where periodic flooding occurs. At the base of the Escarpment, these forests typically occur on fine-textured (silt-clay) nutrient rich soils, in protected locations that are not prone to burning. Vines of Virginia creeper and climbing bittersweet are infrequently found in these forests and large, or thick-stemmed, vines are a good indicator of older habitats that have not burned in a long time (vines tend to grow in girth much more slowly than in length). Many other species uncommon in the province are found only in eastern deciduous forests, including lopseed, Selkirk's violet, nodding trillium, hog peanut and millet grass. The eastern mosses *Callicladium haldanianum* and *Rhodobryum roseum* grow on decaying logs on the forest floor, and *Anomodon minor* is found growing on the bases of oak, elm, ash and maple trees.[79]


Richard Caners

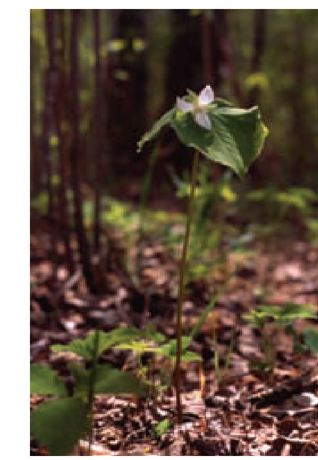
Virginia creeper


Richard Caners

Climbing bittersweet vine

Dutch elm disease has recently resulted in the widespread death of mature American elm trees along the Escarpment, leaving few healthy individual elms on the landscape. When the disease kills large branches or entire trees, the amount of light reaching the forest floor increases, resulting in the growth of shrubs and changes in an otherwise diverse understory.

Forest stands dominated by balsam fir also occur in areas that typically have not burned in a long time, such as on the cool, north-facing slopes of the Escarpment in moist locations, and are sometimes mixed with eastern deciduous species. Balsam fir is a late-succession species, that is, it establishes in stands that have not burned in 50-60 years, commonly regenerating in the woody debris that has begun to accumulate and decompose on the forest floor. It is also relatively shade tolerant and is able to grow in the forest understory. The small enchanter's-nightshade is another species that grows on decayed wood, and is a good indicator of old coniferous-dominated forest stands.


Richard Caners

Nodding trillium

Figure 13: Forest classification in the Riding Mountain Biosphere Reserve

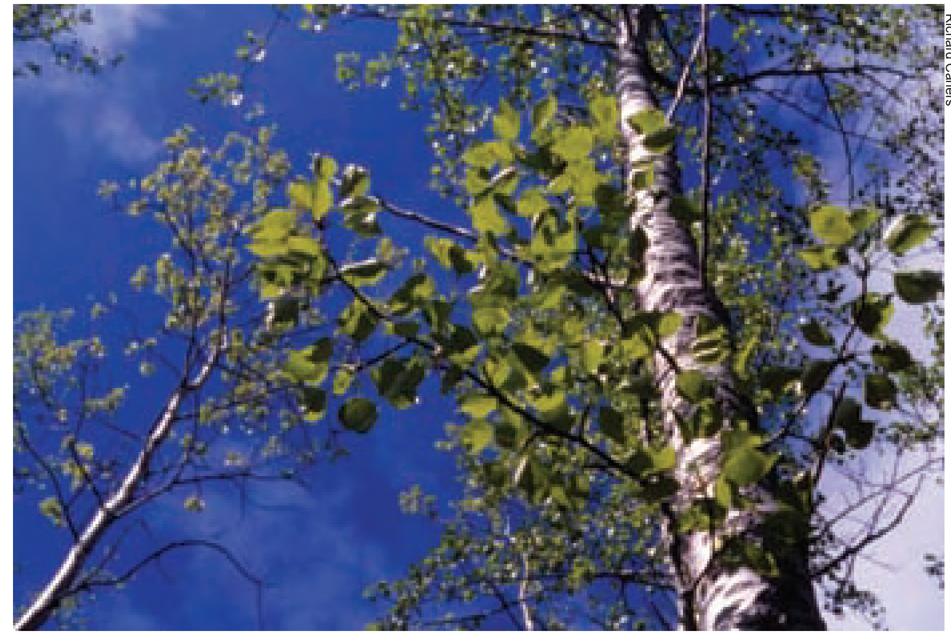
Forest Class	Total area in the RMBR (hectares)	Percent of total forested area	Percent of total RMBR area
Basal area of coniferous trees <25%			
Trembling aspen	295,209.2	67.7	21.4
Trembling aspen-birch (trembling aspen <50%; paper birch >20%)	225.8	0.1	0.0 (< 0.1)
Paper birch	348.9	0.1	0.0 (< 0.1)
Eastern deciduous (American elm, Manitoba maple, green ash)	7,943.9	1.8	0.6
Bur oak	4,226.9	1.0	0.3
Balsam poplar	1,028.6	0.2	0.1
Basal area of coniferous trees 26-50%			
Mixed trembling aspen and coniferous (spruce, fir)	66,473.2	15.2	4.8
Mixed paper birch and coniferous (spruce, fir)	23.1	0.0 (< 0.1)	0.0 (< 0.1)
Mixed balsam poplar and coniferous (spruce, fir, tamarack)	125.9	0.0 (< 0.1)	0.0 (< 0.1)
Basal area of coniferous trees 51-75%			
Jack pine, or mixture with spruce	85.7	0.0 (< 0.1)	0.0 (< 0.1)
White spruce, or mixture with fir, black spruce, pine	28,252.4	6.5	2.0
Black spruce, or mixture with tamarack, fir, white spruce, pine	1,526.2	0.3	0.1
Balsam fir, or mixture with white spruce	2,581.5	0.6	0.2
Basal area of coniferous trees >76%			
Balsam fir 40-100%, mixed with black and white spruce	970.9	0.2	0.1
White spruce 40-100%, mixed with black spruce, fir, pine	9,550.5	2.2	0.7
Black spruce 40-100%, mixed with tamarack, fir, white spruce, pine	16,282.8	3.7	1.2
Tamarack 40-100%, mixed with spruce	1,290.7	0.3	0.1
Total	436,058.1	100.0	31.5


Richard Caners

Dutch elm disease

Boreal forests dominated by jack pine, white spruce, black spruce, trembling aspen or balsam poplar are adapted to recurrent fire and are typically younger in age. Jack pine forests are found in the central and eastern portions of the Park on relatively sandy soils, often mixed with black spruce. Although jack pine stands tend to be quite young as they are adapted to frequent major fire events, stands situated in areas protected from fire can be much older. As the older jack pine die, these stands are now succeeding, or changing, toward stands dominated by black spruce. The north shore of Whirlpool Lake is an example of such a stand, as it is well-protected from fire.

The most common forest type in the Riding Mountain Biosphere Reserve is one dominated by trembling aspen. Aspen forests occur on a wide range of soil types, from clay to silty-sand. Balsam poplar grows on nutrient rich, clay-dominated soils, and is often found growing with trembling aspen in wetter areas, and in


Richard Caners

Balsam poplar

eastern deciduous forests. Stands of trembling aspen commonly have a dense cover of beaked hazelnut in the understory. In the absence of fire for long periods, the larger aspen die, increasing the amount of light in the understory. A dense shrub cover develops, limiting tree regeneration and reducing species diversity at the forest floor. Heavy browsing by elk, deer and moose accelerates the development of these shrub-dominated stands. Large areas that have not burned in a very long time, both along the Escarpment and in the western part of the Park, are dominated almost solely by shrubs.


Richard Caners

Burnt aspen stump among regeneration

White spruce, which often establishes along with trembling aspen immediately after fire in moister areas, grows more slowly and is more shade-tolerant than the faster-growing aspen. White spruce will grow slowly beneath the aspen canopy, but as the larger aspen die, the increased amount of light in the understory allows the white spruce to grow into the canopy. This cycle is renewed again after fire. As seen on **Map 28**, the western part of the Park, which burned in the 1880s, is primarily dominated by aspen that established immediately after fire. Aspen in these forests are approaching the end of their lifespan in some areas and will be replaced by white spruce. In contrast, the central and eastern portions of the Park, which did not burn in the 1880s, are largely dominated by older stands of white spruce and balsam fir. (Refer also to Section 4.2.)


Richard Caners

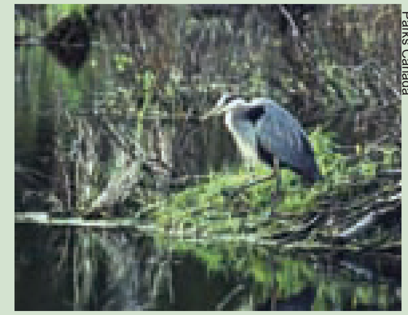
Coniferous forest on the east side of the National Park

Many plant species are dependent on specific habitats for their persistence. For example, a burned-over jack pine stand will be colonized by a certain suite of flowering plants (such as fireweed) and mosses immediately after fire, but over time these species will be replaced by many suites of other species adapted to the changing habitat conditions. In the absence of natural disturbance such as fire, many species may become displaced or even extirpated from large areas; for example, many grassland species are adapted to recurrent fire events. With the loss of each native species, the integrity of the ecosystem declines.[7]


Richard Caners

Old forest stand along escarpment dominated by shrubs

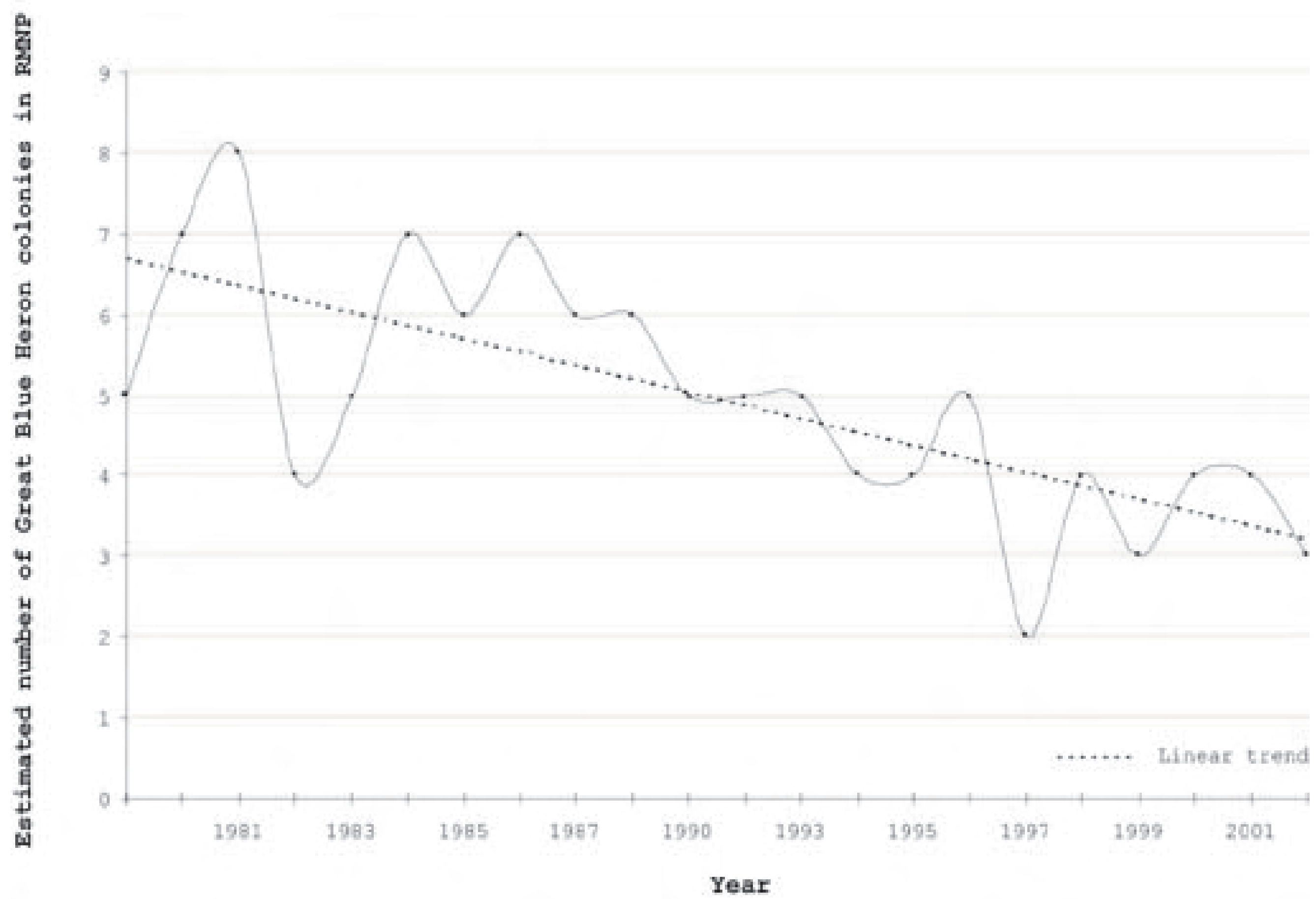
The great blue heron



Parks Canada

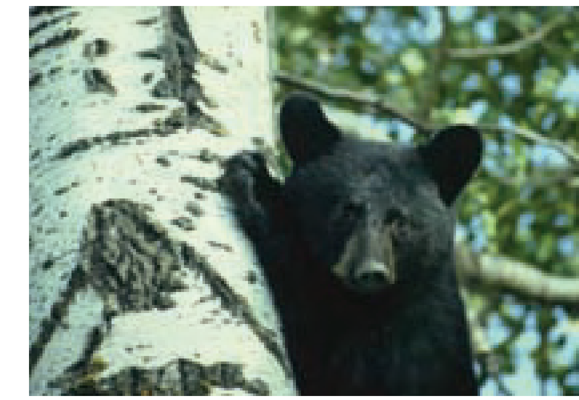
The great blue heron, which breeds in Riding Mountain National Park, is the largest and most widely distributed heron in Canada. The number of great blue heron colonies in the Park has been declining for several years (see **Figure 14** below), with recent estimates placed at approximately three colonies. (Colony size varies by region, and can range from just a few, to hundreds or thousands of breeding pairs.) While there has not been research to explain the decline in Riding Mountain, on a global basis, draining of marshes and destruction of other habitats preferred by herons is believed to be the most serious threat facing the species, as the number of herons breeding in a local area is directly related to the amount of feeding habitat. Pesticides may also play a role, as they are suspected of causing reproductive failures and deaths.[88] Population declines can serve as a warning of wider harm to the ecosystem.

Figure 14: Great blue heron trends



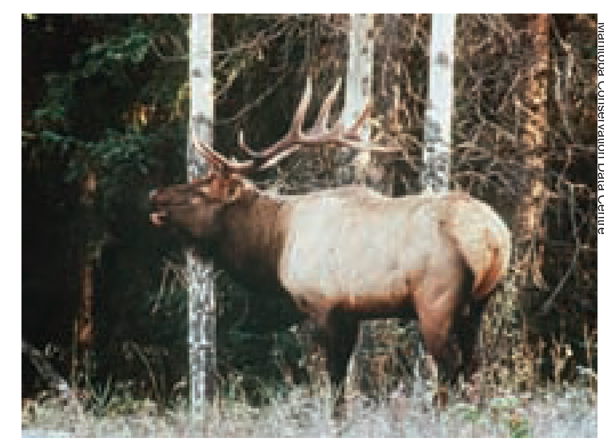
6.2 THE FAUNA

The diversity of habitats found in Riding Mountain National Park is reflected in the approximately 232 bird and 57 mammal species known to occur in the Park.[51] Animal populations are influenced by many things, including climate, natural disturbance cycles (disease, fire) and predator-prey interactions. Since animal diversity is dependent on fully-functioning ecosystems, land clearance and human development are compromising the viability of several species in the region. This may be especially true for animals that require large areas for their feeding and breeding success, such as large carnivores or migrating birds.



Parks Canada

The extensive home ranges of carnivores and other large mammals is a key indicator that the National Park is an integral part of an interconnected greater ecosystem. The alteration of natural habitat in the Riding Mountain region has impacted carnivores such as the gray wolf,[48,50,89] lynx[90] and black bear.[91,92,93,94] Elk and moose populations have also been influenced by human land-use patterns and intervention.[95,96] These ungulates, as well as deer, play an important role in forest dynamics and predator-prey cycles, and have historically travelled throughout the greater ecosystem. Accounts from Anishnabe elders indicate that elk used to migrate along a major route from the Duck Mountains to the Carberry Sandhills.[21] **Map 30** displays the arrangement and quality of ungulate habitat currently found in the Riding Mountain region. Current research studies on elk (dispersal patterns and agriculture interactions) and wolf populations (genetic variability, diet, disease and movement) provide important information about the faunal populations of the Riding Mountain region. (Refer also to Section 4.2 on habitat fragmentation and wolf populations.)



Manitoba Conservation Data Centre

Species of conservation concern

The Manitoba Conservation Data Centre (MB CDC) is a central repository for data on the abundance, location and status of plants and animals in the province. Data is continually being collected, monitored and updated to reflect new and changing information. The MB CDC is closely affiliated with NatureServe, a division of The Nature Conservancy that maintains biological data for all North American Conservation Data Centres and Natural Heritage Programs.

Table 4 in the Maps & Tables section displays the present status of uncommon plants and animals, or species of conservation concern, found in the Riding Mountain Biosphere Reserve. Species are evaluated and ranked by the MB CDC on the basis of their range-wide status (denoted by 'G' for global) and province-wide status (denoted by 'S' for subnational), according to a standardized procedure used by all Conservation Data Centres and Natural Heritage Programs. The numeric rank reflects the relative endangerment of the species, from 1 (very rare) to 5 (demonstrably secure), and are based primarily on the number of global or provincial occurrences, but also take into account information such as the date of collection, degree of habitat threat, geographic distribution patterns, and population sizes and trends. These ranks are used to determine priorities both for further data collection and for protection, and are revised as new information becomes available. (Additional information on the rank definitions can be found in Appendix 1.)

Table 4 also displays information on the number and percent of all recorded occurrences for a given species found in the Riding Mountain Biosphere Reserve. For example, the prairie loggerhead shrike, although observed in the Biosphere Reserve, is more commonly found in more southerly regions of Manitoba. Of the 380 recorded sightings for this species in Manitoba, only one is in the Biosphere Reserve.

The locations of species of conservation concern found in the Biosphere Reserve are displayed in **Map 29**. Although a large number of occurrences are situated within Riding Mountain National Park, several occur throughout the Riding Mountain greater ecosystem. Landowners and government agencies that practice ecologically-sound land stewardship outside of the Park play an important role in the protection of species, their habitats and the natural processes they depend on to survive.

Cooperative beaver management – a success story

Beavers play an important role in the ecosystem, creating wetlands that provide habitat and water sources for a variety of animals, and act as a natural sponge. However, their tenacity and single-mindedness in building dams can cause great frustration for humans living nearby.

For many years, damage to roads, culverts and agricultural lands due to flooding caused by beaver dams was a major and ongoing source of contention for the municipalities surrounding Riding Mountain National


Parks Canada

Park. Large amounts of public and private money, as well as time and energy, were being spent removing beavers and destroying dams.

Creation of the Riding Mountain Region Liaison Committee in 1980 provided a venue for discussion of beaver management and contributed to the formation of the Riding Mountain Biosphere Reserve in 1986. (The Liaison Committee consists of representatives from the councils of the municipalities surrounding the National Park, provincial representatives from Agriculture and Conservation, and federal representatives from Parks Canada.)

These discussions led to research investigating other approaches to control flooding caused by beaver dams. In the late 1990s, staff at Riding Mountain National Park modified two types of water passage devices that could be installed in beaver dams or culverts.

The beaver pond leveler (see photo for Clemson Leveler example) is suitable for both culverts and dams. It allows water to pass through the dam at a rate that prevents flooding and allows water to keep flowing through plugged culverts. The second device, called a beaver deceiver, used for culverts only, consists of a wire fence built out from the upstream end of a culvert. It allows beavers to use the culvert but the fence prevents the beaver from effectively plugging it.

A project by Parks Canada and the Riding Mountain Biosphere Reserve to conduct a large-scale field trial and install the appropriate device in dams and culverts in the municipalities surrounding Riding Mountain National Park, along with several workshops, served to familiarize people with the devices and demonstrate their application. The success of the field trial and improved communication went a long way in turning the debate over beaver dam flooding around the National Park into an example of effective cooperation.


Parks Canada

Clemson Leveler


Parks Canada

Workshop to demonstrate 'beaver deceiver'

Proven Lake Marsh, Important Bird Area

The following information has been provided by the Manitoba Important Bird Area Program.[97]

Proven Lake Wildlife Management Area (WMA) is located south of Riding Mountain National Park, north of the town of Erickson and Rolling River First Nation, within the Rural Municipality of Harrison. About 2,000 ha in size, with a 650 ha wetland at its center, this WMA lies in the heart of some of North America's most productive waterfowl breeding habitat, with numerous lakes, wetlands and prairie potholes attracting large numbers of migrating birds in the spring and fall. Wetlands play a vital role in conservation of prairie soil, water and wildlife, but have been disappearing in the Riding Mountain region at an alarming rate (see Section 5.2).

Donna Danyluk

Proven Lake Marsh

Proven Lake was initially established as a Manitoba Heritage Marsh in 1985 by the provincial government in partnership with Ducks Unlimited Canada, the Manitoba Naturalists Society, Wildlife Habitat Canada and the Manitoba Wildlife Federation. A Heritage Marsh is identified as a wetland with significant value for a diversity of wildlife, including waterfowl, shorebirds and fur-bearing animals and also provides important recreational, economic or educational benefits to people. Proven Lake was subsequently established as a WMA in 1986, and thus has partial protection from mining, logging and hydroelectric development. Surrounding lands are largely privately owned, which has sometimes resulted in conflicts over the control of water levels.

The Important Bird Areas (IBA) program is a global partnership of over 100 countries seeking to identify and protect sites important to the conservation of bird species. The Canadian IBA Program was initiated in 1996 by Bird Studies Canada and the Canadian Nature Federation, and is a key part of the Americas IBA program, which includes the United States, Mexico, and 17 countries in Central and South America. Its goals are to: 1) identify a network of sites that conserve the natural diversity of Canadian bird species; 2) determine the types of protection or stewardship required for each site, and ensure their conservation through partnerships that implement on-the-ground plans; and 3) establish local involvement in site protection and monitoring. **Map 31** shows the locations of designated IBA sites in the Prairie Provinces. The Manitoba IBA program works by building partnerships in local communities to promote long-term bird conservation, as well as provide economic, ecological and educational benefits to Manitoba residents.

Henry Detwiler, Southwest Birders

Black crowned night heron

IBA sites are identified by one or more of the following criteria:

1) sites regularly holding significant numbers of an endangered, threatened, or vulnerable species;

2) sites regularly holding an endemic species, or species with restricted ranges;

3) sites regularly holding an assemblage of species largely restricted to a biome (major region or area of plant or animal life characterized by a prevailing climate); or

4) sites where birds congregate in significant numbers when breeding, in winter, or during migration.

Proven Lake Marsh was designated as an IBA based on the nationally significant numbers of breeding black-crowned night-herons. Approximately 200 nests were observed in 1966 and again in 1996, representing about 4% of the known Canadian population. In addition, large numbers of eared grebes (150 nests recorded in 1996) and Franklin's gulls (800 nests recorded in 1966) nest at Proven Lake, and Canada geese have also recently been nesting. Records from the 1970s show that up to 8,800 American coots and several thousand mallards have been seen on the lake in early fall.[98] Other species that may be observed at Proven Lake include great blue herons, American bitterns, grebes, gulls, hawks, and a variety of ducks.

Several threats have the potential to impact Proven Lake and other wetlands in the region. They can affect the maintenance of wetland structure and function, and the ability of wetlands to support their range of biological diversity, including nesting birds, mammals and invertebrates.

Modern agricultural practices, such as the use of herbicides and pesticides, can have detrimental effects on wildlife in wetlands surrounded by agricultural fields. Conversion of natural habitats to agricultural lands fragments the landscape, reduces the amount of habitat available for wildlife, and affects the function of remaining areas. As well, some wetland areas can dry up when too much water is diverted for agricultural irrigation or other purposes.

Henry Detwiler, Southwest Birders

Eared grebe

Avian botulism outbreaks are a natural occurrence at Proven Lake, and result from "food poisoning" with a neurotoxin produced mostly by the bacterium *Clostridium botulinum*, type C. Despite widespread distribution of type C botulism spores in wetland sediments and in the tissues of aquatic insects, mollusks and vertebrates, outbreaks of avian botulism are sporadic, and occur most often when water levels are low during periods of hot, dry weather. In 2000, an estimated 4,000-5,000 birds died as a result of a botulism outbreak at Proven Lake, including double-crested cormorants, American white pelicans and Canada geese.

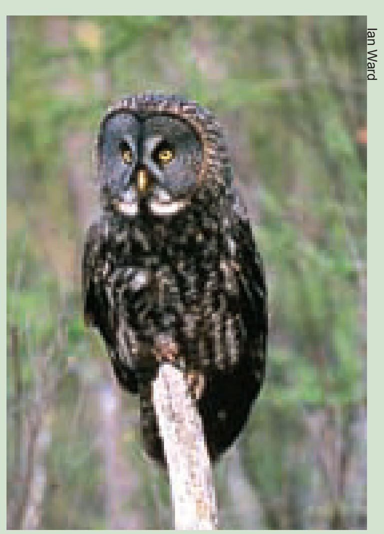
Non-native invasive plant species have the potential to reduce the diversity and alter the functioning of natural ecosystems by displacing native species.[112] Purple loosestrife, found throughout southern Manitoba, presents a potential threat to Proven Lake and other wetland habitats in the region. Other aquatic invasive plants of concern include eurasian water-milfoil and salt cedar.


Charles Pierce, Michigan Wildflowers

Purple loosestrife

Bird diversity in the Riding Mountain region

While the prairie pothole region is known for waterfowl, the mixed forests of Riding Mountain National Park are important and productive habitat for breeding populations of many species of migratory songbirds. Numerous warbler species, including the uncommon Connecticut warbler, breed here along with the western wood-pewee and golden- and ruby-crowned kinglets. The Park is alive with birds in winter as well – boreal chickadees, gray jays, spruce grouse, woodpeckers (including pileated, three-toed and black-backed species) and the much sought-after great gray owl, Manitoba's provincial bird emblem. The diversity of bird species and accessibility of habitats, combined with other wildlife-viewing opportunities, have made the Riding Mountain region a destination for birding and nature tourism.[127]


Ian Ward

Great gray owl

6.3 PROVINCIAL AND FEDERAL REGULATIONS CONCERNING WILDLIFE

Two provincial Acts serve to protect plants and animals in Manitoba.

The Wildlife Act covers matters primarily dealing with wildlife management and research, and protection of property or persons. The Act prohibits activities such as the hunting, killing, capturing, taking, possessing, importing, exporting, buying or selling of wild animals except as permitted by the Act, a regulation or a permit.[99]


Gerry Jones

Short-eared owl

There are currently 10 Order-in-Council regulations under the Act; nine administered by the Wildlife and Ecosystem Protection Branch of Manitoba Conservation, and one by Manitoba Agriculture, Food and Rural Initiatives through the Manitoba Crop Insurance Corporation. These regulations govern such matters as the designation of wildlife lands (e.g., refuges and hunting zones), and revenue collection or disbursement (e.g., royalties and payment of compensation). In addition, 18 ministerial regulations govern matters such as hunting seasons and bag limits, use of vehicles and equipment for hunting, activities that may be undertaken on designated wildlife lands, and keeping of records by fur dealers and taxidermists.[99]

The Endangered Species Act is in place to designate species as threatened, endangered, extirpated or extinct, to ensure the protection and enhance the survival of threatened and endangered species in Manitoba, and enable the reintroduction of extirpated species into the province. This legislation may be applied to any mammal, bird, reptile, amphibian, fish, or plant, living or dead.[99] The Act is binding on the Crown and applies to all lands in Manitoba. The Endangered Species Advisory Committee, which includes individuals with a wide range of experience and knowledge in scientific and natural history, biology and natural resources, advises the Minister of Conservation on the status of species and habitats.[99]

Stewardship refers to the wide range of voluntary actions that people take to care for the environment, and is the key for the protection of habitat and recovery of species at risk.[100]

A species is not protected until it has been declared by regulation under the Act to be threatened, endangered, extirpated or extinct. Then, it is unlawful to kill, injure, possess, disturb or interfere with the species; destroy, disturb or interfere with the habitat of the species; or damage, destroy, obstruct or remove a natural resource on which the species depends for its life and propagation.[99]

Enacted in June 2003, the *Species at Risk Act* (SARA) is the most recent federal law put in place to preserve and protect extirpated, endangered and threatened species on federal lands, aquatic species and migratory birds.[100] SARA is one component of a three-part strategy for the protection of species at risk that also includes the Habitat Stewardship Program and the federal-territorial Accord for the Protection of Species at Risk. The Department of Fisheries and Oceans is responsible for aquatic species at risk, and Environment Canada is responsible for non-aquatic species, including species at risk found in national parks and other protected heritage sites (through Parks Canada), as well as for administration of the Act.[100]

Species assessments are carried out by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), based on the best available scientific, community and Aboriginal knowledge. Rankings designate species as: Extinct, Extirpated, Endangered, Threatened, Special Concern, Not at Risk or Data

Deficient. The committee is currently comprised of 29 appointed voting members from various provincial and territorial government wildlife agencies, 4 federal agencies, wildlife management boards, Aboriginal organizations, universities, and museums. Ongoing monitoring is an important source of information used by COSEWIC when deciding which species should be assessed.[100]

There are 10 species found in or adjacent to the Riding Mountain Biosphere Reserve that are presently listed by COSEWIC as Threatened or of Special Concern (see **Figure 15**). General depictions of the ranges of these species are shown in **Maps 32-41**. Species do not occur throughout these ranges, but are instead found in specific habitats within their range. More detailed descriptions on the biology, habitat requirements, distribution, threats and protection measures for each of these and other COSEWIC-listed species can be obtained from the Canadian Wildlife Service.[101]


Rudolph Koes

Sprague's pipit

The *Species at Risk Act* (SARA) works in combination with several other federal laws to ensure the protection of species and the habitat in which they exist.[102] The *Migratory Birds Convention Act, 1994* is an international agreement to ensure that migratory birds travelling throughout North America will be protected. The *Fisheries Act* is in place to conserve and protect fish and fish habitat in Canadian commercial and recreational fisheries, both freshwater and marine. The law specifies when and how fish may be caught and prohibits actions that are destructive to fish or fish habitat. The *Canada Wildlife Act* gives the federal Minister of the Environment the authority to acquire land for wildlife research, conservation and interpretation, and to establish National Wildlife Areas and marine protected areas. The Act is one way to protect the habitat of SARA-listed species or to respond to emergency situations. The *Wild Animal and Plant Protection and Regulation of International and Interprovincial Trade Act* was enacted to allow Canada to meet its obligations under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The Act protects certain species by controlling the transport of SARA-listed plants and animals and their parts. The *Canadian Environmental Assessment Act* sets out responsibilities and procedures for the environmental assessment of projects that involve the federal government. The goal of the Act is to promote sustainable development, and to find ways to avoid adverse environmental effects.


Dennis Fast

Loggerhead shrike


Dennis Fast

Red-headed woodpecker

Figure 15: COSEWIC-listed species in the Riding Mountain Biosphere Reserve

Map no.	Common Name	Scientific Name	Risk Category	Range	Year of COSEWIC Designation
32	Northern Leopard Frog	*Rana pipiens*	Special Concern	NT AB SK MB	2002
33	Red-headed Woodpecker	*Melanerpes erythrocephalus*	Special Concern	SK MB ON QC	1996
34	Sprague's Pipit	*Anthus spragueii*	Threatened	AB SK MB	2000
35	Monarch	*Danaus plexippus*	Special Concern	BC AB SK MB ON QC NB NS PE	2001
36	Yellow Rail	*Coturnicops noveboracensis*	Special Concern	NT BC AB SK MB ON QC NB	2001
37	Peregrine Falcon anatum subspecies	*Falco peregrinus anatum*	Threatened	YT NT NU BC AB SK MB ON QC NB NS NL	2000
38	Short-eared Owl	*Asio flammeus*	Special Concern	YT NT NU BC AB SK MB ON QC NB NS PE NL	1994
39	Prairie Loggerhead Shrike	*Lanius ludovicianus excubitorides*	Threatened	AB SK MB	1986
40	Chestnut Lamprey	*Ichthyomyzon castaneus*	Special Concern	SK MB	1991
41	Silver Chub	*Macrhybopsis storeriana*	Special Concern	MB ON	2001

As discussed in the previous chapters, the fragmentation of the Riding Mountain greater ecosystem has resulted in the removal of habitat and the alteration of natural disturbance processes, displacing species and threatening their long-term viability. Since habitat loss and degradation are the major threats facing most species,[103] lands and waters must come under conservation management to prevent future losses.[104]

Parks Canada's "Guiding Principles and Operational Policies" mandates an ecosystem-based approach to conservation management of protected heritage areas.[105] Ecosystem-based management "integrates scientific knowledge of ecological relationships within a complex socio-political and values framework toward the general goal of protecting native ecosystem integrity over the long-term."[106] Incorporating science, both the natural and social sciences, should be central to managing parks for ecological integrity and understanding a park's greater ecosystem. Science is necessary to understand the degree of uncertainty and the inherent risks of a decision.[6] Expertise from universities, other federal and provincial agencies and industry will yield important findings about the Riding Mountain greater ecosystem.

Within the aspen parkland ecoregion (see **Map 1**), the Nature Conservancy of Canada (NCC) is using an "ecosystem planning process" to provide a blueprint for conservation action based on both science and experience.[107] This process summarizes species and habitats of conservation concern, identifies threats, develops strategies to abate any threats, and establishes a plan to monitor the success of conservation actions.[107] Ecoregional planning is the first stage in a larger process, and is used to identify sites for conservation projects across the region.[107] For example, NCC has recognized the need for increased conservation efforts between the Riding and Duck Mountains, and has developed a program to focus on this target area (see Section 7.2).

7.1 FIRST NATIONS INVOLVEMENT

An important aspect of managing for ecological integrity is to incorporate the views and expectations of different stakeholders. In addition, First Nations communities have a particularly important role to play in ecosystem management in areas pertaining to park stewardship, natural and cultural resources.[41] Parks Canada appears to be receptive to increased First Nations participation in parks management but action to date has been sporadic, with the exception of co-managed parks such as Wapusk National Park in the Hudson Bay Lowlands. The report of the Panel on the Ecological Integrity of Canada's National Parks states: "A process of healing is needed to develop trust and respect and to facilitate two-way communication and education between Parks Canada and Aboriginal peoples."[6] Parks Canada is embracing "genuine partnerships" in co-management, and has established an Aboriginal Secretariat with a mandate to help all parks develop constructive relationships with First Nations communities.[6]

In the Riding Mountain region, both Parks Canada and adjacent First Nations communities want to develop a synergistic working relationship and implement co-management.[41] There is also the question of protecting sacred sites. As well, by learning about the Riding Mountain Anishnabe traditional land and resource use, Parks Canada staff can gain insight into the traditional knowledge that was once an integral part of managing this area, and through the participation of First Nation people, put into practice available baseline ecological information.[41] Both traditional ecological knowledge and western science can improve understanding of natural systems, and both can be incorporated into parks policies and activities.[6] Better communication of local First Nations perspectives allows both parties to share in the process of ecosystem management.[41]

As noted in Section 3.3, the relationship between Parks Canada and First Nations in the Riding Mountain region remained tense and suspicious from the time of the establishment of the National Park in 1930 until the 1990s. At that time, Keeseekoowenin Ojibway First Nation proposed to Parks Canada that a "Senior Officials Forum" be established to work together to defuse the situation and put into place the mutually-productive relationship that had been established through Treaty No. 2. Parks Canada agreed to the proposal and the Forum began to function.[26]

Based on that success, the Coalition of First Nations With Interests in Riding Mountain National Park was formed so that additional First Nations could become involved. One of the first projects embarked upon was a cooperative arrangement involving the First Nations, Parks Canada and Manitoba Conservation in dealing with the threat of bovine tuberculosis infecting both the wildlife and cattle in the area.[26] Also, to increase Aboriginal workforce participation, Riding Mountain National Park has hired a First Nations employment equity officer.

7.2 FUTURE DIRECTIONS

In the light of past changes that have occurred in the Riding Mountain region, and changes that continue to occur, what actions are required to maintain ecological integrity of the region? How can we meet the needs of the rural economy while meeting the goals of ecological integrity for the National Park?

Conservation initiatives

As mentioned in Section 1.0, the Riding Mountain Biosphere Reserve is a volunteer organization whose mission is "to foster and encourage, through research, information exchange, education and communication, a sustainable regional economy with high biodiversity and landscape values, with Riding Mountain National

Park as a key component." It is an important partner in providing credible information for local landowners to use in land management decisions, in encouraging sustainability of communities within the Biosphere Reserve and providing educational programs.[5]

Several conservation organizations in the Riding Mountain region, including Manitoba Habitat Heritage Corporation, Ducks Unlimited and Nature Conservancy of Canada, provide a range of stewardship incentives including woodlot management, conservation agreements, riparian habitat and water quality protection, wetland conservation and management, and soil and water conservation.[5] Riding Mountain National Park adjoins six Conservation Districts which have a mandate to implement soil and water conservation initiatives. These districts are administered by the Manitoba Department of Water Stewardship but have local boards of directors.[5] Rural municipalities also participate in larger planning districts, administered by the Manitoba Department of Intergovernmental Affairs.

The Parkland Habitat Partnership is an organization created in 2002 by Parks Canada that brings together conservation-minded agencies, organizations and individuals working in the Riding Mountain region including Manitoba Conservation, the Biosphere Reserve Management Committee, researchers, and non-governmental organizations such as the Manitoba Chapter of the Canadian Parks and Wilderness Society (CPAWS Manitoba) and the Nature Conservancy of Canada. CPAWS Manitoba and the Parkland Habitat Partnership promote a vision of conservation for the region along the Manitoba Escarpment from Spruce Woods Provincial Park to Porcupine Mountain Provincial Forest.[5] The intent is to enhance connectivity between protected areas in this region by developing corridors or enhancing habitat to enable wildlife to travel within southwestern Manitoba. It is a broad-scale, long-term vision based on cooperation between willing landowners, non-governmental organizations and government agencies. Further reductions in native habitat through drainage of wetlands, cultivation of native prairie, logging of aspen parkland with subsequent conversion to pasture or cropland, clearing of small woodlots, and conversion of farmland to uses that provide less or no habitat, are not sustainable. All of these actions increase habitat fragmentation, decrease local species diversity and regional biodiversity, and reduce the ability of biological communities to respond to changes in climate.

The Riding Mountain Biosphere Reserve is a natural repository for GIS-based data and information for the region.

Keystone Agricultural Producers has developed the "Alternative Land Use Services" (ALUS) concept in partnership with Delta Waterfowl Foundation. This incentive-based program provides landowners with financial encouragement to care for public environmental resources, including air, water, fish and wildlife, on private land. A report from a seminar held at the 2004 Manitoba Rural Forum describes ALUS as "based on the concept of paying agricultural producers for rendering ecological services that provide environmental benefits to the public at large from public resources on private land."[123]

Planning Districts allow municipalities to work across boundaries to address common areas of concern. There are 45 planning districts in Manitoba. *The Planning Act* is administered by Manitoba Intergovernmental Affairs. Boundaries are based on those of the municipalities involved.

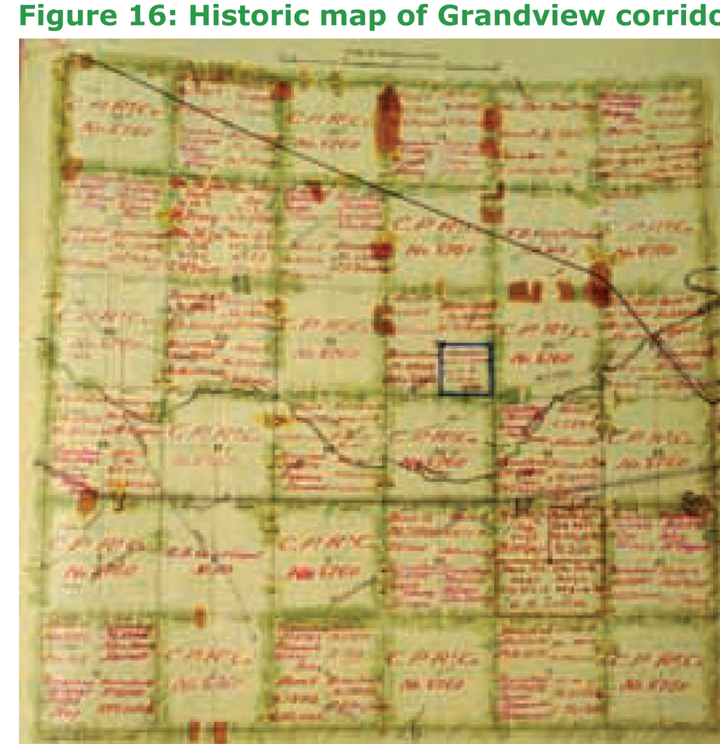
Conservation Districts are concerned with all aspects of watershed management and have boundaries based on watersheds. There are 16 conservation districts in Manitoba as of 2004 (see list in Appendix 2). *The Conservation Districts Act* is administered by Manitoba Water Stewardship. Local conservation district boards are comprised of members of participating municipalities. It is a voluntary program with no regulatory authority. However, they offer a variety of cost-shared programs regarding watershed management to participants.

Use of GIS in conservation-based planning

The use of GIS (Geographic Information Systems) has become the standard for ecosystem-based planning. GIS provides techniques for qualitative and quantitative analysis of landscapes through remotely sensed information (satellite imagery and aerial photography) and other data.[108] These analyses allow planners to determine such things as the degree of habitat fragmentation, the extent and rate of habitat conversion, connectivity to other areas of natural habitat, the movement and arrangement of species and populations, the frequency, distribution and extent of natural disturbance processes, and the potential impacts of management decisions.[108]

Recently, GIS has been used to reconstruct historic landscapes. Through oral histories recounted by elders, GIS was used to illustrate the complex relationship of the Anishnabe people from Waywayseecappo and Rolling River First Nations with their territorial traditional landscape, and how this relationship has changed since European settlement.[21] The Riding Mountain Biosphere Reserve Management Committee is involved in an initiative to reconstruct the Biosphere Reserve with GIS using pre-settlement information from Dominion Land Survey notes and maps from the 1870s and 1880s. Township diagrams from this time contain general notes and depictions along straight lines (transects) about the distribution and types of vegetation and disturbance (beaver dams, flooding, fire). For example, a township map of the Grandview Corridor (Twp 25 Rge 24 west) from 1889 is displayed in **Figure 16**, illustrating the distribution of habitat along each mile line. This information is entered into a GIS database and can then be compared with more recent datasets of the Biosphere Reserve from 1948 (**Map 17**), created by the Riding Mountain Biosphere Reserve Management Committee, and from 1993 (**Map 14**) and 2001 (in progress) by Prairie Farm Rehabilitation Administration and partners.

Figure 16: Historic map of Grandview corridor



Archives of Manitoba [NR 0212/GR 2404/G 10680 Township Plan (Cadastral)]

The Nature Conservancy of Canada is also using historic township data for the aspen parkland ecoregion in southwestern Manitoba.[107] Historic data, especially pre-settlement data, provides an excellent benchmark against which to compare landscape changes as a result of global climate change and human settlement and development, and can help guide restoration strategies (such as prescribed burns).

Increasing GIS capability in the Riding Mountain Biosphere Reserve will ensure an accurate and meaningful approach to conservation and management, and will provide information to landowners and agencies working on the ground. The Biosphere Reserve would be a natural repository for up-to-date GIS-based data for the region, through cooperation and data-sharing arrangements with government and non-government agencies, universities and researchers. The Biosphere Reserve could organize, update and analyze data, and work closely with local Rural Municipalities to give landowners ready access to data, maps and information.

Conservation should be seen as a progressive, iterative and incremental process, continually moving in the direction of long-term goals that are biologically defined.[7]

Figure 17: Conservation agreements held or pending in the Biosphere Reserve as of August, 2003

	Ducks Unlimited Canada		MB Habitat Heritage Corporation		Nature Conservancy of Canada	
Rural Municipality	CAs in place (CAs pending)	Parcels of land owned	CAs in place (CAs pending)	Parcels of land owned	CAs in place (CAs pending)	Parcels of land owned
Clanwilliam		2	1		2	
Dauphin						
Gilbert Plains						
Grandview					(1)	
Harrison		5		1	(1)	
McCreary						
Ochre River						
Park South		2			2 (2)	
Rosedale					(1)	
Rossburn		2				
Shellmouth-Boulton					1	
Shoal Lake	2 (4)	4	6	1		
Silver Creek	1	7	3			
Ste. Rose						
Strathclair	2 (6)	6	3			
Total number (pending)	4 (10)	28	13	2	5 (5)	0
Total acres	998	4,424	2,448	803	1,042 (434)	0

Conservation agreements

Conservation agreements in Manitoba provide a mechanism that allows landowners and conservation agencies to enter into agreements in perpetuity for the protection and enhancement of natural ecosystems, fish and wildlife habitat, and plant or animal species, while enabling the continued use and development of the land by the landowner.[99] Agreements made under the Conservation Agreements Act are binding, and run with the land by way of a caveat filed with the land title certificate. Conservation agreements are tailored to the needs of the landowner and their family.[109] For example, a landowner may want to maintain or manage a small prairie on his/her property, conducting controlled burns or herbicide applications, or harvest firewood from a woodlot in a sustainable manner. These provisions can be written into the agreement with the proviso that there is no break, drain or fill.[109] Conservation agreements are an important tool for protecting large areas of habitat in a cost-effective manner, while not excluding certain land uses by the landowner.[110]

A Conservation Agreements Board, appointed by the Minister of Conservation, provides a forum for discussion about conservation agreements, helps people understand the implications of an agreement, and assists in the resolution of disputes. The Board includes at least one representative from a conservation agency, the government of Manitoba, a municipality or local government district representative, and an agricultural producers' organization.[99]

Three primary agencies are actively promoting the use of conservation agreements for habitat conservation in the Riding Mountain greater ecosystem: Ducks Unlimited Canada, Manitoba Habitat Heritage Corporation, and Nature Conservancy of Canada.[109] **Figure 17** summarizes the number and area of conservation agreements presently held (and pending), and amount of land held by these three agencies in the Riding Mountain Biosphere Reserve as of August, 2003.

Recently there has been a greater effort towards the conservation of forested lands in the Riding Mountain region,[111] as the primary focus until now has been on wetland conservation, particularly by Manitoba Habitat Heritage Corporation and Ducks Unlimited Canada in rural municipalities south of the National Park. The Nature Conservancy of Canada has recently embarked on an initiative to conserve the aspen parkland connecting the Riding and Duck Mountains (see Section 4.2) through conservation agreements and land purchases.[111] Their objective is to secure approximately 9,000 acres of aspen parkland connecting the two mountains in order to provide habitat for wide-ranging species such as the gray wolf, black bear, lynx, moose, elk, white-tailed deer, and migrating waterfowl.[110]

7.3 THE ROLE OF THE CANADIAN PARKS AND WILDERNESS SOCIETY, MANITOBA CHAPTER

The effective management of natural and human-impacted ecosystems requires accurate, regionally-specific information. The Canadian Parks and Wilderness Society (CPAWS) supports open planning and management processes, where all parties have full access to relevant information. Too often, information useful for land-use planning and decisions is not readily available to landowners, rural agencies and others who wish to participate in park management planning, regional planning or other public consultations. Information may be buried in government files,

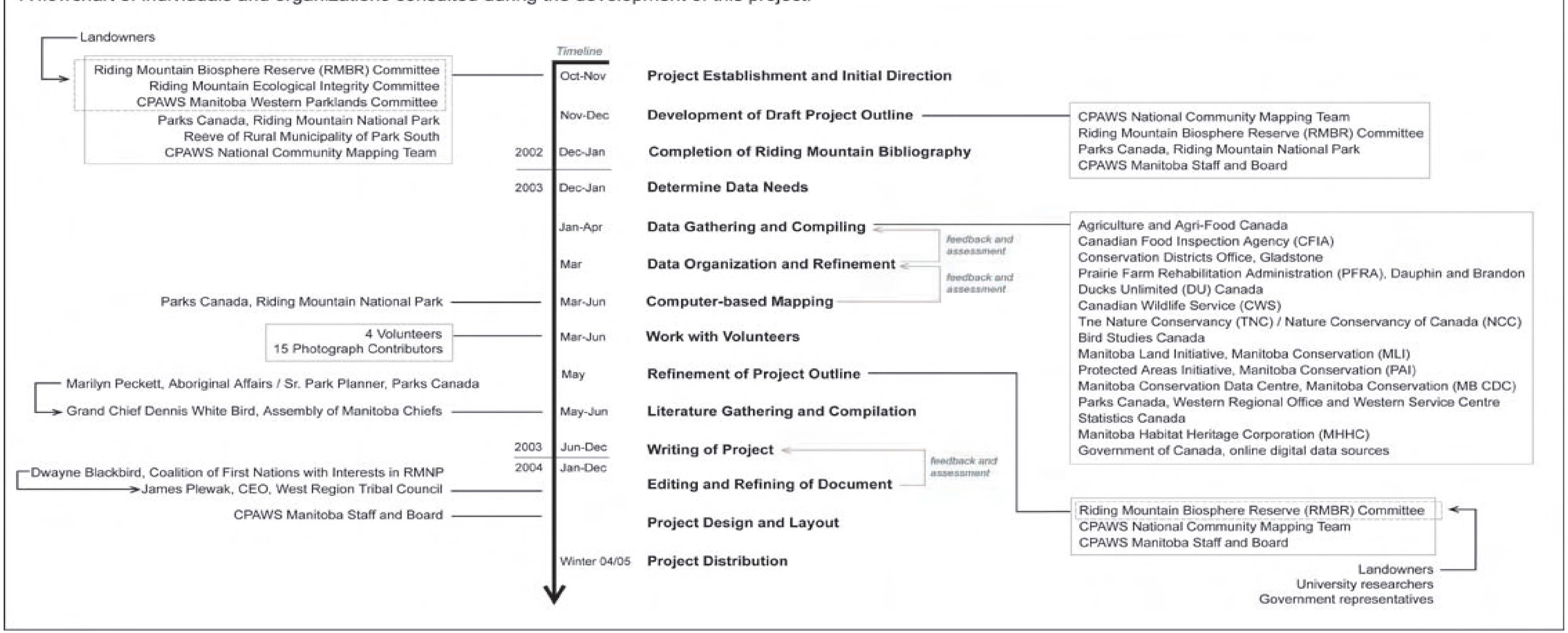
The basis of good planning and management is good information.

consultants' reports, or in university libraries. Lack of relevant data should never be a limiting factor for landowners wanting to make the best decisions possible for their future and the future integrity of surrounding natural ecosystems.

CPAWS has a role to play in providing information on planning and management issues that impact Manitoba's parks and natural ecosystems, and facilitating communication between individuals and groups through the open sharing and dissemination of information. CPAWS is also working to become increasingly more informed on issues affecting First Nation communities.

In determining the most useful information to include in this project, consultations took place with private organizations, individuals and government agencies. The consultation flowchart in **Figure 18** shows how this project evolved and the involvement of participants. Feedback on this project will be collected, and the effectiveness of this community approach as a conservation tool will be assessed. By being available to local communities and increasing awareness about the ecology of the Riding Mountain Biosphere Reserve, we hope this project will encourage interested individuals to participate in land-use decision processes and, in turn, contribute to the maintenance and restoration of ecological integrity in the region.

Figure 18: Riding Mountain Ecosystem Community Atlas - project flowchart



A flowchart of individuals and organizations consulted during the development of this project.

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MAPS & TABLES

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<http://res2.agr.ca/brandon/>

Canada Land Inventory, Canada Centre for Remote Sensing, Natural Resources Canada
<http://ess.nrcan.gc.ca/prod_e.php?c=204_e>
<http://geogratis.cgdi.gc.ca/CLI/frames.html>

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Ecological Stratification Working Group, A National Ecological Framework for Canada
<http://sis.agr.gc.ca/cansis/nsdb/ecostrat/intro.html>
Pdf available at: <http://sis.agr.gc.ca/cansis/publications/ecostrat/intro.html>

Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch
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Table 1

Soil summary statistics for each Rural Municipality in the Riding Mountain Biosphere Reserve (Data provided by Agriculture and Agri-food Canada, 2003. Reproduced with permission).

Rural Municipality	Clanwilliam	Dauphin	Gilb. Plains	Grandview	Harrison	McCreary	Ochre River	Park South	Rosedale	Rossburn	Shellmouth	Boulton	Shoal Lake	Silver Creek	Ste Rose	Strathclair
Hectares sampled	38,669	152,879	105,419	120,624	58,038	52,850	53,733	53,513	87,109	77,587	58,126	58,163	58,038	58,155	63,346	57,972
Slope (percent)																
0-2	4,308	120,813	69,523	43,913	3,575	39,201	36,094	4,191	22,317	29	11,911	5,342	653	5,111	48,731	273
2-5	8,702	12,146	16,140	21,878	6,747	12,540	9,609	12,141	23,572	18,378	29,075	9,787	21,821	28,712	14,023	11,526
5-9	17,792	712	661	12,330	27,584	0	2,602	16,257	15,742	27,408	3,384	26,686	34,233	22,238	0	36,471
9-15	3,554	1,282	0	1,147	11,558	405	925	15,351	3,272	25,657	1,775	497	227	569	0	6,712
15-30	178	2,693	0	873	1,490	131	0	2,335	991	129	0	0	0	203	0	80
>30	61	1,632	4,822	5,102	2,704	306	359	362	6,644	3,089	8,978	972	0	194	0	1,384
Unclassified	2,173	13,385	14,003	34,284	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Water	1,901	214	271	1,096	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441
Drainage[1]																
Very Poor	2,185	2,777	2,536	5,254	6,688	4,303	3,995	9,229	361	6,522	195	3,957	0	78	4,013	884
Poor	3,626	5,460	2,564	451	2,607	7,568	6,097	1,945	2,399	6,798	2,590	1,054	11,418	10,309	5,840	5,704
Poor, drained	0	1,905	1,446	0	0	3,739	810	0	575	0	0	0	0	0	1,104	0
Imperfect	26	103,286	20,384	3,650	451	23,551	24,827	714	13,675	215	1,970	310	0	0	37,777	0
Well	27,935	22,952	59,327	0	41,454	12,821	11,260	30,704	44,946	57,506	37,658	36,628	45,517	46,446	13,185	48,459
Rapid	823	2,570	4,890	69,950	2,459	600	2,478	8,046	10,584	4,790	12,710	1,334	0	194	836	1,399
Rock	0	0	0	5,939	0	0	0	0	0	0	0	0	0	0	0	0
Marsh	0	328	0	0	0	0	123	0	0	0	0	0	0	0	0	0
Unclassified	2,173	13,385	14,003	34,284	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Water	1,901	214	271	1,096	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441
Management Considerations[1]																
Fine Texture	1,650	22,593	9,533	4,861	0	6,979	4,058	0	4,321	0	724	185	0	0	0	0
Fine Texture and Wetness	114	825	463	208	0	1,333	188	0	0	0	17	0	0	0	0	0
Fine Texture and Topography	2,497	0	194	6,531	0	0	0	0	56	0	0	43	0	0	0	0
Medium Texture	6,156	70,923	51,006	51,496	4,826	25,927	23,903	4,735	32,741	14,661	33,793	9,919	18,252	26,487	45,579	9,606
Coarse Texture	1,662	28,972	18,578	3,730	1,013	3,225	6,717	5,897	6,270	415	3,733	13	0	0	6,218	171
Coarse Texture and Wetness	120	1,449	1,262	0	0	603	1,804	610	431	30	347	0	0	0	968	0
Coarse Texture and Topography	664	0	0	39	1,085	0	0	7,697	1,080	2,120	0	362	0	0	0	0
Topography	16,493	6,135	5,289	12,883	37,440	711	3,887	21,163	22,298	45,327	14,066	27,750	27,265	20,152	0	40,080
Bedrock	0	186	0	0	0	131	0	0	2,479	0	0	0	0	0	0	0
Wetness	3,054	7,193	4,456	2,265	2,607	13,585	7,569	1,640	2,863	6,754	2,421	1,632	11,418	10,309	8,773	5,704
Organic	2,185	677	364	3,231	6,688	90	1,341	8,895	0	6,522	0	3,379	0	78	1,216	884
Marsh	0	328	0	0	0	0	123	0	0	0	0	0	0	0	0	0
Unclassified	2,173	13,385	14,003	34,284	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Water	1,901	214	271	1,096	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441
Agricultural Capability[1]																
1	0	2,619	4,217	6,722	0	0	0	0	4,848	0	0	0	0	0	0	0
2	4,888	63,126	50,658	44,958	3,666	16,535	12,503	1,236	20,602	11,642	19,210	9,381	18,252	25,929	27,498	9,508
3	19,750	46,276	23,729	21,035	26,954	20,645	19,820	16,884	24,138	25,292	18,621	27,422	27,041	19,902	21,299	32,794
4	3,147	8,656	407	13	10,038	1,740	3,575	11,329	7,773	20,711	1,798	135	224	512	858	6,113
5	4,565	13,293	4,777	2,797	3,874	9,045	9,173	11,616	8,202	8,598	6,322	1,396	11,418	10,412	9,086	5,764
6	40	4,040	6,995	6,488	2,434	4,520	3,013	443	6,925	2,255	9,173	1,420	0	194	2,797	1,384
7	22	593	0	0	5	0	164	234	51	809	0	972	0	0	0	0
Unclassified	2,173	13,385	14,003	34,189	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Organic	1,901	677	271	1,191	6,688	90	1,341	8,895	0	6,523	0	3,379	0	78	1,216	884
Water	2,184	152,879	364	3,231	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441
Irrigation Suitability																
Excellent	0	0	0	0	0	0	0	0	1,580	0	0	0	0	0	0	0
Good	7,246	23,284	59,337	52,945	5,240	2,584	2,211	7,756	24,903	14,535	32,476	9,807	18,252	26,487	16,023	9,606
Fair	16,403	74,217	8,645	8,449	35,185	25,848	30,132	20,088	24,541	43,111	7,129	27,088	27,265	19,856	31,977	38,653
Poor	8,762	41,101	22,801	20,618	6,366	24,062	15,905	13,899	21,515	11,663	15,518	3,010	11,418	10,605	13,538	7,303
Organic	2,185	677	364	3,231	6,688	90	1,341	8,895	0	6,522	0	3,379	0	78	1,216	884
Unclassified	2,173	13,385	14,003	34,189	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Water	1,901	214	271	1,191	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441
Potential Environmental Impacts Under Irrigation[1]																
Minimal	1,157	12,349	11,898	4,930	689	9,422	1,650	117	3,745	0	0	20	0	0	1,104	0
Low	7,815	88,855	55,706	55,035	4,645	36,008	29,013	5,646	27,853	14,476	33,304	11,432	22,474	33,593	36,510	10,414
Moderate	17,388	19,736	661	12,291	25,562	3,561	9,489	10,126	22,555	28,702	6,069	26,984	34,233	22,332	18,447	36,386
High	6,050	17,662	22,518	10,700	16,074	3,503	8,096	25,852	18,387	26,131	15,750	1,470	227	1,024	5,477	8,762
Organic	2,185	677	364	2,288	6,688	90	1,341	8,895	0	6,522	0	3,379	0	78	1,216	884
Unclassified	2,173	13,385	14,003	34,189	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Water	1,901	214	271	1,191	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441
Water Erosion Risk																
Negligible	8,196	62,830	14,374	8,098	8,931	29,285	23,911	16,671	16,761	14,087	6,552	5,123	11,531	10,475	27,273	7,185
Low	2,135	36,868	9,018	5,425	961	14,351	15,490	5,421	8,792	2,008	1,798	488	506	2,578	14,406	0
Moderate	1,195	2,577	38,743	25,015	3,647	8,530	6,189	3,117	21,772	8,808	14,884	108	20,842	23,317	21,062	7,009
High	5,286	3,290	10,377	15,607	6,261	37	113	4,089	5,142	11,374	16,161	8,706	23,690	7,119	13	27,121
Severe	17,784	10,545	18,635	31,102	33,858	380	3,887	21,341	20,071	39,553	15,728	28,859	365	13,538	0	15,131
Unclassified	2,173	13,385	114,003	34,281	40	0	4,114	6	14,257	18	0	12,037	99	0	94	85
Water	1,901	214	271	1,096	4,339	267	30	2,870	314	1,738	3,003	2,842	1,005	1,128	498	1,441

[1] Please refer to Appendix 1 for further information.

N

2001 community profile summary statistics for rural (non-urban) populations in the Riding Mountain Biosphere Reserve

(Data provided by Statistics Canada, 2003. Reproduced with permission).

Rural Municipality	Clanwilliam		Dauphin		Gilbert Plains		Grandview		Harrison		McCreary		Ochre River		Park South		Rosedale		Rossburn		Sh-Boulton		Shoal Lake		Silver Creek	
General Characteristics																										
Population in 2001	467		2,273		862		839		837		525		952		889		1,598		524		946		578		532	
Population in 1996	470		2,488		976		904		894		582		980		961		1,644		625		1,074		621		567	
Population density per square kilometer	1.3		1.5		0.8		0.7		1.8		1		1.8		1.8		1.8		0.8		0.9		1		1	
Land area (square kilometers)	354.01		1,516.11		1,045.51		1,155.12		476.75		522.69		535.59		500.85		865.58		679.29		1,095.07		568.17		525.43	
Total private dwellings	537		1,009		364		369		683		226		524		1,056		600		310		490		422		287	
Total families	145		665		255		255		255		160		295		270		395		140		290		150		160	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Age Characteristics																										
0-4	10	10	50	45	35	25	15	30	10	10	15	10	25	25	10	15	50	50	15	10	25	30	15	15	20	15
5-14	25	20	160	125	65	50	45	50	35	55	40	30	65	65	50	55	170	110	40	35	60	65	40	30	45	35
15-19	20	20	100	100	35	45	35	40	20	15	20	25	30	30	25	20	70	55	20	15	30	30	25	20	25	15
20-24	10	5	60	60	20	15	20	30	10	10	15	15	25	20	20	15	45	20	10	5	30	20	15	15	15	5
25-44	55	60	270	265	115	105	100	95	95	75	55	55	105	120	115	105	205	195	65	60	130	110	80	60	70	70
45-54	45	40	245	210	80	70	95	80	45	60	65	45	65	80	70	70	105	105	45	45	70	70	40	35	40	40
55-64	35	30	155	125	60	35	65	40	60	60	35	30	70	50	75	75	100	85	50	40	75	50	30	30	40	20
65-74	35	15	100	70	30	25	45	30	70	65	25	15	55	40	65	45	65	55	30	20	50	35	30	30	25	20
75-84	15	15	65	45	20	10	15	10	40	60	15	15	35	30	35	30	40	45	15	10	20	20	20	30	15	20
85+	0	0	10	15	5	5	0	5	15	25	0	0	5	15	5	5	10	15	0	5	5	15	5	10	0	5
Total - all persons[1]	240	225	1,215	1,060	465	395	435	405	405	435	285	240	480	470	465	420	860	740	280	240	500	450	300	275	280	250
Median age of population	46.3	42.6	43.2	42.1	40.8	38.6	45.4	40.0	50.6	54.4	45.2	40.3	42.4	41.3	47.1	46.5	35.9	38.7	45.1	43.5	41.8	41.4	40.4	44.7	38.9	39.8
Immigration Characteristics																										
Canadian-born population[2]	265	200	1,145	1,055	460	380	420	395	390	370	280	215	490	425	425	370	790	705	270	220	480	455	300	265	270	250
Foreign-born population[3]	0	0	45	30	10	15	0	10	10	35	0	10	20	15	35	55	60	20	10	0	25	15	10	0	15	0
Immigrated before 1991	0	0	20	15	10	0	0	10	15	15	0	10	0	15	10	0	60	15	0	0	20	10	0	10	15	0
Immigrated between 1991 and 2001[4]	0	0	25	20	0	15	0	0	0	15	0	0	10	0	25	50	0	0	0	0	0	0	0	0	0	0
Aboriginal Population																										
Aboriginal identity population[5]	15	15	25	25	10	20	0	15	10	0	30	20	75	60	25	20	10	0	0	0	0	30	0	0	10	15
Non-aboriginal population	250	185	1,165	1,065	460	380	425	390	395	405	250	210	435	380	435	400	840	720	275	220	505	440	305	270	280	235
Earnings																										
All persons with earnings (counts)[6]	200	175	795	640	265	165	320	265	245	235	170	155	300	255	275	225	460	300	195	125	355	265	185	150	185	130
Average earnings (all persons with earnings)	$19,133	$13,727	$25,377	$19,565	$7,189	$12,537	$19,866	$25,629	$18,600	$22,653	$21,195	$12,135	$23,786	$13,940	$21,523	$25,435	$21,365	$14,304	$10,905	$9,665	$22,902	$15,854	$23,683	$17,034	$17,722	$15,283
Worked full year, full time[7]	165	55	500	325	200	60	220	130	120	130	90	60	130	100	125	100	290	155	140	55	235	115	95	30	105	55
Average earnings (worked full year, full time)	$19,366	$16,987	$28,591	$22,693	$5,739	$14,339	$24,044	$34,077	$18,823	$31,068	$31,243	$16,754	$28,285	$16,213	$28,980	$39,567	$24,707	$18,676	$11,296	$10,879	$20,747	$18,631	$26,488	$20,927	$26,272	$20,261
Persons 15 years of age and older with income[8]	415		1,810		625		655		705		440		745		720		1,065		395		785		475		420	
Median total income of people greater than 15 years[9]	$13,971		$19,087		$12,824		$18,512		$14,390		$12,366		$12,829		$16,060		$14,915		$13,009		$16,281		$18,393		$13,986	
% composition of income = earnings[10]	80.1		76.6		50.0		84.6		64.9		69.6		65.0		65.5		71.4		58.2		74.3		68.0		72.2	
% composition of income = government transfers	12.0		13.4		32.8		11.5		22.2		21.2		16.7		16.3		20.4		21.9		18.6		20.3		23.7	
% composition of income = other	7.9		10.0		16.9		4.0		12.9		9.1		19.0		18.2		8.3		19.5		7.0		12.1		4.4	
Place of Work Status[11]																										
Employed labour force 15 years and over[12]	190	155	735	615	285	200	315	250	210	215	185	135	275	215	275	175	490	335	205	120	355	245	185	140	175	125
Worked at home	100	45	280	135	180	70	185	55	90	55	125	50	125	55	100	35	185	130	130	50	195	120	70	45	85	40
Worked outside Canada	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0
No fixed workplace address	20	0	95	30	15	20	40	15	30	15	15	0	50	10	35	0	55	30	20	0	60	0	30	10	0	0
Worked at usual place	75	105	350	445	95	105	95	180	90	145	40	85	90	155	140	140	245	170	50	75	95	125	80	85	85	85
Mode of Transportation to Work[13]																										
Total - all modes	90	105	450	475	110	125	135	190	120	160	55	90	145	160	175	140	300	205	70	75	155	130	115	95	90	80
Car, truck, van, as driver	85	105	430	440	80	115	110	175	95	110	35	80	135	150	115	110	270	175	60	55	130	110	95	80	70	70
Car, truck, van, as passenger	10	0	10	30	10	10	10	10	0	10	10	0	10	15	25	15	20	15	10	15	10	0	0	10	0	0
Public transit	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Walked or bicycled	0	0	0	0	15	0	15	10	10	35	10	10	0	0	15	15	15	15	0	0	0	15	20	0	15	0
Other methods	0	0	15	0	0	0	0	0	10	0	10	0	0	0	15	0	0	0	0	0	10	0	0	0	0	0
Persons Reporting Hours of Unpaid Work[14]																										
Unpaid work	210	180	925	835	335	280	345	315	310	335	205	210	325	340	355	330	555	545	230	170	390	360	220	230	220	195
Unpaid housework[15]	210	185	905	835	325	275	340	320	305	330	205	210	325	340	350	325	540	545	220	170	390	360	225	230	210	195
Looking after children, without pay[16]	65	65	300	355	140	160	120	135	75	85	70	85	80	115	95	105	200	265	55	80	95	140	90	75	65	95
Unpaid care or assistance to seniors[17]	30	40	225	260	70	100	60	55	95	100	90	105	40	90	70	65	160	175	50	45	45	70	45	70	30	55
Labour Force Indicators																										
Participation rate[18]	84.4	89.2	75.9	73.4	83.1	67.8	91.5	78.8	63.8	61.6	76.0	70.5	76.9	59.0	76.9	53.6	78.0	55.5	85.4	73.5	86.7	67.1	75.5	63.0	80.4	62.5
Employment rate[19]	84.4	83.8	73.9	69.5	80.3	67.8	90.1	74.2	60.9	57.5	72.0	61.4	70.5	55.1	70.5	50.7	77.2	56.3	83.3	73.5	84.3	64.5	75.5	60.9	76.1	62.5
Under-employed rate[20]	0.0	6.1	2.6	5.4	0.0	0.0	3.1	5.8	4.5	4.4	5.3	12.9	8.3	4.3	8.3	5.4	2.0	0.0	0.0	0.0	4.2	3.9	0.0	0.0	5.4	0.0
Industry[21]																										
Total - Experienced labour force[22]	190	170	755	640	290	200	325	265	220	225	190	155	300	230	300	185	495	335	200	125	355	250	185	145	185	125
Agricultural and other resource-based industries	80	25	310	85	210	85	180	40	85	50	130	55	120	50	90	20	240	135	130	40	230	85	90	20	115	45
Manufacturing and construction industries	30	20	140	0	15	10	40	0	25	0	20	10	40	10	50	0	120	25	25	10	40	15	10	10	10	10
Wholesale and retail trade	10	10	75	75	30	15	35	50	25	25	10	15	35	30	15	15	55	25	10	20	15	20	10	20	10	0
Finance and real estate	0	10	15	55	10	10	10	25	15	10	0	0	10	10	0	15	0	10	0	0	0	20	0	10	0	15
Health and education	10	35	50	205	0	65	15	125	0	80	0	60	35	80	30	50	25	95	10	35	10	45	25	50	0	15
Business services	30	15	85	70	10	20	25	0	25	20	10	0	45	15	20	0	45	10	15	0	40	0	30	25	25	10
Other	30	55	80	145	15	10	25	25	50	35	25	15	25	45	90	80	10	30	10	15	30	60	15	15	30	30
Occupations[23]																										
Total - Experienced labour force	195	165	755	640	285	200	320	265	220	225	190	150	305	225	300	180	490	335	205	125	355	250	185	145	185	125
Management	10	10	70	45	0	0	40	10	25	25	0	0	10	10	30	15	25	30	0	10	10	10	10	0	0	0
Business, finance and administration	15	30	35	170	15	35	10	65	0	40	0	25	10	40	0	45	0	35	0	10	0	50	0	40	0	30
Natural and applied sciences and related	10	0	65	0	10	0	0	0	0	0	15	0	15	0	25	0	10	10	0	0	0	10	0	0	10	0
Health	0	10	20	65	0	30	0	60	0	35	0	25	10	20	0	25	10	20	0	10	0	15	10	25	0	10
Social science, education, government and religion	0	15	15	40	0	10	0	25	10	20	0	25	15	30	25	15	15	35	0	10	0	15	15	10	0	0
Art, culture, recreation and sport	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	10	0	0	0	0	0	0	0	10
Sales and service	10	60	50	220	25	55	0	50	25	45	0	30	45	75	35	65	15	55	15	40	10	70	0	50	20	50
Trades, transport, equipment operators and related	75	0	200	15	40	0	90	10	55	10	30	0	90	0	55	0	130	0	50	0	60	0	55	10	40	0
Unique to primary industry	75	20	280	80	190	65	165	35	95	40	135	40	115	45	115	15	245	130	125	40	235	75	95	15	120	30
Unique to processing, manufacturing and utilities	0	15	20	10	10	0	10	10	10	0	10	0	0	0	10	0	50	20	0	0	25	0	0	0	0	0

Table 2 (cont'd)

Rural Municipality	Ste Rose		Strathclair	
General Characteristics				
Population in 2001	895		892	
Population in 1996	944		1,026	
Population density per square kilometer	1.4		1.7	
Land area (square kilometers)	626.03		539.95	
Total private dwellings	338		576	
Total families	270		250	
	Male	Female	Male	Female
Age Characteristics [1]				
0-4	30	25	20	15
5-14	55	55	50	55
15-19	40	25	30	30
20-24	35	20	25	15
25-44	120	115	85	80
45-54	80	65	95	85
55-64	60	45	40	50
65-74	35	35	55	65
75-84	20	25	40	45
85+	5	5	15	20
Total - all persons	480	420	445	445
Median age of population	40.1	42.0	46.8	48.5
Immigration Characteristics				
Canadian-born population [2]	445	410	375	425
Foreign-born population [3]	10	0	40	50
Immigrated before 1991	0	10	15	15
Immigrated between 1991 and 2001 [4]	0	0	25	40
Aboriginal Population				
Aboriginal identity population [5]	150	140	10	25
Non-aboriginal population	300	275	405	445
Earnings				
All persons with earnings (counts) [6]	280	270	235	190
Average earnings (all persons with earnings)	$22,731	$18,655	$17,465	$17,656
Worked full year, full time [7]	165	135	120	105
Average earnings (worked full year, full time)	$24,740	$21,996	$23,965	$22,419
Persons 15 years of age and older with income [8]	685		705	
Median total income of people greater than 15 years [9]	$16,057		$15,012	
% composition of income = earnings [10]	77.6		54.3	
% composition of income = government transfers	15.0		29.6	
% composition of income = other	7.5		16.4	
Place of Work Status [11]				
Employed labour force 15 years and over [12]	235	255	200	170
Worked at home	120	65	120	50
Worked outside Canada	0	0	0	0
No fixed workplace address	30	0	15	0
Worked at usual place	90	180	70	125
Mode of Transportation to Work [13]				
Total - all modes	120	190	85	125
Car, truck, van, as driver	95	135	65	100
Car, truck, van, as passenger	0	20	0	15
Public transit	0	0	10	0
Walked or bicycled	25	30	10	15
Other methods	0	0	0	0
Persons Reporting Hours of Unpaid Work [14]				
Unpaid work	320	345	320	325
Unpaid housework [15]	315	340	315	325
Looking after children, without pay [16]	120	170	100	145
Unpaid care or assistance to seniors [17]	80	110	105	115
Labour Force Indicators				
Participation rate [18]	73.6	74.3	62.5	48.0
Employment rate [19]	66.7	71.4	56.9	45.3
Under-employed rate [20]	13.2	3.8	8.9	5.6
Industry [21]				
Total - Experienced labour force [22]	270	260	225	175
Agricultural and other resource-based industries	105	45	120	35
Manufacturing and construction industries	50	0	25	10
Wholesale and retail trade	25	35	25	50
Finance and real estate	10	10	10	10
Health and education	30	145	10	30
Business services	20	20	25	15
Other	30	10	15	30
Occupations [23]				
Total - Experienced labour force	270	260	220	170
Management	0	15	10	0
Business, finance and administration	10	45	10	55
Natural and applied sciences and related	10	0	0	0
Health	10	50	10	15
Social science, education, government and religion	10	15	0	0
Art, culture, recreation and sport	0	0	0	10
Sales and service	55	85	20	55
Trades, transport, equipment operators and related	75	10	55	10
Unique to primary industry	100	45	120	35
Unique to processing, manufacturing and utilities	10	0	0	0

Footnotes found in the table (as defined by Statistics Canada, 2003):

1 Refers to the age at last birthday (as of the census reference date, May 15, 2001). **Please note that population totals may not always add properly, as a rounding error has been incorporated into all numerical values to preserve confidentiality.**

2 Includes persons born in Canada as well as a small number of persons born outside Canada who are Canadian citizens by birth.

3 This population is also referred to as the immigrant population, which is defined as persons who are, or have ever been, landed immigrants in Canada.

4 Includes data up to May 15, 2001.

5 This is a grouping of the total population into non-Aboriginal or Aboriginal population, with Aboriginal persons further divided into Aboriginal groups, based on their responses to three questions on the 2001 Census form. Included in the Aboriginal population are those persons who reported identifying with at least one Aboriginal group, that is, North American Indian, Metis or Inuit, and/or who reported being a Treaty Indian or a Registered Indian, as defined by the Indian Act of Canada, and/or who reported they were members of an Indian Band or First Nation.

6 Refers to total income received by a persons 15 years of age and over who received wages and salaries, net income from a non-farm unincorporated business and/or professional practice, and/or net farm self-employment income during calendar year 2000, who reported non-zero earnings.

7 The term full-year full-time workers refers to persons 15 years of age and over (excluding institutional residents) who worked 49-52 weeks (mostly full time) in 2000 for pay or in self-employment.

8 Refers to the total money income received during calendar year 2000 by persons 15 years of age and over.

9 Refers to the median total income of persons 15 years of age and over reported for persons with income.

10 The percentages shown in tables providing the composition of total income are based upon aggregate source amounts (for example, employment income, government transfer payments or other income) that are generated, rounded and subjected to independent suppression for confidentiality reasons prior to calculation. Due to this calculation method, the sum of the percentages may not add to 100.0%.

11 Classification of people aged 15 or over who worked at some point between January 1, 2000 and May 15, 2001 (Census Day), according to whether they worked at home, worked outside Canada, had no fixed workplace address, or worked at a specific address.

12 Persons who, during the week (Sunday to Saturday) prior to Census Day (May 15, 2001): (a) did any work at all for pay or in self-employment or without pay in a family farm, business or professional practice; (b) were absent from their job or business, with or without pay, for the entire week because of a vacation, an illness, a labour dispute at their place of work, or any other reasons.

13 Refers to the mode of transportation to work of non-institutional residents 15 years of age and over who worked at some time since January 1, 2000. Persons who indicate that they either had no fixed workplace address, or specified a usual workplace address, are asked to identify the mode of transportation they most frequently use to commute from home to work.

14 Includes all persons reporting hours of unpaid housework; hours looking after children, without pay; and hours of unpaid care or assistance to seniors.

15 Refers to the number of persons reporting hours of unpaid housework, yard work or home maintenance in the week (Sunday to Saturday) prior to Census Day (May 15, 2001). Unpaid housework includes work for one's own household or for the household of others. Data are available for persons 15 years of age and over, excluding institutional residents.

16 Refers to the number of persons reporting hours spent looking after their own or someone else's children, without pay, in the week (Sunday to Saturday) prior to Census Day (May 15, 2001). Data are available for persons 15 years of age and over, excluding institutional residents.

17 Refers to the number of persons reporting hours spent providing unpaid care or assistance to seniors in the week (Sunday to Saturday) prior to Census Day (May 15, 2001). Data are available for persons 15 years of age and over, excluding institutional residents.

18 Refers to the labour force in the week (Sunday to Saturday) prior to Census Day (May 15, 2001), expressed as a percentage of the population 15 years of age and over.

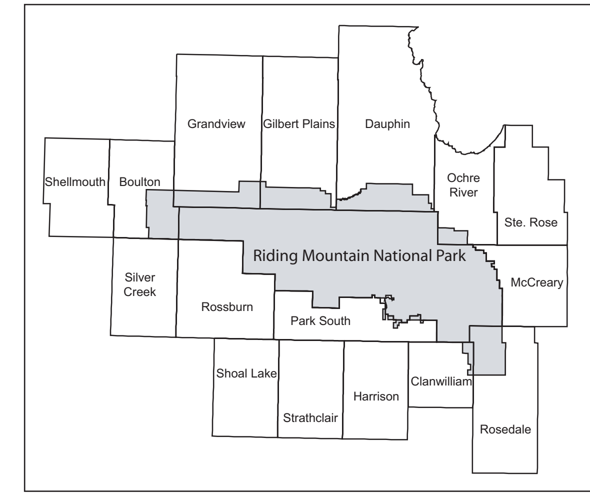
19 Refers to the number of persons employed in the week (Sunday to Saturday) prior to Census Day (May 15, 2001), expressed as a percentage of the total population 15 years of age and over.

20 Refers to the unemployed expressed as a percentage of the labour force in the week (Sunday to Saturday) prior to Census Day (May 15, 2001).

21 The North American Industry Classification System (NAICS) is a classification system developed under the North American Free Trade Agreement (NAFTA) by the statistical agencies of Canada, Mexico and the United States. It is designed to produce industry statistics that are comparable among the three countries by providing common definitions of their industrial structure. In Canada, the NAICS replaces the 1980 Standard Industrial Classification (1980 SIC) used to code industry data in the 1986, 1991 and 1996 Censuses.

22 Refers to persons 15 years and over, excluding institutional residents, who were employed or unemployed during the week (Sunday to Saturday) prior to Census Day, and who had last worked for pay or in self-employment in either 2000 or 2001.

23 The 2001 National Occupational Classification for Statistics (2001 NOC-S) is a revision of the 1991 Standard Occupational Classification (1991 SOC). The 1991 SOC was used to code occupation data from the 1991 and 1996 Censuses.



Wetland summary statistics for each Rural Municipality in the Riding Mountain Biosphere Reserve (Data provided by Ducks Unlimited, 2003. Reproduced with permission).

	Clanwilliam	Dauphin	Gilb. Plains	Grandview	Harrison	McCreary	Ochre River	Park South	Rosedale	Rossburn	Sh-Boulton	Shoal Lake	Silver Creek	Ste Rose	Strathclair
Quarter sections sampled	544	2,008	1,356	1,568	864	887	739	803	1,080	1,152	1,528	864	864	944	864
Total area sampled (acres)	90,460	331,960	225,381	260,685	143,423	130,648	122,891	133,947	179,293	191,676	254,085	143,512	143,745	156,558	143,422
Total Wetland Count															
Range of values[1]	0 - 29	0 - 14	0 - 11	0 - 10	0 - 29	0 - 12	0 - 10	0 - 30	0 - 24	0 - 35	0 - 24	0 - 28	0 - 34	0 - 16	0 - 26
Sum[2]	4,743	1,252	986	1,666	7,015	1,659	668	6,616	2,043	10,692	4,624	9,362	5,876	1,044	8,724
Per sq mile[3]	34.9	2.5	2.9	4.3	32.5	8.4	3.6	33.0	7.6	37.1	12.1	43.3	27.2	4.4	40.4
Average[4] ± Stdev	8.7 ± 4.9	0.6 ± 1.3	0.7 ± 1.4	1.1 ± 1.7	8.1 ± 4.8	2.1 ± 2.7	0.9 ± 1.6	8.2 ± 4.7	1.9 ± 3.2	9.3 ± 5.2	3.0 ± 3.4	10.8 ± 4.6	6.8 ± 5.0	1.1 ± 1.9	10.1 ± 4.7
Proportion[5]	0.998	0.307	0.336	0.432	0.991	0.661	0.402	0.981	0.492	0.991	0.749	0.998	0.941	0.453	0.998
Total Wetland Acres															
Range of values	0 - 169.9	0 - 170.4	0 - 107	0 - 166.3	0 - 171	0 - 144.1	0 - 173.9	0 - 168.6	0 - 65.2	0 - 158.6	0 - 168.6	0 - 166.1	0 - 140.3	0 - 172.6	0 - 147.9
Sum	13,308.0	7,742.7	1,676.0	5,093.3	24,972.3	8,961.3	6,467.5	23,717.0	2,263.0	23,231.8	16,710.0	22,743.3	13,487.5	9,322.4	20,300.3
Per sq mile	97.9	15.4	4.9	13.0	115.6	45.5	35.0	118.1	8.4	80.7	43.7	105.3	62.4	39.5	94.0
Average ± Stdev	24.5 ± 29.0	3.9 ± 19.6	1.2 ± 5.2	3.2 ± 12.7	28.9 ± 31.3	11.4 ± 22.2	8.8 ± 31.0	29.5 ± 27.9	2.1 ± 6.3	20.2 ± 20.0	10.9 ± 25.9	26.3 ± 19.7	15.6 ± 19.4	9.9 ± 31.4	23.5 ± 19.9
Proportion	0.998	0.313	0.344	0.436	0.993	0.684	0.407	0.981	0.515	0.995	0.762	0.998	0.949	0.462	0.999
Small Wetland Count (wetlands < 2 acres)															
Range of values	0 - 25	0 - 11	0 - 10	0 - 10	0 - 27	0 - 10	0 - 8	0 - 24	0 - 19	0 - 30	0 - 18	0 - 23	0 - 31	0 - 13	0 - 23
Sum	3,661	978	797	1,099	4,986	1,051	496	4,563	1,765	7,985	3,414	6,272	4,329	712	6,010
Per sq mile	26.9	1.9	2.4	2.8	23.1	5.3	2.7	22.7	6.5	27.7	8.9	29.0	20.0	3.0	27.8
Average ± Stdev	6.7 ± 4.4	0.5 ± 1.1	0.6 ± 1.2	0.7 ± 1.2	5.8 ± 4.4	1.3 ± 1.9	0.7 ± 1.3	5.7 ± 4.0	1.6 ± 2.7	6.9 ± 4.7	2.2 ± 2.9	7.3 ± 4.0	5.0 ± 4.2	0.8 ± 1.5	7.0 ± 4.2
Proportion	0.960	0.256	0.302	0.358	0.897	0.552	0.340	0.935	0.470	0.950	0.622	0.979	0.868	0.340	0.971
Small Wetland Acres (wetlands < 2 acres)															
Range of values	0 - 14	0 - 8	0 - 5.6	0 - 6.4	0 - 13.9	0 - 19.3	0 - 6.3	0 - 12.9	0 - 12.2	0 - 16.4	0 - 52.6	0 - 27.9	0 - 28.5	0 - 7.6	0 - 17.1
Sum	1,789.4	485.0	420.5	591.7	2,657.0	667.6	241.7	2,384.3	865.9	4,163.6	2,056.4	3,644.0	2,536.1	363.3	3,460.0
Per sq mile	13.2	1.0	1.2	1.5	12.3	3.4	1.3	11.9	3.2	14.5	5.4	16.9	11.7	1.5	16.0
Average ± Stdev	3.3 ± 2.3	0.2 ± 0.6	0.3 ± 0.7	0.4 ± 0.8	3.1 ± 2.3	0.8 ± 1.6	0.3 ± 0.8	3.0 ± 2.2	0.8 ± 1.5	3.6 ± 2.7	1.3 ± 2.7	4.2 ± 2.7	2.9 ± 2.9	0.4 ± 0.8	4.0 ± 2.6
Proportion	0.972	0.264	0.315	0.370	0.948	0.596	0.345	0.945	0.496	0.954	0.650	0.988	0.898	0.358	0.980
Large Wetland Count (wetlands > 2 acres)															
Range of values	0 - 7	0 - 6	0 - 4	0 - 6	0 - 9	0 - 9	0 - 4	0 - 9	0 - 7	0 - 10	0 - 8	0 - 12	0 - 10	0 - 7	0 - 12
Sum	1,082	274	189	567	2,029	608	172	2,053	278	2,707	1,210	3,090	1,547	332	2,714
Per sq mile	8.0	0.5	0.6	1.4	9.4	3.1	0.9	10.2	1.0	9.4	3.2	14.3	7.2	1.4	12.6
Average ± Stdev	2.0 ± 1.5	0.1 ± 0.4	0.1 ± 0.4	0.4 ± 0.8	2.3 ± 1.6	0.8 ± 1.2	0.2 ± 0.6	2.6 ± 1.7	0.3 ± 0.8	2.3 ± 1.7	0.8 ± 1.1	3.6 ± 1.9	1.8 ± 1.7	0.4 ± 0.7	3.1 ± 2.0
Proportion	0.825	0.107	0.108	0.212	0.904	0.478	0.171	0.920	0.146	0.855	0.465	0.957	0.740	0.248	0.928
Large Wetland Acres (wetlands > 2 acres)															
Range of values	0 - 169.9	0 - 170.4	0 - 106.7	0 - 166.3	0 - 171	0 - 143.4	0 - 173.9	0 - 168.6	0 - 62.9	0 - 158.3	0 - 168.6	0 - 166.1	0 - 139	0 - 172.6	0 - 147.9
Sum	11,518.6	7,257.7	1,255.5	4,501.6	22,315.3	8,293.7	6,225.8	21,332.7	1,397.1	19,068.2	14,653.6	19,099.3	10,951.4	8,959.1	16,840.3
Per sq mile	84.7	14.5	3.7	11.5	103.3	42.2	33.7	106.3	5.2	66.2	38.4	88.4	50.7	38.0	78.0
Average ± Stdev	21.2 ± 29.6	3.6 ± 19.6	0.9 ± 5.1	2.9 ± 12.6	25.8 ± 32.0	10.5 ± 22.0	8.4 ± 31.0	26.6 ± 28.4	1.3 ± 5.5	16.6 ± 20.4	9.6 ± 25.9	22.1 ± 20.2	12.7 ± 19.2	9.5 ± 31.4	19.5 ± 20.5
Proportion	0.825	0.107	0.108	0.212	0.904	0.478	0.171	0.920	0.146	0.855	0.465	0.957	0.740	0.248	0.928
Open Water Acres[6]															
Range of values	0 - 169.9	0 - 145.4	0 - 68.7	0 - 166.3	0 - 166.6	0 - 118.8	0 - 100.3	0 - 168.3	0 - 20.2	0 - 149.4	0 - 167.5	0 - 166.1	0 - 131.4	0 - 164.8	0 - 141.4
Sum	4,899.9	4,385.2	195.6	2,554.4	10,646.6	2,880.3	2,366.7	8,617.4	148.4	6,615.3	9,823.6	4,325.9	2,900.0	3,586.6	5,795.1
Per sq mile	36.0	8.7	0.6	6.5	49.3	14.6	12.8	42.9	0.5	23.0	25.7	20.0	13.4	15.2	26.8
Average ± Stdev	9.0 ± 25.4	2.2 ± 13.6	0.1 ± 2.3	1.6 ± 10.8	12.3 ± 26.2	3.7 ± 12.0	3.2 ± 13.3	10.7 ± 23.8	0.1 ± 1.3	5.7 ± 15.3	6.4 ± 24.6	5.0 ± 14.8	3.4 ± 10.0	3.8 ± 17.5	6.7 ± 16.5
Proportion	0.419	0.051	0.033	0.158	0.603	0.356	0.104	0.570	0.047	0.518	0.298	0.674	0.444	0.123	0.576
Deep Marsh Acres[6]															
Range of values	0 - 42.3	0 - 47.8	0 - 26.5	0 - 13.1	0 - 82.1	0 - 77.8	0 - 34	0 - 40.9	0 - 16.9	0 - 31.6	0 - 22.7	0 - 67.4	0 - 96.3	0 - 45.1	0 - 69.2
Sum	1,941.0	931.2	299.5	658.0	5,682.1	1,957.1	680.2	4,464.3	259.3	3,986.6	1,830.2	7,758.2	4,157.7	1,243.5	5,927.3
Per sq mile	14.3	1.9	0.9	1.7	26.3	9.9	3.7	22.2	1.0	13.8	4.8	35.9	19.2	5.3	27.4
Average ± Stdev	3.6 ± 5.4	0.5 ± 3.0	0.2 ± 1.6	0.4 ± 1.2	6.6 ± 8.2	2.5 ± 6.2	0.9 ± 3.5	5.6 ± 6.0	0.2 ± 1.1	3.5 ± 4.1	1.2 ± 2.4	9.0 ± 6.8	4.8 ± 8.9	1.3 ± 4.6	6.9 ± 7.1
Proportion	0.724	0.086	0.081	0.214	0.899	0.474	0.210	0.848	0.145	0.777	0.514	0.973	0.759	0.238	0.941
Shallow Marsh Acres[6]															
Range of values	0 - 69.6	0 - 117.9	0 - 40	0 - 87.8	0 - 41.4	0 - 56.3	0 - 166.6	0 - 77.8	0 - 54.9	0 - 108.7	0 - 93.4	0 - 44.7	0 - 46.9	0 - 162.6	0 - 26
Sum	5,180.8	2,424.5	1,180.1	1,876.4	4,902.1	4,076.3	3,419.1	9,002.4	1,465.7	8,046.0	4,148.8	6,014.0	4,745.2	4,490.6	4,913.5
Per sq mile	38.1	4.8	3.5	4.8	22.7	20.7	18.5	44.8	5.4	27.9	10.9	27.8	22.0	19.0	22.7
Average ± Stdev	9.5 ± 11.3	1.2 ± 5.5	0.9 ± 2.8	1.2 ± 3.8	5.7 ± 5.4	5.2 ± 8.8	4.6 ± 20.0	11.2 ± 12.1	1.4 ± 4.9	7.0 ± 8.7	2.7 ± 4.6	7.0 ± 4.3	5.5 ± 6.2	4.8 ± 18.0	5.7 ± 3.6
Proportion	0.954	0.311	0.344	0.425	0.958	0.648	0.390	0.973	0.387	0.885	0.715	0.988	0.912	0.447	0.980
Other Wetland Acres[6] (including wet meadows, mudflats, dry wetlands, forested wetlands and riparian zones)															
Range of values	0 - 14.7	0 - 0	0 - 0	0 - 0	0 - 52.7	0 - 4.4	0 - 0	0 - 22.5	0 - 9.6	0 - 59.6	0 - 28.7	0 - 34.5	0 - 20	0 - 0	0 - 19.6
Sum	1,279.2	0.0	0.0	0.0	3,730.7	38.0	0.0	1,626.8	384.0	4,394.6	819.3	4,639.1	1,609.4	0.0	3,656.2
Per sq mile	9.4	0.0	0.0	0.0	17.3	0.2	0.0	8.1	1.4	15.3	2.1	21.5	7.5	0.0	16.9
Average ± Stdev	2.4 ± 2.5	0.0 ± 0.0	0.0 ± 0.0	0.0 ± 0.0	4.3 ± 5.0	0.0 ± 0.4	0.0 ± 0.0	2.0 ± 2.5	0.4 ± 0.9	3.8 ± 7.2	0.5 ± 2.0	5.4 ± 3.8	1.9 ± 2.2	0.0 ± 0.0	4.2 ± 2.8
Proportion	0.858	0.000	0.000	0.000	0.968	0.153	0.000	0.834	0.325	0.779	0.309	0.991	0.810	0.000	0.990

[1] Range of values - provides a the range of values (minimum to maximum) across all sampled quarter sections for the RM.
[2] Sum - provides the total (summation) of values across all sampled quarter sections for the RM.
[3] Per sq mile - provides the mean value for all sampled quarter sections for the RM, standardized to square miles.
[4] Average - provides the mean value for all sampled quarter sections for the RM.
[5] Proportion - provides the proportion of sampled quarter sections for the RM that contain the feature of interest.

[6] Wetland category information
- Open Water - open water with unknown water chemistry or turbidity
- Deep Marsh - emergent vegetation growing in areas of persistent surface water throughout the growing season.
- Shallow Marsh - emergent vegetation growing in areas of intermittent surface water throughout the growing season.
- Other Wetlands - the following wetland categories have been merged into an 'other wetland' category:
  - Wet Meadow - low-lying areas with saturated soils for an undetermined period of time.
  - Mud Flat - areas of hydric soils with sparse to no vegetation cover; surface water not present.
  - Riverine - surface water and adjacent riparian habitat of unknown water chemistry or turbidity; represents large rivers only.
  - Other Wetlands - all remaining wetland cover types (i.e. dry basins; salt bed basins; forested wetlands etc.).

Table 4

Plant and animal species of conservation concern in the Biosphere Reserve

Common Name	Scientific Name[1]	Global Rank	Provincial Rank	Occurrences in the RMBR	Occurrences in Manitoba	% Occurrences in the RMBR
Plants						
Leathery grape-fern	*Botrychium minganese*	G4	S1S2	1		33
Porter's chess	*Botrychium multifidum*	G5	S3	1		14
Canada brome grass	*Bromus porteri*	G5	S3?	3		43
Bellow-beaked sedge	*Bromus pubescens*	G5Q	SU	1		14
Douglas sedge	*Carex albicans* var. *albicans*	G5T4T5	SU	1		50
Douglas sedge	*Carex douglasii*	G5	S3?	1		20
Porcupine sedge	*Carex hystericina*	G5	S3?	1		14
Parry's sedge	*Carex parryana*	G4	S3?	-		-
Stalked sedge	*Carex pedunculata*	G5	S3?	1		17
Prairie sedge	*Carex prairea*	G5?	S4?	5	1	5
Black sedge	*Carex raymondii*	G5	S2S3	1		100
Sedge	*Carex sterilis*	G4	SR	1		25
Rigid sedge	*Carex tetanica*	G4G5	S2	1	3	
Torrey's sedge	*Carex torreyi*	G4	S4	1		20
White-scaled sedge	*Carex xerantica*	G5	S3?	-		-
Yellow indian paintbrush	*Castilleja pallida* ssp. *septentronalis*	G5	S1?	1		100
Large white-flowered ground-cherry	*Chamaesaracha grandiflora*	G3?	S3	3	0	5
Northern golden-carpet	*Chrysosplenium tetrandrum*	G5	S2S3	-		-
Alternate-leaved dogwood	*Cornus alternifolia*	G5	S2S3	-		-
Dodder	*Cuscuta pentagona* var. *pentagona*	G5T5	S1?	1		50
Schweinitz's flatsedge	*Cyperus schweinitzii*	G5	S2	1	5	
Small's spike-rush	*Eleocharis smallii*	G5?	S3?	1		100
Various-glumed wild rye	*Elymus diversiglumus*	G3?Q	S2?	1		100
Tufted fleabane	*Erigeron caespitosus*	G5	S2	2		67
Beautiful cotton-grass	*Eriophorum callitrix*	G5	S2	-		-
Prostrate spurge	*Euphorbia geyeri*	G5	S2	1		33
Plains rough fescue	*Festuca hallii*	G4	S3	7	8	9
Cleavers, goosegrass	*Galium aparine*	G5	S2	2		33
Graceful manna grass	*Glyceria pulchella*	G5	S2	1		25
Tuberous-rooted sunflower	*Helianthus nuttallii* ssp. *rydbergii*	G5T5	G5T3T5 S2	1		20
Western jewelweed	*Impatiens noli-tangere*	G?	S2	1		100
Marsh felwort	*Lomatogonium rotatum*	G5	S2S3	2		100
White adder's-mouth	*Malaxis brachypoda*	G4Q	S2?	1		14
Millet grass	*Milium effusum*	G5	S2	2		100
Foxtail muhly	*Muhlenbergia andina*	G4	S1	-		-
Leafy musineon	*Musineon divaricatum*	G5	S2	1		17
Canada rice-grass	*Oryzopsis canadensis*	G5	S1	1		25
Indian rice-grass	*Oryzopsis hymenoides*	G5	S2	2		33
Wooly or hairy sweet cicely	*Osmorhiza claytonii*	G5	S2	-		-
Blunt-fruited sweet cicely	*Osmorhiza depauperata*	G5	S2?	3		43
Sand millet	*Panicum wilcoxianum*	G5	S2	1		17
Smooth blue beard-tongue	*Penstemon nitidus*	G5	S2	2		29
Round-leaved bog orchid	*Platanthera orbiculata*	G5?	S3	1	7	
Plains blue grass	*Poa arida*	G5	S4	-		-
Large-leaved pondweed	*Potamogeton amplifolius*	G5	S2?	2	4	4
Illinois pondweed	*Potamogeton illinoensis*	G5	S2	1		50
Pondweed	*Potamogeton strictifolius*	G5	S3	1		25
Short-capsuled willow	*Salix brachycarpa*	G5	S2S3	1		33
Northern spike-moss	*Selaginella selaginoides*	G5	S2	2		50
White-eyed grass	*Sisyrinchium campestre*	G5	SU	1	4	
Richardson needle grass	*Stipa richardsonii*	G5	S1	2		40
Green needle grass	*Stipa viridula*	G5	S3	24	265	9
Golden bean	*Thermopsis rhombifolia*	G5	S2	3	3	3
Pale manna grass	*Torreyochloa pallida* var. *fernaldii*	G5?T4Q	S2	1		25
Dwarf bilberry	*Vaccinium caespitosum*	G5	S2	3	1	7
Long-spurred violet	*Viola selkirkii*	G5?	S2	-		-
Water-meal	*Wolffia columbiana*	G5	S1	6		86
Birds						
Yellow rail	*Coturnicops noveboracensis*	G4	S4B,SZN	1	6	
Loggerhead shrike	*Lanius ludovicianus*	G4	S2S3B,SZN	2	380	1
Barred owl	*Strix varia*	G5	S3S4	5	4	1
Short-eared owl	*Asio flammeus*	G5	S3S4B,SZN	-		-
Cooper's hawk	*Accipiter cooperii*	G5	S4B, SZN	-		-
Peregrine Falcon	*Falco peregrinus*	G4	S1B,SZN	-		-
Fishes and Amphibians						
Chestnut lamprey	*Ichthyomyzon castaneus*	G4	S3S4	1	0	0
Silver chub	*Macrhybopsis storeriana*	G5	S3	-		-
Northern Leopard-frog	*Rana pipiens*	G5	S4	-		-
Habitats						
Plains rough fescue (spear grass)	*Festuca hallii* (*Stipa* spp.)	-	1	2	2	100

[1] Scientific nomenclature is that used by the Manitoba Conservation Data Centre at the time of report generation.

Information provided by the Manitoba Conservation Data Centre, 2003. Please note that the Manitoba CDC is continually updating their databases to reflect newly acquired information. Reproduced with permission. Please refer to Appendix 1 for rank definitions, and Map 29 for locations.

SCIENTIFIC NAMES OF PLANT SPECIES REFERENCED IN TEXT

TREES AND SHRUBS

Alder (*Alnus spp.*)

Alternate-leaved dogwood (*Cornus alternifolia*)

American elm (*Ulmus americana*)

Balsam fir (*Abies balsamea*)

Balsam poplar (*Populus balsamifera*)

Black spruce (*Picea mariana*)

Buffaloberry (*Shepherdia canadensis*)

Bur oak (*Quercus macrocarpa*)

Beaked hazelnut (*Corylus cornuta*)

Chokecherry (*Prunus virginiana*)

Cottonwood (*Populus deltoides*)

Green ash (*Fraxinus pennsylvanica*)

Hawthorn (*Crataegus spp.*)

Jack pine (*Pinus banksiana*)

Juniper (*Juniperus spp.*)

Labrador tea (*Ledum groenlandicum*)

Manitoba maple (*Acer negundo*)

Mountain maple (*Acer spicatum*)

Paper birch (*Betula papyrifera*)

Pin cherry (*Prunus pensylvanica*)

Saskatoon (*Amelanchier alnifolia*)

Snowberry (*Symphoricarpos occidentalis*)

Tamarack (*Larix laricina*)

Trembling aspen (*Populus tremuloides*)

White spruce (*Picea glauca*)

Willow (*Salix spp.*)

OTHER PLANTS

Cattail (*Typha spp.*)

Climbing bittersweet (*Celastrus scandens*)

Eurasian water-milfoil (*Myriophyllum spicatum*)

Fireweed (*Epilobium angustifolium*)

Hog peanut (*Amphicarpa bracteata*)

Kentucky blue grass (*Poa pratensis*)

Large yellow lady's-slipper (*Cypripedium calceolus*)

Leafy spurge (*Euphorbia esula*)

Lopseed (*Phryma leptostachia*)

Millet grass (*Milium effusum*)

Nodding trillium (*Trillium cernuum*)

Prairie crocus (*Anemone patens*)

Purple loosestrife (*Lythrum salicaria*)

Salt cedar (*Tamarix ramosissima*)

Scorpionweed (*Phacelia franklinii*)

Selkirk's violet (*Viola selkirkii*)

Seneca root (*Polygala senega*)

Small enchanter's-nightshade (*Circaea alpina*)

Smooth brome (*Bromus inermis*)

Sweet grass (*Hierocloe odorata*)

Virginia creeper (*Parthenocissus quinquefolia*)

Wild sarsaparilla (*Aralia nudicaulus*)

Wild strawberry (*Fragaria virginiana*)

Wormwood (*Artemisia canadensis*)

Yarrow (*Achillea spp.*)

A complete list of the flora of Riding Mountain National Park can be found in *Plants of Riding Mountain National Park* by W.J. Cody (1988).[87]

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APPENDIX 1: SUPPLEMENTARY INFORMATION TO ACCOMPANY SELECTED MAPS AND TABLES

For more information on Soil Maps 4-12, please refer to the following publication: Fraser, W.R., P. Cyr, R.G. Eilers and G.W. Lelyk. 2001. Technical Manual for Manitoba RM Soils and Terrain Information Bulletins. Land Resource Group (Manitoba), Semiarid Prairie Agricultural Research Centre, Research Branch, Agriculture and Agri-Food Canada. Special Report 01-1. 33 pp.

MAP 4: AGRICULTURAL CAPABILITY OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

The Canada Land Inventory "Soil Capability for Agriculture" is one of the most widely recognized agricultural interpretations of soil capability. All soils have been grouped into one of 7 agriculture capability classes, as described by Agriculture Canada, with all soils in the same class having a similar relative degree of risk for annual crop production. Subclasses (not displayed on the accompanying map) are used to indicate the most significant limitations or hazards. The accompanying map is generalized, and shows only the dominant soil capability class for each soil polygon, i.e. area of land that contains fairly homogeneous or consistent soil properties (such as drainage, texture, parent material) within its boundaries.

Class 1 - Soils have no important agricultural limitations for crop use. The soils have level or gently sloping topography; they are deep, well to imperfectly drained and have moderate water holding capacity. The soils are naturally well supplied with plant nutrients, easily maintained in tilling and fertility; and are moderately high to high in productivity for a wide range of cereal and special crops.

Class 2 - Soils have moderate limitations that reduce the choice of crops or require moderate conservation practices. The soils have good water holding capacity and are either naturally well supplied with nutrients or are highly responsive to inputs of fertilizer. They are moderate to high in productivity for a fairly wide range of crops. The limitations are not severe and good soil management and cropping practices can be applied without serious difficulty.

Class 3 - Soils have moderate limitations that restrict the range of crops or require moderate conservation practices. Limitations are more severe than those in Class 2 and conservation practices are more difficult to apply and maintain. The limitations affect the timing and ease of tilling, planting and harvesting, the choice of crops and maintenance of conservation practices. Limitations include one or more of the following: moderate climatic limitation, erosion, structure, permeability, low fertility, topography, overflow, wetness, low water holding capacity or slow release of water to plants, stoniness and depth of soil to consolidated bedrock. Under good management, these soils are fair to moderately high in productivity for a fairly wide range of field crops.

Class 4 - Soils have severe limitations that restrict the choice of crops or require special conservation practices or both. These soils have such limitations that they are only suited for a few crops, or the yield for a range of crops may be low, or the risk of crop failure is high. The limitations may seriously affect such farm practices as the timing and ease of tillage, planting and harvesting, and the application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops but may have high productivity for a specially adapted crop. The limitations include the adverse effects of one or more the following: climate, accumulative undesirable soil characteristics, low fertility, deficiencies in the storage capacity or release of soil moisture to plants, structure, permeability, salinity, erosion, topography, overflow, wetness, stoniness, and depth of soil to consolidated bedrock.

Class 5 - Soils have very severe limitations that restrict their capability to produce perennial forage crops, although improvement practices may be feasible. These soils have such serious soil, climatic or other limitations that they are not capable for use in the sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native species of perennial forage plants. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilizing and water control. Some soils in Class 5 can be used for cultivated field crops provided unusually intensive management is used. Some of these soils are also adapted to special crops requiring soil conditions unlike those needed by the common crops.

Class 6 - Soils are capable only of producing perennial forage crops but improvement practices are not feasible. Class 6 soils have some capability for natural sustained grazing of farm animals, but have such serious soil, climatic or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents the use of farm machinery, or because the soils are not responsive to improvement practices, or because stock watering facilities are inadequate.

Class 7 - Soils in this class have no capability for arable culture or permanent pasture because of extremely severe limitations. These soils may or may not have a high capability for wildlife, forestry and recreation.

MAP 6: SOIL DRAINAGE OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

A major factor influencing soil drainage in the Biosphere Reserve is the hummocky topography; the majority of wet soils occur in isolated depressions. Agriculture Canada indicates that under natural conditions some soils are so wet that the production of crops commonly grown in the area is generally not possible. The poorly drained Gleysolic soils are not generally used for annual crop production unless surface and/or subsurface drainage is provided and maintained. The majority of these soils therefore remain in a relatively natural state supporting wetland vegetation.

In the accompanying map, drainage is described on the basis of actual moisture content in excess of field capacity, and the length of the saturation period within the plant rooting zone. Five drainage classes plus three land classes are shown, as described by Agriculture Canada. The soil drainage classes displayed are generalized, based on the drainage class of the first (usually dominant) soil type in each soil polygon.

Very poor - Water is removed from the soil so slowly that the water table remains at or on the soil surface for the greater part of the time the soil is not frozen. Excess water is present in the soil throughout most of the year.

Poor - Water is removed so slowly in relation to supply that the soil remains wet for a large part of the time the soil is not frozen. Excess water is available within the soil for a large part of the time.

Imperfect - Water is removed from the soil sufficiently slowly in relation to supply that the soil remains wet for a significant part of the growing season. Excess water moves slowly down the profile if precipitation is the major source.

Well - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying materials or laterally as subsurface flow.

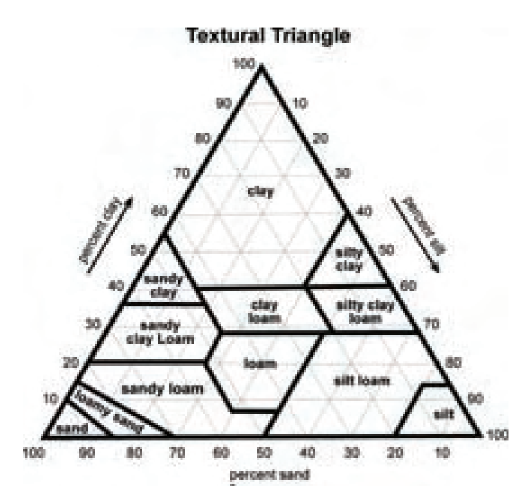
Rapid - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep slopes during heavy rainfall.

MAP 7: SURFICIAL TEXTURE OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

Surface texture is a fundamental soil property and is related to several soil attributes, such as soil moisture holding capacity, soil structure, permeability, ease of tillage and susceptibility to erosion. Soils in the accompanying map have been grouped into six broadly-defined surface texture groups (organics, coarse sands, sands, coarse loamy, loamy, clayey) and four non-soil groups (unclassified, marsh, eroded slopes, water).

Surface Texture	Group Surface Texture Class
organics	organic, fibric, mesic, humic
coarse sands	coarse sand, sand, medium sand, gravelly loamy sand, gravelly sandy loam, loamy clay sand
sands	sand, loamy fine sand, loamy sand, fine sand
coarse loamy	very fine sandy loam, sandy loam, silty loam, very fine sand, loamy very fine sand
loamy	loam, silty loam, silty clay loam, clay loam
clayey	silty clay, clay, hard clay
unclassified	
marsh	
eroded slopes	
water	

The six broadly defined surface texture groups can be subdivided into more refined classes, but have not been displayed on this map. The familiar soil texture triangle shows the relationship between soil texture and the sand, silt and clay content of the soil (adapted from the Agriculture Canada Expert Committee on Soil Survey 1987).[19]



MAP 10: POTENTIAL ENVIRONMENTAL IMPACT UNDER IRRIGATION FOR THE RIDING MOUNTAIN BIOSPHERE RESERVE

Please note that the potential environmental impact ratings for the accompanying map apply only to irrigated lands. This interpretation has not been designed for, nor should it be interpreted or used for, any other type of environmental impact concerns. These should be addressed separately, using appropriate criteria and assumptions.

The soil factors considered are those properties that determine water retention and movement through the soil; topographic features are those that affect runoff and redistribution of moisture on the landscape. Several factors are specifically considered: soil texture, hydraulic conductivity, salinity, geological uniformity, depth to water table and topography. The risk of altering surface and subsurface soil drainage regimes, soil salinity, potential for runoff, erosion and flooding is determined by specific criteria for each property. Use of this rating is intended to serve as a warning of potential environmental concern. It may be possible to design and/or give special consideration to soil-water-crop management practices that will mitigate any adverse impact.

This generalized interpretive map is based on the dominant soil series and slope class for each soil polygon. The nature of any subclass limitations and the classification of subdominant components are not shown at this generalized map scale.

MAP 12: ATTRIBUTES OF SOIL LANDSCAPES OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

The accompanying map highlights attributes of soil landscapes that a land manager must consider for any intended land use. Agriculture Canada describes seven such considerations:

Fine texture - Soil landscapes with fine-textured soils (clays and silty clays), and thus low infiltration and internal permeability rates. These soils require special considerations for agricultural purposes to mitigate surface ponding (water logging) and runoff. The timing and type of tillage practices used may be restricted.

Medium texture - Soil landscapes with medium to moderately fine textures (loams to clay loams), and good water and nutrient retention properties. Good management and cropping practices are required to minimize leaching and the risk of erosion for agriculture.

Coarse texture - Soil landscapes with coarse to very coarse-textured soils (loamy sands, sands and gravels) have a high permeability throughout the profile, and require special management practices related to application of agricultural chemicals, animal wastes and municipal effluent to protect and sustain the long term quality of the soil and water resources. The risk of soil erosion can be minimized through the use of shelterbelts and maintenance of crop residues.

Topography - Soil landscapes with slopes greater than 5% are steep enough to require special management practices to minimize the risk of water erosion.

Wetness - Soil landscapes that have poorly drained soils and/or >50% wetlands (due to seasonal and annual flooding, surface ponding, permanent water bodies and/or high water tables), requiring special management practices to mitigate adverse impact on water quality, protect subsurface aquifers, and sustain crop production during periods of high risk of water logging.

Organic - Soil landscapes with organic soils requiring special management considerations of drainage, tillage and cropping to sustain productivity and minimize subsidence and erosion.

Bedrock - Soil landscapes that have a shallow depth to bedrock (<50 cm) and/or exposed bedrock which may prevent the use of some or all tillage practices as well as the range of potential crops. These conditions require special cropping and management practices to sustain agricultural production.

MAP 14: 1993 LANDSCAPE CLASSIFICATION OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

From: Manitoba Conservation. 2003. Land use/ land cover Landsat TM maps, 1993-1994 edition - metadata. Department of Remote Sensing, Winnipeg.

1. Agricultural Cropland - Lands dedicated to the production of annual cereal, oil seed and other speciality crops.

2. Deciduous Forest - 75-100% of the forest canopy is deciduous. Dominant species include trembling aspen, balsam poplar and paper birch. May include small patches of grassland, marsh or fens less than two hectares in size.

3. Water Bodies - Open water: lakes, rivers, streams, ponds and lagoons.

4. Grassland/Rangeland - Mixed native and/or non-native prairie grasses and herbs. May also include scattered stands of willow, choke cherry, pin cherry and saskatoon, with normally less than 10% shrub or tree cover. Many of these areas are used for cutting of hay and grazing. Both upland and lowland meadows fall into this class.

5. Mixedwood Forest - 25-75% of the canopy is coniferous. May include patches of treed bog, marsh or fens less than two hectares in size.

6. Marsh and Fens - Wet areas with standing or slowly moving water. Vegetation consists of grasses and/or sedges. Marshes will include common hydrophytic (water-loving) vegetation such as cattail and rushes. Fens will be formed on minerotrophic (nutrient-rich) sites. Areas are frequently interspersed with channels or pools of open water.

7. Treed and Open Bogs - Peat-covered or peat-filled depressions with a high water table. Bogs are covered with a carpet of *Sphagnum* moss and ericaceous shrubs (evergreen plants belonging to the plant family, *Ericaceae*, such as Labrador tea), and may be treeless or treed with black spruce and/or tamarack.

8. Treed Rock - Exposed bedrock with less than 50% tree cover.

9. Coniferous Forest - 75-100% of the canopy is comprised of coniferous species, typically dominated by pine and spruce. May include patches of treed bog, marsh or fens less than two hectares in size.

10. Burnt Areas – Burnt forested areas with sporadic regeneration; can include patches of unburnt trees.

11. Open Deciduous - Lands characterized by rough topography, shallow soil, or poor drainage. Supports shrubs such as willow, alder, saskatoon and/or stunted deciduous tree cover, with up to 50% scattered tree or shrub cover.

12. Forage Crops - Consists of perennial forage such as alfalfa and clover or blends of these with non-native species of grass. Fall-seeded crops such as winter wheat or fall rye are included here.

13. Cultural Features - Built-up areas such as cities and towns, golf courses, cemeteries, shopping centres, large recreation sites, airports, cottage developments, peat farms, etc.

14. Forest Cutover - Areas where commercial logging operations have clearcut or partially removed a standing forest. Includes areas which have been recently replanted.

15. Bare Rock, Gravel and Sand - Exposed areas of bedrock, sand dunes, and beaches, gravel quarry/pit operations, mine tailings, borrow pits and rock quarries.

16. Roads and Trails - Highways, secondary roads, trails, cut survey lines, right-of-ways, railway lines and transmission lines.

MAP 15: RECREATIONAL CLASSIFICATION OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

From: Canada Land Inventory. 1999. Land capability for recreation – metadata. Government of Canada, Natural Resources, Canadian Centre for Remote Sensing.

Seven classes of land were differentiated on the basis of the intensity or quantity of outdoor recreational use which may be generated and sustained per unit area of land per year, under perfect market conditions. "Quantity" may be measured by visitor days, a visitor day being any reasonable portion of a 24-hour period during which an individual person uses a unit of land for recreation. "Perfect market conditions" implies there is uniform demand and accessibility for all areas. Both intensive and dispersed activities are recognized. "Intensive" activities are those in which relatively large numbers of people may be accommodated per unit area, while "dispersed" activities are those which normally require a relatively larger area per person.

Also available from the Canada Land Inventory are detailed subclass descriptions for each of the following seven classes. Subclasses indicate the kinds of features which provide opportunity for recreation.

Class 1 - Very high capability for outdoor recreation. Lands have natural capability to engender and sustain very high total annual use based on one or more recreational activities of an intensive nature. Class 1 land units should be able to generate and sustain a level of use comparable to that at an outstanding and large bathing beach or a nationally known ski slope.

Class 2 - High capability. Lands have natural capability to engender and sustain high total annual use based on one or more recreational activities of an intensive nature.

Class 3 - Moderately high capability. Lands have natural capability to engender and sustain moderately high total annual use based usually on intensive or moderately intensive activities.

Class 4 - Moderate capability. Lands have natural capability to engender and sustain moderate total annual use based usually on dispersed activities.

Class 5 - Moderately low capability for outdoor recreation. Lands have natural capability to engender and sustain moderately low total annual use based on dispersed activities.

Class 6 - Low capability. Lands lack the natural quality and significant features to rate higher, but have the natural capability to engender and sustain low total annual use based on dispersed activities.

Class 7 - Very low capability. Lands have practically no capability for any popular type of recreational activity, but may have some capability for very specialized activities with recreational aspects, or may simply provide open space.

MAP 27: WATERFOWL HABITAT CLASSIFICATION OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

From: Canada Land Inventory. 1999. Land capability for wildlife: waterfowl – metadata. Government of Canada, Natural Resources, Canadian Centre for Remote Sensing.

Land is divided into areas on the basis of physiographic characteristics important to waterfowl survival, growth and reproduction. The degree of limitation associated with each area determines its capability class (Classes 1-7 below). Ratings are established on the basis of the optimum vegetation structure and composition that can be maintained when good wildlife management is practiced. As such, the assigned capability ratings do not reflect present land use (except in extreme cases such as heavily populated urban areas), ownership, lack of access, distance from cities or amount of hunting pressure.

With the exception of class 1 and special class 3M, the classes below are divided into subclasses according to the nature of the limitations that determine the class. Subclasses are used to denote significant limiting factors that may affect either the waterfowl or the ability of the land to produce suitable habitat conditions. See the Canada Land Inventory for detailed subclass descriptions.

Class 1 – Very high capability. Lands have no significant limitations to the production of waterfowl, and provide a wide variety and abundance of important habitat elements. Rolling topography is well suited to the formation of wetlands. Predominant water areas on these lands are both shallow and deep permanent marshes, and deep, open water areas with well-developed marsh edges.

Class 1S - Class 1 areas that also serve as important migration stops.

Class 2 – High capability, but less than class 1. Lands have very slight limitations to the production of waterfowl, due to climatic, fertility, or permeability of the soils. Topography tends to be more undulating than rolling; a higher proportion of the water areas than in class 1 are small temporary ponds or deep, open water areas with poorly developed marsh edges.

Class 2S - Class 2 areas that also serve as important migration stops.

Class 3 – Moderately high capability, but productivity may be reduced in some years because of occasional droughts. Lands have slight limitations to the production of waterfowl due to climate or to characteristics of the land that affect the quality and quantity of habitat. These lands have a high proportion of both temporary and semi-permanent shallow marshes poorly interspersed with deep marshes and bodies of open water.

Class 3S - Class 3 areas that also serve as important migration stops.

Class 3M - Lands may not be useful for waterfowl production, but are important as migration or wintering areas.

Class 4 – Moderate capability. Lands have moderate limitations to the production of waterfowl, similar to those in class 3 but to a greater degree. Water areas are predominantly temporary ponds, or deep, open waters with poorly developed marsh edges, or both.

Class 5 – Moderately low capability. Lands have moderately severe limitations to the production of waterfowl, usually a combination of two or more of the following factors: climate, soil moisture, permeability, fertility, topography, salinity, flooding, and poor interspersion of water areas.

Class 6 – Very low capability. Lands have severe limitations to the production of waterfowl that are easily identified, including aridity, salinity, very flat topography, steep-sided lakes, extremely porous soils, and soils containing few available minerals.

Class 7 - Negligible or non-existent capability. Lands have limitations so severe that almost no waterfowl are produced.

MAP 30: UNGULATE HABITAT CLASSIFICATION OF THE RIDING MOUNTAIN BIOSPHERE RESERVE

From: Canada Land Inventory. 1999. Land capability for wildlife: ungulates – metadata. Government of Canada, Natural Resources, Canadian Centre for Remote Sensing.

With the exception of Class 1, the following classes are divided into two subclasses (climate and land characteristics) according to the limitations they impose. In most cases the limitations do not affect the animals themselves, but rather the ability of the land to produce suitable food and/or vegetation cover. See the Canada Land Inventory for detailed subclass descriptions.

Class 1 – High capability. Lands have no significant limitations to the production of ungulates, and provide a wide variety and abundance of food plants and other habitat elements.

Class 1W - Class 1 areas that are winter ranges on which animals from surrounding areas depend.

Class 2 – High capability but less than class 1. Lands have very slight limitations to the production of ungulates due to climatic or other factors.

Class 2W - Class 2 areas that are winter ranges on which animals from surrounding areas depend.

Class 3 - Moderately high capability, but productivity may be reduced in some years. Lands have slight limitations to the production of ungulates due to characteristics of the land that affect the quality and quantity of habitat, or to climatic factors that limit the mobility of ungulates or the availability of food and cover.

Class 3W - Class 3 areas that are winter ranges on which animals from surrounding areas depend.

Class 4 – Moderate capability. Lands have moderate limitations to the production of ungulates similar to those in class 3, but to a greater degree.

Class 5 – Moderately low capability. Lands have moderately severe limitations to the production of ungulates, usually a combination of two or more of climate, soil moisture, fertility, depth of bedrock or other impervious layers, topography, flooding, exposure, and adverse soil characteristics.

Class 6 – Very low capability. Lands have severe limitations to the production of ungulates that are easily recognized; for example, soil depth may be negligible or climatic factors so extreme that ungulate populations are severely reduced.

Class 7 - Lands have limitations so severe that there is no ungulate production.

TABLE 4: PLANT AND ANIMAL SPECIES OF CONSERVATION CONCERN IN THE RIDING MOUNTAIN BIOSPHERE RESERVE

From: Manitoba Conservation. 2003. Manitoba Conservation Data Centre: Species Ranks and Ranking Criteria. Please note that the MB CDC is continually updating their databases to reflect newly acquired information. See <http://web2.gov.mb.ca/conservation/cdc/info.php>

The Manitoba Conservation Data Centre (MB CDC) defines a "species of conservation concern" as species that are rare, disjunct (found outside the normal range), or at risk throughout their range or in Manitoba and in need of further research. The term also includes species that are listed under the Manitoba Endangered Species Act, or that have a special designation by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC).

Species are evaluated and ranked by MB CDC on the basis of their range-wide (global, or 'G') status, and their province-wide (subnational, or 'S') status according to a standardized procedure used by all Conservation Data Centres and Natural Heritage Programs. For each level of distribution, global and provincial, species are assigned a numeric rank ranging from 1 (very rare) to 5 (demonstrably secure). The ranks and qualifiers used in the table are defined below. For example, the Alternated-leaved dogwood is presently ranked G5, S2S3. This means that the species is abundant and secure throughout its range, while in Manitoba it is ranked somewhere between rare or uncommon, and may be vulnerable to extirpation.

Species Rank Definitions

1 – Very rare throughout its range or in the province (usually 5 or fewer occurrences, or very few remaining individuals); may be especially vulnerable to extirpation.

2 – Rare throughout its range or in the province (usually 6 to 20 occurrences); may be vulnerable to extirpation.

3 – Uncommon throughout its range or in the province (usually 21 to 100 occurrences).

4 – Widespread, abundant and apparently secure throughout its range or in the province; has many occurrences (usually > 100) but is of long-term concern.

5 – Demonstrably widespread, abundant and secure throughout its range or in the province.

U – Possibly in peril, but status is uncertain and more information is needed.

H – Historically known but may be rediscovered.

X – Believed to be extinct and known only from historical records; continued searches for the species will be conducted.

Other Codes

G#G# , S#S# - A range between two numeric ranks indicating the range of uncertainty about the status of a species.

Qualifiers

A – Species is accidental in the province; includes species (usually birds or butterflies) recorded very infrequently, hundreds or thousands of kilometres outside their usual range.

B – Denotes the breeding status of a migratory species. For example, the rank S1B,SZN indicates that breeding occurrences for the species are ranked S1 (critically imperilled) in the province, while non-breeding occurrences are not ranked in the province (see Z and N qualifiers below).

E – Species is an exotic established in the province, but may be native in nearby regions.

HYB – Organism represents a hybrid of species.

N – Denotes the non-breeding status of a migratory species. For example, the rank S1B,SZN indicates that breeding occurrences for the species are ranked S1 (critically imperilled) in the province, while non-breeding occurrences are not ranked in the province (see Z qualifier below).

P – Indicates that an organism may potentially occur in the province.

Q – Indicates that taxonomic questions or problems are involved, and more information is needed to refine the rank; appended to the global rank.

R – Denotes a species that has been reported in the province, but is lacking documentation which could provide a basis for either accepting or rejecting the report.

T – Denotes a rank for a subspecific taxon (a subspecies, variety or population), and is appended to the global rank of a species.

Z – Indicates that ranking is not applicable.

– Modifier to SX or SH, indicates that the species has been reintroduced but the population has not yet established.

? – Denotes an inexactness or uncertainty for a species ranked by its number of occurrences.

APPENDIX 2: ORGANIZATIONS AND AGENCIES WORKING IN THE BIOSPHERE RESERVE

The following is a general but not exhaustive list of a variety of organizations working directly or indirectly on the land in the Riding Mountain region. Where available, general Internet sites are provided (last visited September, 2004) or other contact information.

GOVERNMENT AGENCIES (FEDERAL, AND PROVINCIAL)

Agriculture and Agri-food Canada (Winnipeg)
<http://www.agr.gc.ca/>

Canadian Food Inspection Agency (Winnipeg)
<http://www.inspection.gc.ca/>

Canadian Wildlife Service (Winnipeg)
<http://www.cws-scf.ec.gc.ca/index_e.cfm>
<http://www.mb.ec.gc.ca/nature/d00s02.en.html>

Environment Canada (Winnipeg)
<http://www.ec.gc.ca/>

Fisheries and Oceans Canada (Dauphin)
101 - 1st Avenue N.W., Dauphin, MB, R7N 1G8
Tel: (204) 622-4060

Manitoba Agriculture, Food and Rural Initiatives (Dauphin, Ste. Rose, Russell)
<http://www.gov.mb.ca/agriculture/index.shtml>

Manitoba Association of Agricultural Societies (Winnipeg)

Manitoba Conservation, Crown Lands Branch (Neepawa) <http://www.gov.mb.ca/conservation/crownlands/>

Manitoba Conservation, Forestry Branch (Winnipeg)
<http://www.gov.mb.ca/conservation/forestry/>

Manitoba Conservation, Parks and Natural Areas Branch (Winnipeg)
<http://www.gov.mb.ca/conservation/parks/>

Manitoba Conservation, Protected Areas Initiative (Winnipeg)
<http://www.gov.mb.ca/conservation/pai/>

Manitoba Conservation, Wildlife and Ecosystem Protection Branch (Winnipeg)
<http://www.gov.mb.ca/conservation/wildlife/>

Manitoba Conservation: Environment Office (Brandon, Dauphin)
Western Region: 1129 Queens Ave, Brandon, MB, R7A 1L9, Tel: (204) 726-6064

Manitoba Conservation: Natural Resources Office (Brandon District) 1129 Queens Ave, Brandon, MB, R7A 1L9, Tel: (204) 726-6441 or -6296

Manitoba Heritage Marsh Program (Winnipeg)
<http://www.gov.mb.ca/conservation/wildlife/managing/heritage_marshes.html>

Manitoba Hydro (Winnipeg)
<http://www.hydro.mb.ca/>

Manitoba Industry, Economic Development & Mines (Winnipeg)
<http://www.gov.mb.ca/itm/>

Manitoba Culture, Heritage and Tourism Regional Services Office (Brandon, Dauphin, Winnipeg)
<http://www.gov.mb.ca/chc/>

Manitoba Intergovernmental Affairs, Rural Economic Development Initiatives (Winnipeg)
<http://www.gov.mb.ca/ia/>

Manitoba Regional Highways Office (Brandon, Dauphin)
1525 - 1st Street North, Brandon, MB, R7C 1B5
Tel: (204)726-6807

Manitoba Water Stewardship (Winnipeg)
<http://www.gov.mb.ca/waterstewardship/>

Manitoba Weed Supervisors Association (Dauphin, Gilbert Plains) <http://www.gov.mb.ca/agriculture/contact/weeddistricts/>

Parks Canada, Riding Mountain National Park
<http://www.pc.gc.ca/pn-np/mb/riding/index_e.asp>

Prairie Farm Rehabilitation Administration (Brandon, Dauphin)
<http://www.agr.gc.ca/pfra/main_e.htm>

Rural Economic Development (Brandon)
<http://www.city.brandon.mb.ca/westmanadvantage/Business_programs1_provincial.html>

FIRST NATIONS

Birdtail Sioux First Nation (Birdtail Creek)
P.O. Box 22, Beulah, MB, R0M 0B0
Tel: (204) 568-4540

Ebb and Flow First Nation*
General Delivery, Ebb and Flow, MB, R0L 0R0
Tel: (204) 448-2134

Gamblers First Nation
P.O. Box 250, Binscarth, MB, R0J 0G0
Tel: (204) 532-2464

Keeseekoowenin Ojibway First Nation*
Box 100, Elphinstone, MB, R0J 0N0
Tel: (204) 625-2004

Rolling River First Nation*
P.O. Box 145, Erickson, MB, R0J 0P0
Tel: (204) 636-2211

Sandy Bay First Nation*
P.O. Box 109, Marius, MB, R0H 0T0
Tel: (204) 843-2462

Tootinaowaziibeeng Treaty Reserve* (Valley River)
General Delivery, Shortdale, MB, R0L 1W0
Tel: (204) 546-3334

Waywayseecappo First Nation Treaty 4 - 1874*
Box 9, Waywayseecappo, MB, R0J 1S0
Tel: (204) 859-2879

West Region Tribal Council (Dauphin)
21 - 4th Ave NW, Dauphin, MB, R7N 1H9
Tel: (204) 638-8225 / Toll free: 1-888-358-7340

(West Region Tribal Council members include the First Nations of Ebb and Flow, Gamblers, Keeseekoowenin, O-Chi-Chak-Ko-Sipi (Crane River), Pine Creek, Rolling River and Skownan.)

* **Members of the "Coalition of First Nations With Interests in Riding Mountain National Park"** (Membership as of December, 2004. Coordination and technical assistance provided by West Region Tribal Council.)

RURAL MUNICIPALITIES

<http://www.communityprofiles.mb.ca/csd/>

Clanwilliam (Erickson)
Dauphin (Dauphin)
Gilbert Plains (Gilbert Plains)
Grandview (Grandview)
Harrison (Newdale)
McCreary (McCreary)
Ochre River (Ochre River)
Park South (Erickson)
Rosedale (Neepawa)
Rossburn (Rossburn)
Shellmouth-Boulton (Inglis)
Shoal Lake (Shoal Lake)
Silver Creek (Angusville)
Ste. Rose (Ste. Rose du Lac)
Strathclair (Strathclair)

Association of Manitoba Municipalities (Portage La Prairie) <http://www.amm.mb.ca/>

PLANNING DISTRICTS

<http://www.gov.mb.ca/chc/fippa/wheretosend/planning.html>

Agassiz (McCreary)
Brandon and Area (Brandon)
Mid-West (Miniota)
Mountainview (Ethelbert)
Neepawa and Area (Neepawa)
Roblin (Roblin)
Rossburn (Rossburn)
Shoal Lake (Shoal Lake)
South Riding Mountain (Erickson)
Tri-Roads (Russell)

CONSERVATION DISTRICTS

<http://www.gov.mb.ca/waterstewardship/mwsb/cd/index.html>

Alonsa (Alonsa)
Intermountain (Ethelbert)
Lake of the Prairies (Inglis)
LaSalle – Redboine (Holland)
Little Saskatchewan River (Oak River)
Turtle River (Ste. Rose du Lac)
Upper Assiniboine (Miniota)
Whitemud (Neepawa)

NON-GOVERNMENTAL ORGANIZATIONS & INDUSTRY

Assiniboine Community College (Brandon) <http://public.assiniboine.net/>

Bird Studies Canada - Important Bird Areas Program <http://www.bsc-eoc.org>

Brandon Natural History Society

Brandon University (Brandon) <http://www.brandonu.ca>

Canadian Parks and Wilderness Society, Manitoba Chapter (CPAWS Manitoba) (Winnipeg) <http://www.cpawsmb.org/>

Clear Lake Cabin Association (Wasagaming)

Dauphin Lake Basin Advisory Board (Dauphin)

Delta Waterfowl Foundation (Portage La Prairie) <http://www.deltawaterfowl.org/>

Ducks Unlimited Canada (Brandon, Winnipeg) <http://www.ducks.ca/>

Farming with Fewer Chemicals <http://www.umanitoba.ca/outreach/fewerchemicals>

Fish and Lake Improvement Program for the Parkland Region <www.flippr.ca/index.html>

Friends of Riding Mountain National Park (Wasagaming) <http://www.friendsofridingmountain.com/who_we_are.htm/>

Intermountain Naturalists (Dauphin)

Keystone Agricultural Producers (Winnipeg) <http://www.kap.mb.ca/>

Louisiana-Pacific Canada Limited (Swan River) <http://www.lpcorp.com/>

Manitoba Bison Association <http://www.manitoba-bison.com/meat/meat.html>

Manitoba Cattle Producers Association (Winnipeg, Erickson, Ste. Rose) <http://www.gov.mb.ca/agriculture/livestock/beef/mcpa.html>

Manitoba Elk Growers Association (Oak Lake) <http://www.manitobaelk.ca/>

Manitoba Forage Council (Winnipeg) <http://www.escape.ca/~mfc/>

Manitoba Forestry Association (Winnipeg) <http://www.mbforestryassoc.ca/>

Manitoba Habitat Heritage Corporation (Brandon, Shoal Lake, Minnedosa, Winnipeg) <http://www.mhhc.mb.ca/>

Manitoba Lodges and Outfitters Association <http://www.mloa.com/>

Manitoba Naturalists Society (Winnipeg) <http://www.manitobanature.ca/>

Manitoba Recreational Trail Association <http://www.mrta.mb.ca/>

Manitoba Wildlife Federation (Winnipeg) <http://www.mwf.mb.ca/>

MB-North Dakota Zero Tillage Farmers Association (Isabella) <http://www.mandakzerotill.org/>

Mixedwood Forest Society (Swan River) <http://www.mixedwoodforestsociety.org/>

Nature Conservancy of Canada (Brandon, Winnipeg) <http://www.natureconservancy.ca/HTML/Site_MB_Main_e.htm>

Parkland Habitat Partnership (Riding Mountain National Park)

Parkland Tourism <http://www.parklandtourism.com/>

Riding Mountain Biosphere Reserve Management Committee (Onanole)
P.O. Box 232, Onanole, MB, R0J 1N0
Tel: (204) 848-4574 / Email: rmbr@mts.net
<http://www.biosphere-canada.ca/home.asp>

Riding Mountain Landowner Association (formerly South Riding Mountain Landowner Association)

Rocky Mountain Elk Foundation (Minitonas) <http://www.rmef.org>

Rossburn Subdivision Trail Association (Rossburn) <http://www.town.neepawa.mb.ca/rsta/>

Sierra Club of Canada (Prairie Chapter, Edmonton) <http://www.sierraclub.ca>

Travel Country Roads Canada (formerly Country Roads Agri-tourism Product Club) (Neepawa)
Box 1728, Neepawa, MB, R0J 1H0
Tel: (204) 476-5062 / Toll free: 1-866-476-5062
<http://www.countryroadsagritourism.com/>

University of Manitoba (Winnipeg) <http://www.umanitoba.ca>

University of Winnipeg (Winnipeg) <http://www.uwinnipeg.ca>

Wasagaming Cottage Association (Wasagaming)

Wasagaming Tenants Association (Wasagaming)

Wildlife Habitat Canada (Ottawa) <http://www.whc.org/>

Woodlot Association of Manitoba (Winnipeg)
900 Corydon Ave, Winnipeg, MB, R3M 0Y4
Tel: (204) 453-7102

CPAWS
CANADIAN PARKS AND WILDERNESS SOCIETY
MANITOBA CHAPTER

WWW.CPAWSMB.ORG