

Meadow Lake Provincial Park

ECOSYSTEM-BASED MANAGEMENT PLAN 2019

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Ecosystem-based Management Plan for Meadow Lake Provincial Park

Drafted by
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Approval Form

The Ecosystem-based Management Plan for Meadow Lake Provincial Park (2019) is hereby approved for use by the Ministry of Parks, Culture and Sport in the management of the ecosystem and landscape of Meadow Lake Provincial Park.

Recommended for approval by

May 20th, 2019

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EXECUTIVE SUMMARY

Meadow Lake Provincial Park (MLPP) is a 1700 km^2 Natural Environment Park at the southern edge of the boreal forest, bordered on the south by agricultural land and on the north by commercial forest. Most of the park is made up of natural vegetation, which is classified into 20 ecosites including grassland, pine-dominated stands on sandy soils, aspen stands and aspen-white spruce mixedwoods on loamy soils, black spruce stands on moist soils, and extensive peatlands. About a quarter of the park is water, including several popular recreation lakes and the Waterhen River system. The park supports rich biodiversity, including 376 vascular plants, 191 birds, 48 mammals, 4 amphibians, and 1 reptile. Habitat for the diversity of animal species depends on the diversity of vegetation types.

The park landscape is shaped by both natural and anthropogenic disturbances. The natural disturbance regime is dominated by wildfire, but there have been few large fires since the "Great Fire of 1919". The human history includes aboriginal use and 20th Century trapping, logging, and homesteading. Recreation became the dominant land use with the creation of the park in 1959. The footprint of development on MLPP is relatively heavy, with over 700 campsites, over 300 cottages, 14 natural gas wells and associated pipelines, and over 900 km of roads and trails. The park is also used for hunting (including commercial outfitting), trapping, sport fishing, and livestock grazing.

This ecosystem-based management plan provides strategic directions for the maintenance, protection and restoration of natural landscape, ecosystem and species diversity of MLPP, which in turn enhances visistor experience and public appreciation and understanding. In the plan, each issue is given context, management goals and objectives are identified and corresponding recommendations are provided. The management plan is designed to provide a long term and comprehensive framework to guide both park operations and park services in using natural resources in sustainable manner. The plan identified two main ecosystem-based management goals and nine objectives, including:

- **Goal 1 - Enhancement of Recreational, Aesthetic, Educational, and Interpretive Opportunities within a Safe Outdoor Environment.**
  - Objective 1. Manage park vegetation to ensure an attractive, safe and natural environment for park patrons utilizing MLPP trails and non-core area campgrounds
  - Objective 2. Provide enhanced opportunities for the interpretation of park vegetation, landscapes, ecosystems, and species
  - Objective 3. Manage core area vegetation to regenerate a vigorous natural forest in campgrounds, and adjacent beach and recreation areas, and to ensure the timely removal of hazardous trees
- **Goal 2 – Maintain and Restore the Natural Landscape, Ecosystem, and Species Diversity of MLPP**
  - Objective 1. Restore a more natural disturbance regime to park ecosystems
  - Objective 2. Assess the impact of all ongoing management activities and proposed developments on park biodiversity and make management recommendations
  - Objective 3. Monitor the state of MLPP environment and the outcomes of ecosystem-based management actions
  - Objective 4. Ongoing inventory of MLPP's biological and ecological resources

- Objective 5. Prospects for expanding MLPP to create a land management unit with greater ecological integrity and stability
- Objective 6. Build conservation partnerships with non-governmental organizations and other government agencies

Major recommendations include:

- Managing future development and cancelling existing grazing permits are recommended, to avoid degrading the natural capital of the park – the scenery, natural setting, and biodiversity that attract people to go there in the first place.
- The relative lack of forest renewal since the 1940s has led to a high proportion of the forest being in the mature to old stage and little area of young forest. Maintaining a diversity of forest age-classes over the various ecosites is necessary to provide habitat for all of the biodiversity of the park. Renewal of some of the mature to old forest by natural disturbance emulation harvests and/or fire treatments to create more young forest, while maintaining most of the old to very old forest (i.e. white spruce stands), are recommended to increase age-class diversity. Development of forest management plan and fire management plan is necessary to indicate specific management actions regarding the maintenance and renewal of park ecosystems.
- Invasion by exotic plant species, while localized at present, is considered to be a major future threat, because of the proximity of agricultural land and the high fragmentation by roads and other developments, and grazing activity. Control of existing infestations and reduction in activities such as ATV travel and livestock grazing that contribute to invasion, are recommended.
- Closure and reclamation of roads and trails that are not needed for access or recreation is recommended to reduce fragmentation and spread of exotic plants.
- Management of core-area vegetation is recommended to identify and deal with risk trees, and to renew the forests surrounding most developments.
- The climate of MLPP is expected to become warmer and drier over the coming century, with grasslands becoming a more important part of the landscape. The patches of grassland now present, besides being important as unique ecosystems, will be the source area for this expansion, so maintaining their ecological health is critical. Therefore, development of specific grassland management plan for MLPP is recommended. Other unusual ecosystems (e.g. wetlands) and occurrence of species at risk in the park are recommended to document and assess their habitats and any threats to them to maintain the diversity of species and ecosystems in MLPP.
- The park zoning map requires revision using current standards, and using the ecosystem-based management plan as a foundation. Expanding the park to the north should be considered to provide more protection for wildlife habitat, plant biodiversity and water quality. Other land surveys surrounding the park are also recommended to identify potential lands and ecosystem diversity for park expansion.
- There is a need to develop the interpretive material on the concepts of ecosystem-based management planning and specific topics related to ecosystem-based management such as role of ecosystem diversity and natural disturbances, grassland remnants, threat of exotic species and fragmentation.

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1 PURPOSE, APPROACH AND PROCESS

1.1 Purpose of the Plan

The purpose of this plan is to provide a foundation for ecosystem-based management of Meadow Lake Provincial Park (MLPP), in accord with current standards and policies and the guideline of ecosystem-based management plans provided by Park Division. This plan is intended to address issues related to management of the park's terrestrial ecosystems. The emphasis of the plan is on the general directions for ecosystem management, rather than on day-to-day operational issues. It is expected that the ecosystem-based management plan will provide a building block for revision of the overall Park Management Strategy.

The rationale for developing ecosystem-based management of MLPP is as follows:

- Ecosystems are the natural units for management in MLPP –scaled to humans; not too big, not too small (e.g., forest stand, grassland patch, river reach, lake zone, etc.)
- Threats posed by human activities are many: alterations to fire regimes, introduction of exotic invasive plants, insects, and diseases, acid precipitation from oil and gas development, climate change, mechanical disturbance in the core area, unauthorized ATV use, dams, grazing, etc.
- Management actions are needed to mitigate/relieve these threats and to maintain natural landscape, vegetation biodiversity, and ecological processes. These actions include: forest harvesting, prescribed burns, grazing in grasslands, management of invasive exotics, tree risk and tree regeneration in the core area, etc.
- Planning is required to give context to threats to the park ecosystems, and our responses to those threats. Contexts to be addressed include: social, economic, ecological, and landscape contexts.

1.2 Planning Approach

Ecosystem-based management has become the dominant paradigm for protected areas in North America. Saskatchewan Environment summarized this paradigm in a set of principles for their operations (SERM 1999):

- Focus on the large spatial and long temporal scales.
- Concentrate on ecosystem health and integrity.
- Make decisions based on science-based and traditional knowledge and human values.
- Involve those who will be affected by decisions, or who have an interest in the outcome.
- Use adaptive management by learning from experience.
- Look at the big picture.
- Base planning units on natural boundaries when appropriate.
- Design with nature.

Ecosystem-based management differs from traditional resource management in several ways. It is based on the ecosystem concept, in which ecosystems are viewed as open, evolving, complex systems with dynamic interactions between system components – including human, ecosystem features and ecological processes. An integral part of ecosystem-based management is that the human system is viewed as part of the ecosystem. Land managers are expected to consider the whole interconnected system, not just individual species, resources or issues. They have to take the long-term view (recognize that ecosystems are constantly changing) and the landscape view (recognize that ecosystems interact with their surroundings).

In addition to the shift in understanding, there is a shift in values. One of the goals of ecosystem-based management plan is maintaining ecosystem integrity. This includes conserving the biodiversity of the area under consideration, including genetic diversity, species diversity, and ecosystem/landscape diversity. These comprise the "natural capital" of the area, which is valued alongside the human-created capital such as campsites and roads. Uses and management must meet the test of sustainability, meaning that they cannot reduce the opportunities of future generations. Development which leads to a permanent reduction in natural capital (e.g. eliminating some componnents of biodiversity, or degrading soil and water systems) would fail this test.

Ecosystem-based management is knowledge-intensive, integrated and holistic science. Because it is based on understanding of the ecosystems being managed, it requires ecological inventory and research. Choosing management actions requires knowledge of ecological structure and processes. But because this knowledge is rarely adequate for decision making, plans should include research and monitoring, so that each management action leads to improved understanding. Plans are subject to revision as understanding improves.

1.3 Planning Process

This plan was based mainly on a review and analysis of existing information. The project team initially met with Parks Service staff at MLPP to discuss issues and information sources. Parks Service provided extensive files from previous work on vegetation management and other issues at MLPP. The project team conducted a brief field reconnaissance of the ecosystems of the park, which was combined with their own field experience over many years in this region. Following this reconnaissance, the team worked through the available information, bringing in scientific literature as appropriate, and consulting with Parks Service staff on specific issues. Duty to consult and public consultation processes were also implemented to achieve comments and feedback before the approval of the plan.

2 KEY ISSUES AND PRIORITIES

2.1 Biodiversity Issues

2.1.1 Restoration of a More Natural Disturbance Regime to Park Ecosystems

Supporting the full range of biodiversity in MLPP requires maintaining significant areas of young, mature, and old forest. Analysis of the disturbance history and current age distribution shows that most of the park's forest is in the mature to old stage, because there has been relatively little renewal since the 1940s or 1950s. This is related to fire suppression and absence of logging. However, the broader landscape view shows that there has been substantial renewal by recent logging in the commercial forest bordering the park to the north. While the broader view reduces the urgency of this issue, some renewal of mature forest inside the park is desirable, with disturbances by harvesting and/or fire being the preferred approaches. However, there is also a need to protect the limited areas of old forest, because of their critical value for some components of biodiversity.

2.1.2 Maintaining and Restoring the Diversity of Natural Landscapes, Ecosystems and Species

The natural capital of MLPP is based on the beautiful lakes, the natural forests and wetlands that surround them. Without this natural capital, there would be no park.

The diversity of terrestrial ecosystems in MLPP is represented by the new provincial classification of ecosites (McLaughlan, Wright, and Jiricka 2010). Predictive ecosite mapping shows that at least 20 ecosites are important in the park. These ecosites differ in tree canopy, understory vegetation, and soil properties. Maintaining the natural capital of MLPP requires that this range of ecosites continues to be fully represented. In part, this requires maintaining significant areas of all forest age classes (see Section 2.1.1).

Climate change may cause changes in vegetations requiring recognition that the vegetation of MLPP will change over the coming century, with grassland expanding and forest shrinking. Rather than trying to freeze the current pattern of ecosystems, the aim of conservation management should be to enable this transition to occur with as little ecological degradation as possible. This transition can be supported by maintaining the health of ecosystems and reducing threats to them.

Exotic invasion is one of the most serious threats to the natural capital of the park, and it is one of the key factors that determine whether natural and anthropogenic disturbances lead to ecological degradation. The park is remarkable in having almost entirely natural vegetation, but there are several factors that increase the future threat: the proximity to agricultural land along the south boundary; the presence of cattle grazing within the park; and the high fragmentation by roads and trails, pipeline and utility corridors, and recreational developments. Managing future threat is one of the most critical issues in preserving the integrity of natural ecosystems of MLPP.

2.1.3 Conservation of Unique Ecosystems and Rare Species

Most of the ecosites described in MLPP are common types found in other parts of the southern boreal forest. The main unique ecosystem within the context of the park is the scattered patches of grassland. Apart from adding prairie biodiversity to a mostly forested park, grasslands are significant because they are expected to become a more important part of the park landscape with the shift to a warmer, drier climate over the coming century. The current grassland patches will provide the source areas for this expansion, so maintaining their ecological health is critical.

While a number of rare plants and animals are documented for MLPP, the emphasis in this plan is on the "coarse-filter" approach to conservation. Maintaining the diversity and health of ecosystems (see Section 2.1.2) will provide the habitats needed by rare species.

2.1.4 Conserving Animal Populations and Species across MLPP

The vegetation of MLPP supports a wide range of animal species, including birds of forests and wetlands, ungulates and furbearers. Common wildlife species found in MLPP include moose, white-tailed deer, elk, black bear, timber wolf, cougar, lynx, snowshow hare, beaver, muskrat and over 175 bird species. Analysis of their diverse habitat requirements underscores the need to maintain the whole range of ecosites and age classes. Additionally, a more natural disturbance such as wildfire or prescribed fires is also critical factor to conserve wildlife population due to creating of diverse food resources and habitat for wildlife species. For example, moose especially favour young successional stages of trees (e.g. aspen) that are results of fire disturbance. Maintaining and restoring natural ecosystems at late seral stages (e.g. mature and old-growth forest) are necessary to conserve species that prefer old-growth ecosystems (e.g. pileated woodpeckers). Therefore, an ecosystem-based management approach allows for the conservation of all animal species rather than focusing on single-species management.

2.2 Landscape and Ecosystem Management Issues

2.2.1 Fragmentation

The natural capital of MLPP depends not just on the area of natural ecosystems, but on how that area is spatially distributed. A contiguous 1000 ha block of natural forest has more value than the same area in several patches separated by roads and other developments. Fragmentation at the landscape level of MLPP is induced by the ongoing activities of recreational and industrial uses (e.g. trails, gaswells and gaslines, cottages and campsites) of park land as well as natural disturbances such as wildfire. As a result of fragmentation, habitat loss has large, consistently negative effects on biodiversity of birds, mammals and plants. Therefore, without limiting development of resource use activities within the park boundary, the diversity of species, ecosystems and landscape will be threatened and diminished. Fragmentation due to the expansion of access ways also provide opportunities for the invasion of introduced weeds.

One of the goals of the park is to provide recreational facilities for the public, and there is naturally an interest in increasing visitor numbers by developing more facilities. However, the benefit of increased development must be weighed against the cost to natural capital (Figure 2.1). This cost ultimately reduces the values of the natural setting, the attractive scenery, and the biodiversity that attract people to the park as the first place.

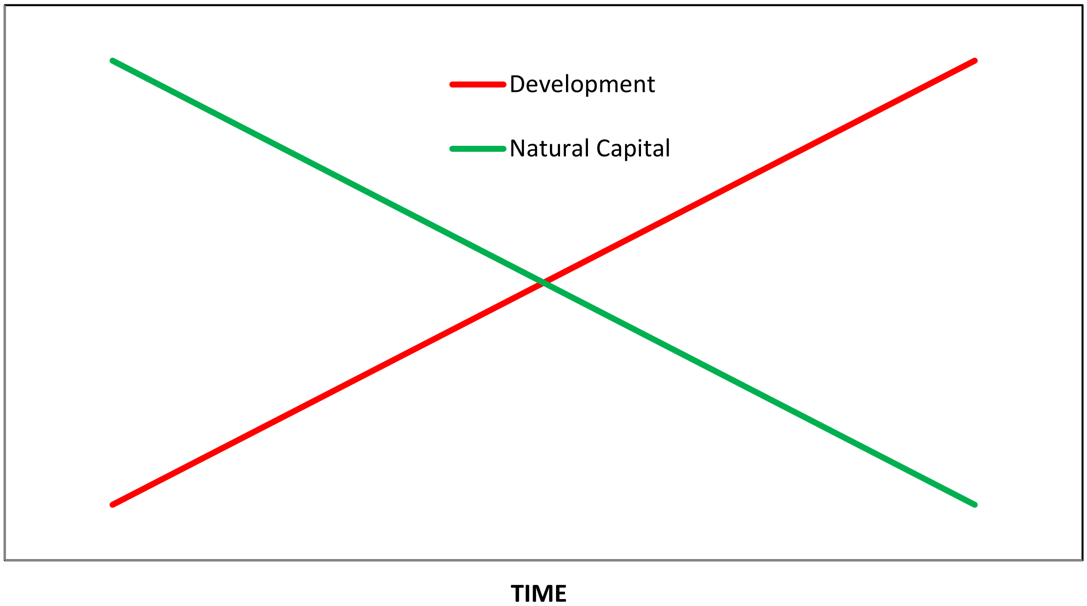

Figure 2.1 The tradeoff between development and natural capital (Modified from Klasen et al. 2016).

MLPP already has a relatively high development footprint for a natural environment park, with hundreds of kilometres of roads and trails, numerous campgrounds and cottage subdivisions, as well as a variety of other resources uses. Therefore, the emphasis in the future should be on limiting further development and minimizing the ecological footprint of any new developments.

2.2.2 Core Area Vegetation Management

The development that already exists in MLPP plays an important role in accommodating visitors. However, management of the vegetation in core area facilities creates issues of its own. The immediate issue is detection and treatment of risk trees which could endanger park users. The long-term issue is the need to renew the forest in core areas, because the aging forest will create more risk trees that will eventually fall down. Other issues in the core area relate to physical damage, especially along the shorelines which are the focus of much visitor activity.

2.2.3 Park Expansion, Re-designation, Vegetation Management, and Conservation

MLPP was originally designed around the high recreational potential of the chain of lakes along the Waterhen River system. The resulting narrow east-west strip of park is bordered on the north by an upland area which is used for commercial forestry. One idea that has been suggested is to expand the park to include this upland. This would create a larger contiguous block of land, much of which could be designated as a natural zone with limited development. However, this area is already heavily impacted by roads and recent clearcuts, so incorporation into the park would require a mix of restoration and natural recovery. Ironically, incorporating recently logged lands into the park would allow a re-balancing of the age-class distribution of the park forest without undertaking further logging. Recent logging systems are designed to minimize ecological degradation and recent cutblocks outside of the park should show little in the way of erosion or soil degradation (i.e. compaction and rutting).

2.2.4 Assessing the Ecosystem Effects of Resource Extraction Activities

Overall, resource extraction has a limited impact on MLPP. Commercial timber harvesting has been absent for many years. Apart from a few gravel quarries there is no mining. However, MLPP is one of the few provincial parks with oil/gas development, with a network of wells and pipelines which contribute to the overall fragmentation of the park (see Section 3.5.1). However, their impact is limited to the current footprint, as policies now in place will prevent future surface disturbance for gas wells. Hunting and trapping are traditional activities which are regulated for sustainability and do not have major negative impacts. However, the practice of baiting by commercial hunting outfitters is contentious. This practice contributes to ATV traffic which keeps many kilometers of trail open, that would otherwise be closed or not exist at all, ATV traffic spreads exotic plants, and the grain baits used for deer may contain seeds of exotics. The other contentious extractive issue is cattle grazing, which has major effects on vegetation structure, brings exotic plants into the park, and is unattractive to recreationists along the Waterhen River. Cattle are primarily grazing animals and are more suited, ecologically, to life in a grassland environment.

2.3 Interpretation and Information Management Issues

2.3.1 Interpretation of Natural Vegetation and Landscapes, Species At Risk, and Management Actions

Ecosystem-based management planning provides a number of themes that can be communicated to the public in interpretive programming, including:

- The diversity of ecosystems in MLPP, with the material structured by the new forest ecosite classification.
- The role of ecosystem diversity (including age-class diversity) in providing habitats for a range of animals (e.g. differences in bird communities among ecosite types).
- The natural role of fire in forests of the park; successional stages following fire; and treatments such as prescribed burning that can be used to return fire to the landscape.
- Climate change and its expected effects on park ecosystems.
- Grassland remnants: their links to the prairie grasslands of southern Saskatchewan, and their potentially important role in the response of the park to climate change.
- The threat of exotic species: where they came from, and how they affect ecosystems in the park.
- The threat of fragmentation: effects of roads on animal habitat use; role of road and trails in distributing exotic species; effects of fragmentation on species at risk.

2.3.2 Parks Ecosystem Database: The Management and Use of Natural Resource Data

Ecosystem-based management depends on monitoring to determine the effectiveness of management actions and subsequent revision of plans. Monitoring is useless without orderly storage of data. Saskatchewan Parks Service has played an active role in development of the Vegetation Information System Saskatchewan (VegISS), a multi-agency database for storage and sharing of vegetation data. Past and future vegetation data collected in MLPP should be entered into VegISS to ensure that it is properly stored and can be accessed in the future. One of the key variables in organizing vegetation plots is ecosite. The new provincial classification of forest ecosites should be used to classify all vegetation data collected in MLPP. In addition to VegISS, the resource information collected for the ecosystem-based management plan in MLPP is aslo stored in the Parks Ecosystem Database (PED). The PED is the repository of all the known biological and ecological data on the Saskatchewan provincial parks.

3. LANDSCAPE AND ECOLOGY OF THE PARK

3.1 Regional Landscape and Administrative Context

Meadow Lake Provincial Park (MLPP) is located at the boundary between the Mid-Boreal Upland Ecoregion (the main area of commercial forest in Saskatchewan) and the Boreal Transition Ecoregion (the southern fringe in which agriculture has encroached on the boreal forest) (Padbury and Acton 1994) (Figure 3.1). According to Wilson and Martin (1998), MLPP is important in representing the Boreal Transition in the provincial park system, but is less so for the Mid-Boreal Upland, which is also represented by Duck Mountain, Narrow Hills, Clarence-Steepbank and Candle Lake Provincial Parks.

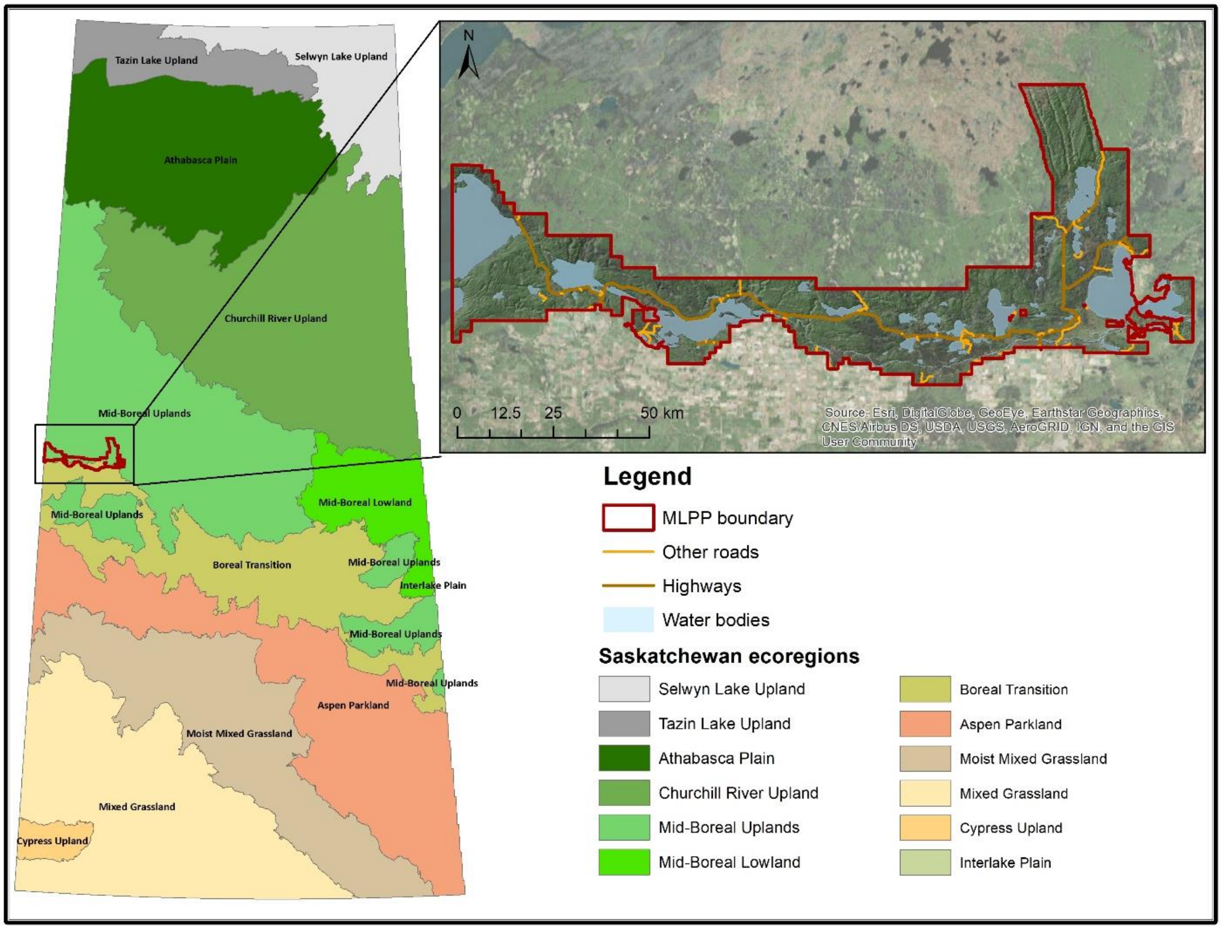

Figure 3.1 Location of MLPP (park boundary in red) in relation to the Ecoregions of Saskatchewan.

This transitional location is reflected in the different types of land administration surrounding MLPP (Figure 3.2). Immediately north of the Park is a belt of Provincial Forest approximately 30 km wide which is managed for commercial forestry under the Mistik Forest Management Agreement. North of that is the remote terrain of the Cold Lake Air Weapons Range. Immediately south of the Park is the agricultural zone in the Meadow Lake – Pierceland area, which is mostly either privately owned farmland or agricultural crown land. The closest settlements are in this agricultural zone, the main one being Meadow Lake (population 4771 in 2006), only 41 km from the park gate. There are two Indian reserves bordering the Park, Big Island Lake Cree Nation in the west and Waterhen Lake First Nation in the east. Therefore, the Park is at the interface of major changes in land use.

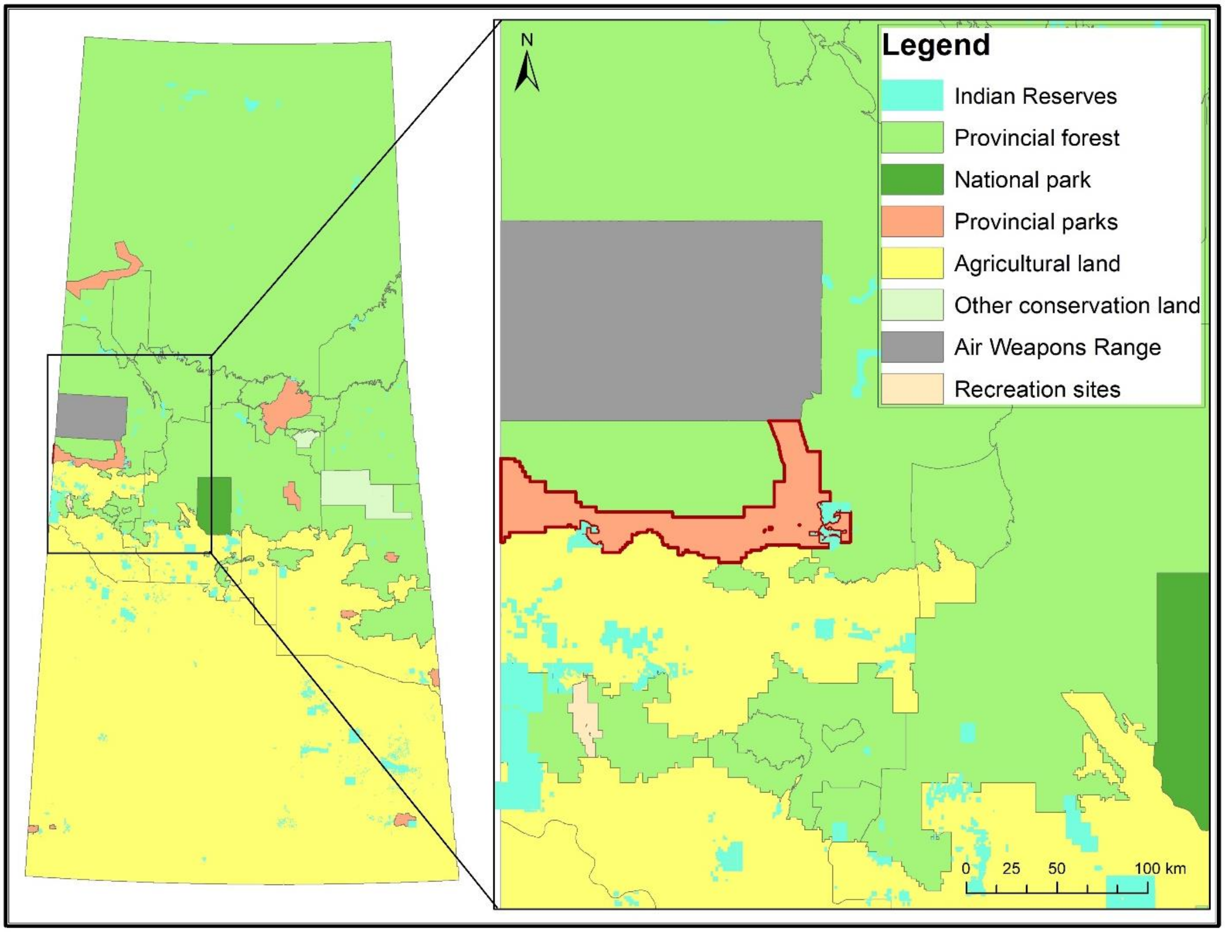

Figure 3.2 Land administration in the region of MLPP.

To more closely examine the surroundings of the park, a buffer of 2 km was plotted around the park boundary. Land uses within this strip were mapped on recent remote sensing imagery (Figure 3.3). This shows the close proximity of cleared land to the south boundary of the park. Along the east and north sides of the park, where it borders on provincial forest, this map also shows the area of recent timber harvesting. Contrasting land uses are literally right up against the park boundary (Figures 3.4).

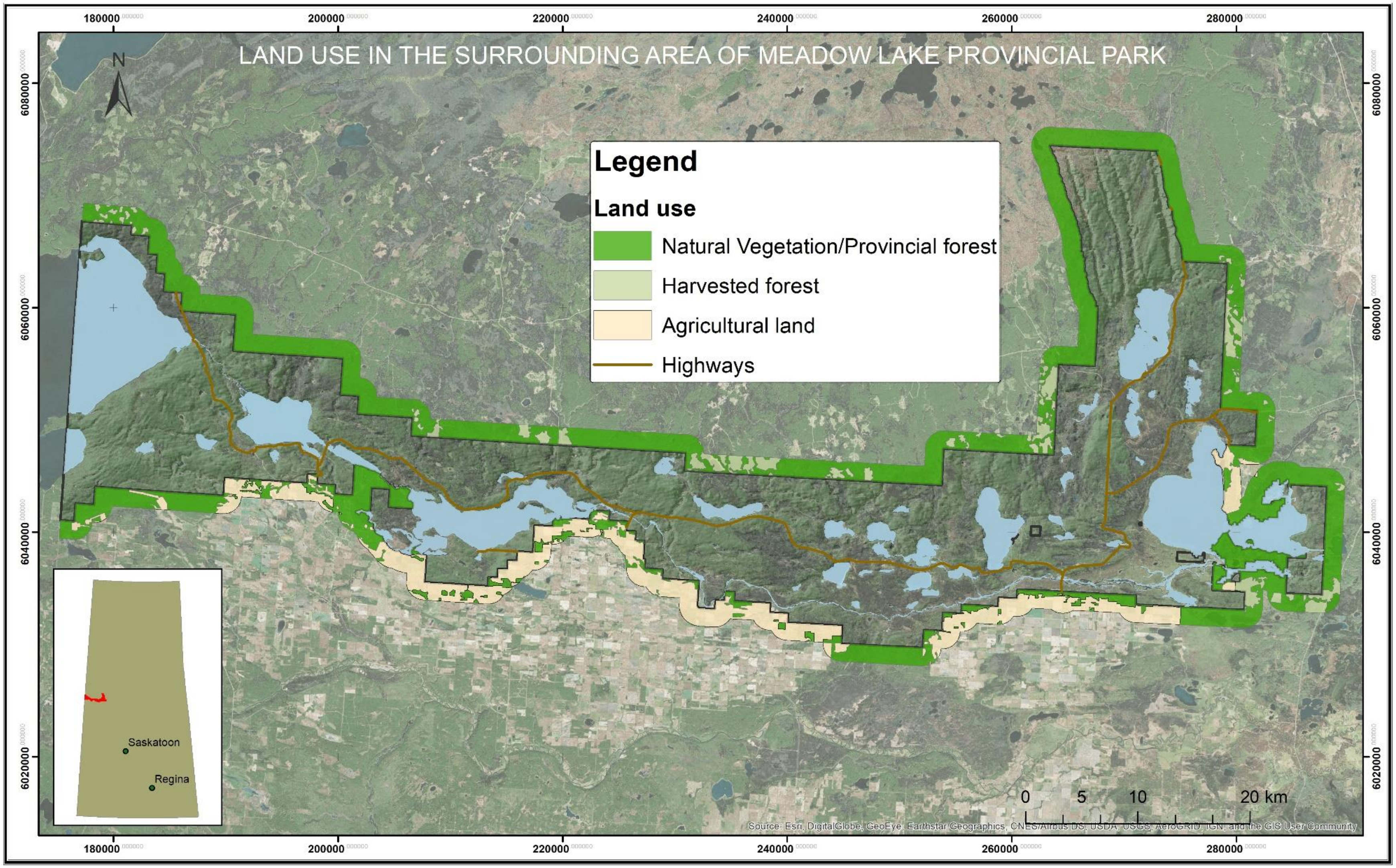

Figure 3.3 Land use in the area within 1.6 km of the boundary of MLPP.

Figure 3.4 A recent clearcut immediately adjacent to MLPP (to the left of the road) in the Salt Creek area.

The formation of MLPP in 1959 was centred around the recreational potential of the many attractive lakes along the Waterhen River system, and the largely natural forests surrounding them. Within the context of the provincial park system, MLPP is one of 12 Natural Environment Parks, which are considered to be large areas representative of high quality, nature-oriented outdoor recreation opportunities (Wilson and Zielke 1997). It is the fourth largest provincial park by area, and often ranks first in visitation (Wilson and Zielke 1997). While it provides local recreation opportunities for the nearby communities, it is relatively remote from larger cities, so its primary focus is destination-type extended-stay visitation (Wilson and Zielke 1997).

MLPP is linear in shape, about 110 km east-west and up to 32 km north-south, largely following the course of the Cold and Waterhen River system from Cold Lake on the Alberta border to Waterhen Lake. The area is 165,893 ha, of which 23% is covered by lakes and rivers (Wilson and Martin 1998). Elevations range from 472 to 625 metres over most of its area, which includes the central river system and lakes as well as the plains and rolling hills which border them. However, this main area also skirts the lower edge of the Mostoos Escarpment, a prominent slope which rises northward to the higher plateau of the Mostoos Hills. In 1994, a portion was added to the northeast corner of MLPP to represent the entire height of this escarpment, with elevations rising to 730 metres.

3.2 Physical Setting

3.2.1 Climate

The climate of MLPP is typical of the southern edge of the boreal forest. Temperatures are somewhat cooler and precipitation is somewhat higher compared to the Prairie Ecozone of southern Saskatchewan.

The average of 1408 growing degree-days[1] compares to 1612 growing degree-days at North Battleford (in the Aspen Parkland, about 200 km south of the park). Annual precipitation of 432 mm compares to 366 mm at North Battleford. The result is a somewhat moister climate compared to the Prairies. Hogg (1994) showed that the forest/grassland boundary in the Prairie Provinces is closely related to a climatic moisture index (CMI), calculated as annual precipitation minus annual potential evapotranspiration[2]. CMI values in the forest are generally positive (excess of precipitation over potential evapotranspiration) while those in the grassland are generally negative. CMI in MLPP averages -34 mm, close to the zero value that Hogg found typical of the forest/grassland boundary. By comparison, CMI at North Battleford is -128 mm, and values in the driest parts of the Prairies go below -400 mm. Precipitation is concentrated in the warm months, with 69% of the annual total occurring in the five months from May through September.

Climate change is expected to have a major effect on this region. Analysis of global climate models (Thorpe 2011) shows that the park could be substantially warmer by the 2050s, depending on which climate change scenario is used. Precipitation could stay the same or increase somewhat by the 2050s, depending on the scenario. However, because of the substantial warming, the climatic moisture index will be lower, indicating a drier climate. The seasonal distribution of precipitation is not predicted to change much by either scenario.

An ecoclimatic model (Thorpe 2011) was used to predict the effect of this climatic change on vegetation zones. For the region of MLPP, this model is driven by the climatic moisture index (CMI), with a threshold of -18 mm separating forest from Aspen Parkland, and -143 mm separating Aspen Parkland from Moist Mixed Grassland.

Application of the model to the current climate shows the position of the park close to the climatic boundary between forest and aspen parkland (Figure 3.5). This seems reasonable in light of the amount of aspen dieback seen in this part of Saskatchewan during recent droughts (see below). The cooler scenario for the 2050s shows the climate of the Aspen Parkland Ecoregion expanding northward over the park and the forest land to the north (Figure 3.6). The warmer scenario for the 2050s shows further northward shifts, with the climate of the Moist Mixed Grassland Ecoregion approaching the park (Figure 3.6). In addition to these changes in average conditions, climatologists predict that variability will increase, meaning that extreme events such as severe droughts may happen more frequently (Thorpe 2011).

[1] The sum of growing degree-days is a measure of the length and warmth of the growing season, and is calculated by summing the daily deviations above a base temperature of 5° C over the whole year.
[2] Potential evapotranspiration is an estimate of the amount of evaporation that would occur if there is always an ample supply of soil moisture and depends mostly on temperature.

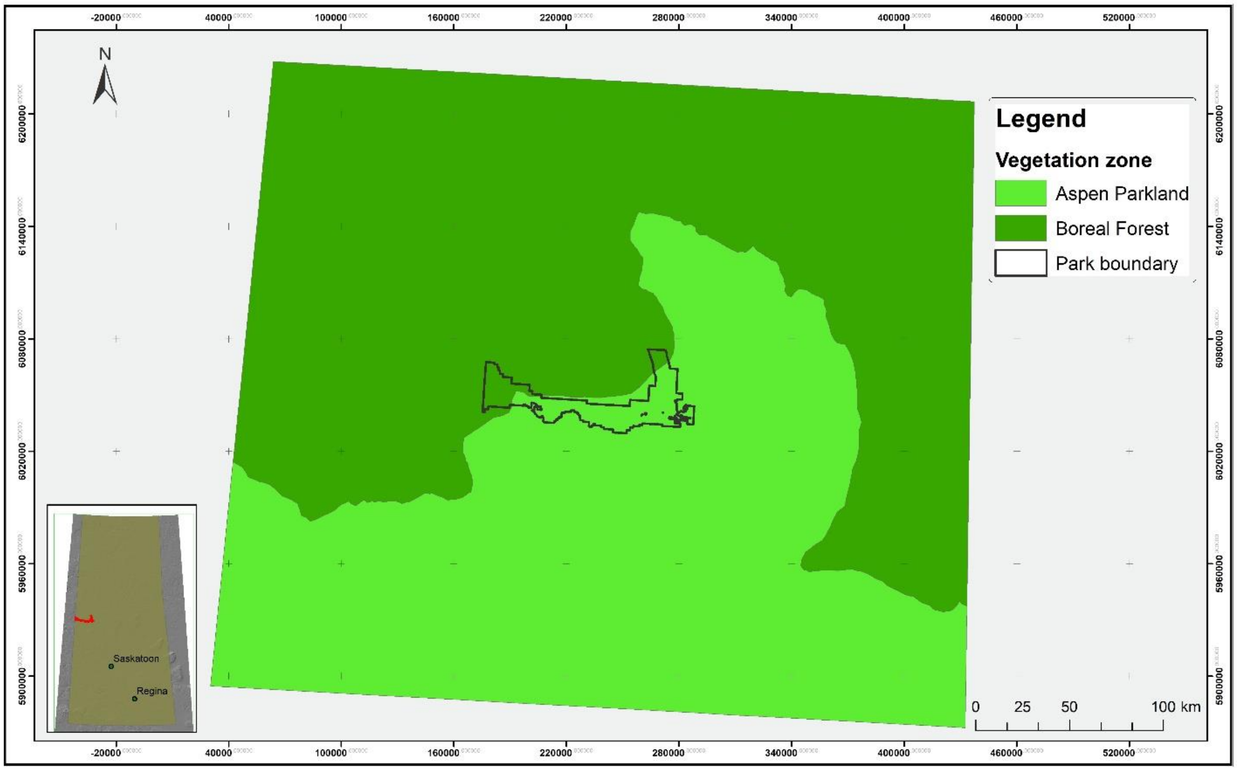

Figure 3.5 Vegetation zones predicted from an ecoclimatic model, based on the climate of 1961-90.

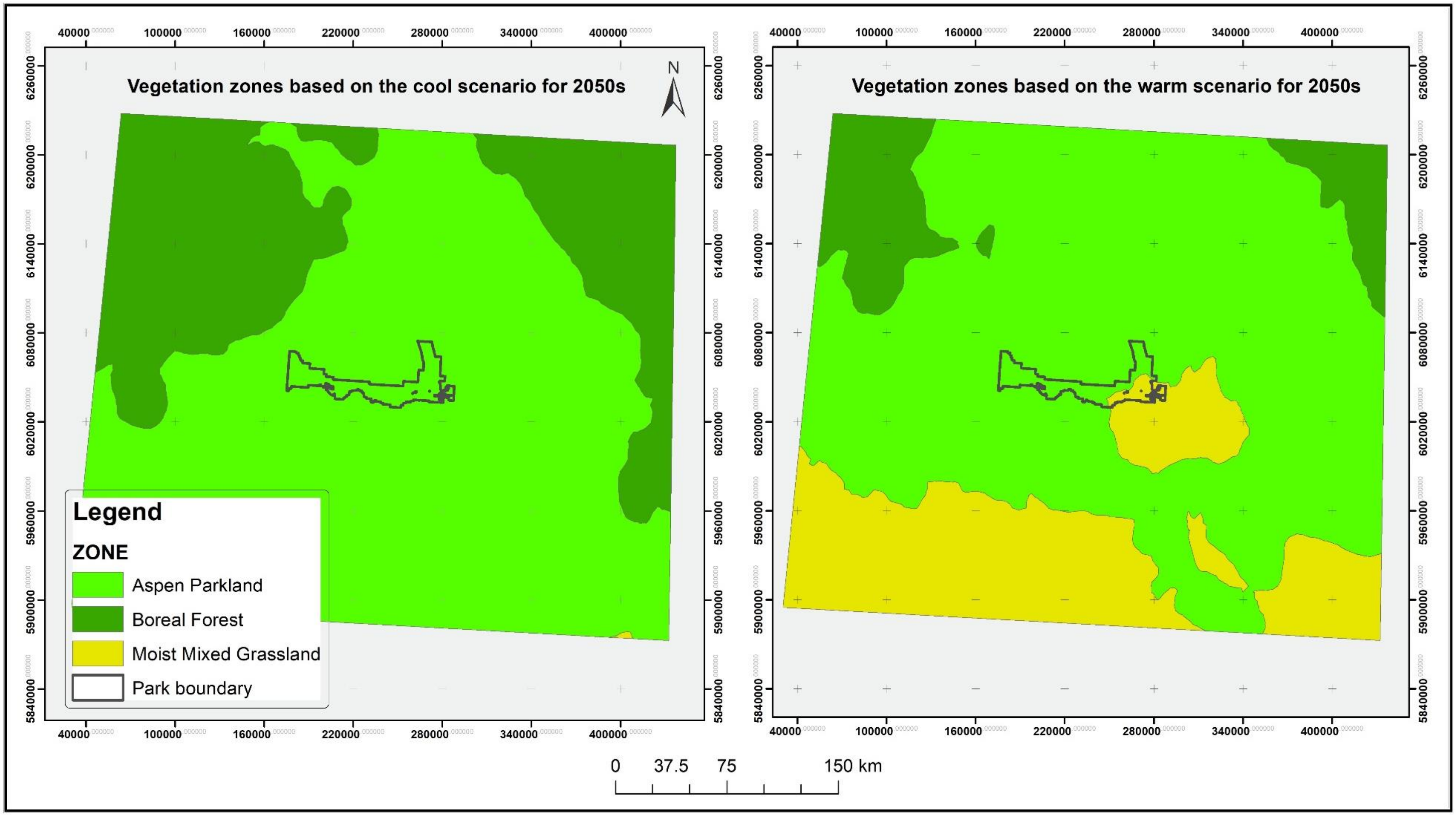

Figure 3.6 Vegetation zones predicted on the basis of two scenarios for the 2050s.

We do not know which of these scenarios will be closest to reality. We also do not know how fast the vegetation will change in response to these climatic changes. It is reasonable to expect established trees and other forest vegetation to persist for some time even as the climate gradually becomes less suitable for them. Therefore, the vegetation of the park in the 2050s cannot be exactly predicted. However, we can expect a trend toward declining forest cover and expansion of grasslands. This could occur in two ways: failure of tree regeneration following disturbance; or mortality of mature trees. The first type of change is thought to have happened after a wildfire during the 1988-1989 drought in the Nisbet Provincial Forest, an even more climatically marginal forest area in central Saskatchewan (Godwin and Thorpe 2009). The second type of change, in the form of aspen die-back, has been widely observed during recent drought years in northwestern Saskatchewan. Hogg et al. (2008) monitored aspen stands in Aspen Parkland and Boreal Forest during the severe drought of 2001-2002, and found that growth declines and tree mortality reduced net biomass increment to zero. Many other examples of recent tree mortality attributed to drought and heat stress have been documented around the world (Allen et al. 2010). Both types of change are more likely to happen on dry sites such as steep south-facing slopes, and during dry years. If droughts occur more frequently in the future, each such event could prompt an incremental expansion of grasslands on the most vulnerable sites. As discussed in Section 3.5.5, the existing patches of grassland, most of which are tiny and insignificant-looking, could serve as the source areas for expansion.

3.2.2 Landforms and soils

The shape of the land and the types of materials available for soil formation are determined by **landform**. Landforms express the way the land was deposited during and after the most recent melting of the continental glaciers, about 12,000 years ago (Christiansen et al. 1975). Generalized landforms in MLPP are shown in Figure 3.7.

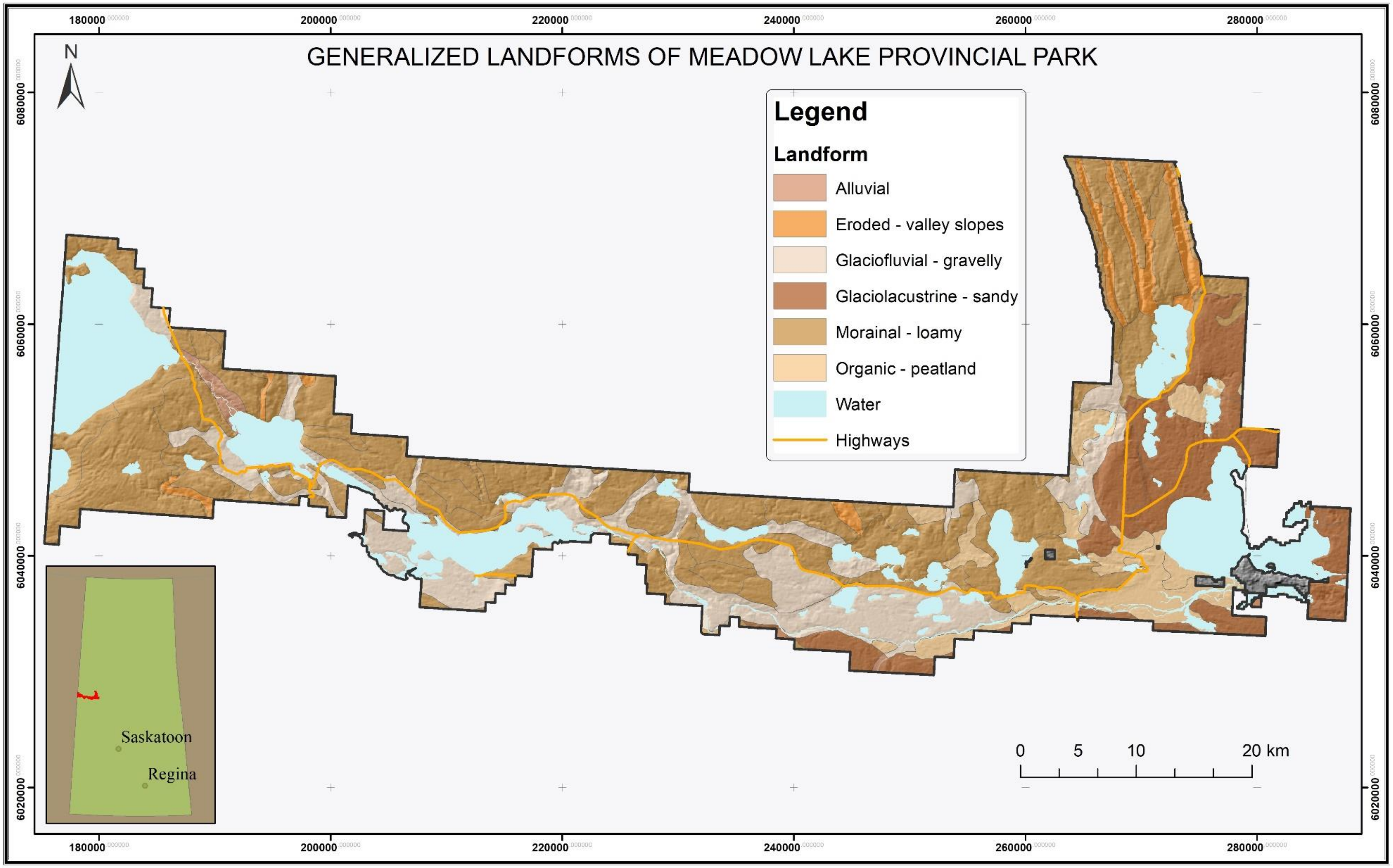

Figure 3.7 Generalized landforms of MLPP.

About 50% of the land area in MLPP consists of morainal landforms – hummocky deposits of glacial till which slumped down directly from the melting ice. Glacial till consists of a mixture of unsorted materials: sand, silt, and clay, along with scattered rocks. The resulting soils are loamy-textured. Most of the morainal landforms in MLPP are irregularly rolling, but they also include the Mostoos Escarpment, a strong south-facing slope which rises northward from the Park. The thickness of these glacial deposits above the underlying Cretaceous bedrock ranges from less than 60 metres to as much as 120 metres in the Mostoos Hills (Christiansen et al. 1975).

About 21% of the land area consists of glaciofluvial landforms, which were deposited by streams of glacial meltwater roughly where the Waterhen River is now. These deposits form gravelly or sandy plains bordering the present course of the river. In flowing water, the larger particles settle out, and the resulting deposits are coarse-textured. Some of the lakes in the Kimball to Matheson area were formed by burial of remnant blocks of ice in these glaciofluvial deposits, followed by melting to form kettle lakes (Christiansen et al. 1975).

About 16% of MLPP consists of glaciolacustrine or fluvial-lacustrine sands, which were deposited where the meltwater streams flowed into a large lake formed by accumulation of meltwater in the area south and east of MLPP. Waterhen and Meadow Lakes are modern remnants of this glacial lake. Where the meltwater streams flowed into this lake, they formed deltas of sandy material. Some of these sandy deposits were shaped by the wind into dunes (Christiansen et al. 1975). These landforms are mostly in the area from Flotten Lake to Waterhen Lake.

About 9% of MLPP consists of organic landforms, which formed over the 12,000 years since deglaciation, in poorly drained depressions and flats. In these permanently wet areas, lack of oxygen limits the decomposition of plant material, so it gradually accumulates to form peat. The largest area of peatland is found along the flat lower reaches of the Waterhen River and Otter Creek as they approach Waterhen Lake. Smaller areas of peatland occur in poorly drained depressions throughout MLPP.

About 4% of MLPP is mapped as eroded valley slopes, mostly in four deep valleys which have been cut into the morainal landforms of the Mostoos Escarpment at the northeast end of MLPP. About 1% is mapped as alluvial deposits formed along streams since deglaciation.

Soils are formed by the interaction of these materials with the vegetation that has grown on them over the millennia since the glaciers melted. The type of soil depends on the original material, the climate, the moisture conditions at the soil surface, and the type of vegetation. The climate in MLPP has usually been moist enough to support forest growth. In this moist environment, the dominant soil-forming process is downward movement of clay and other particles. Well-drained gray Luvisolic soils are dominant in the park (Figure 3.8 & 3.9).

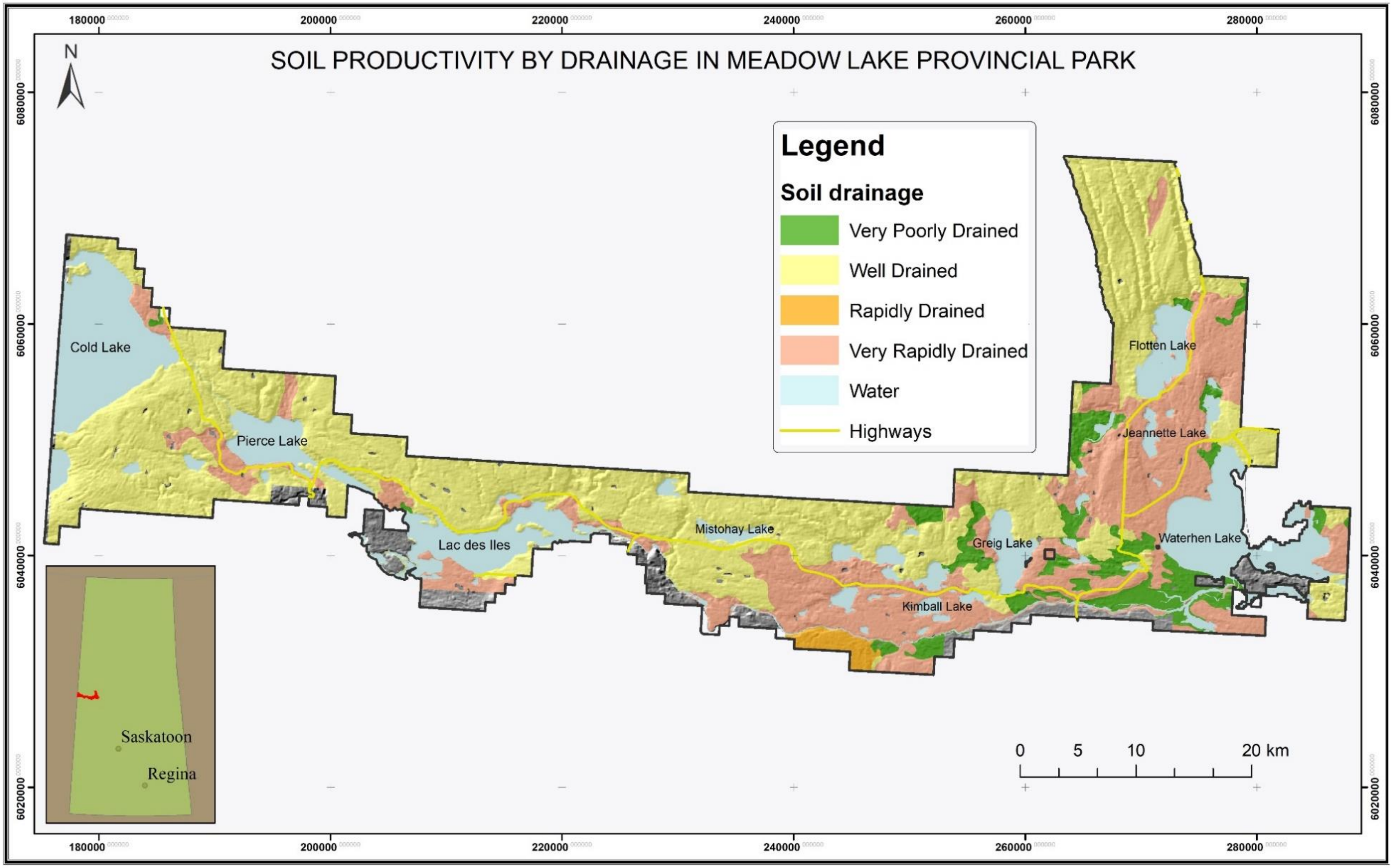

Figure 3.8 Soil productivity by drainage in MLPP

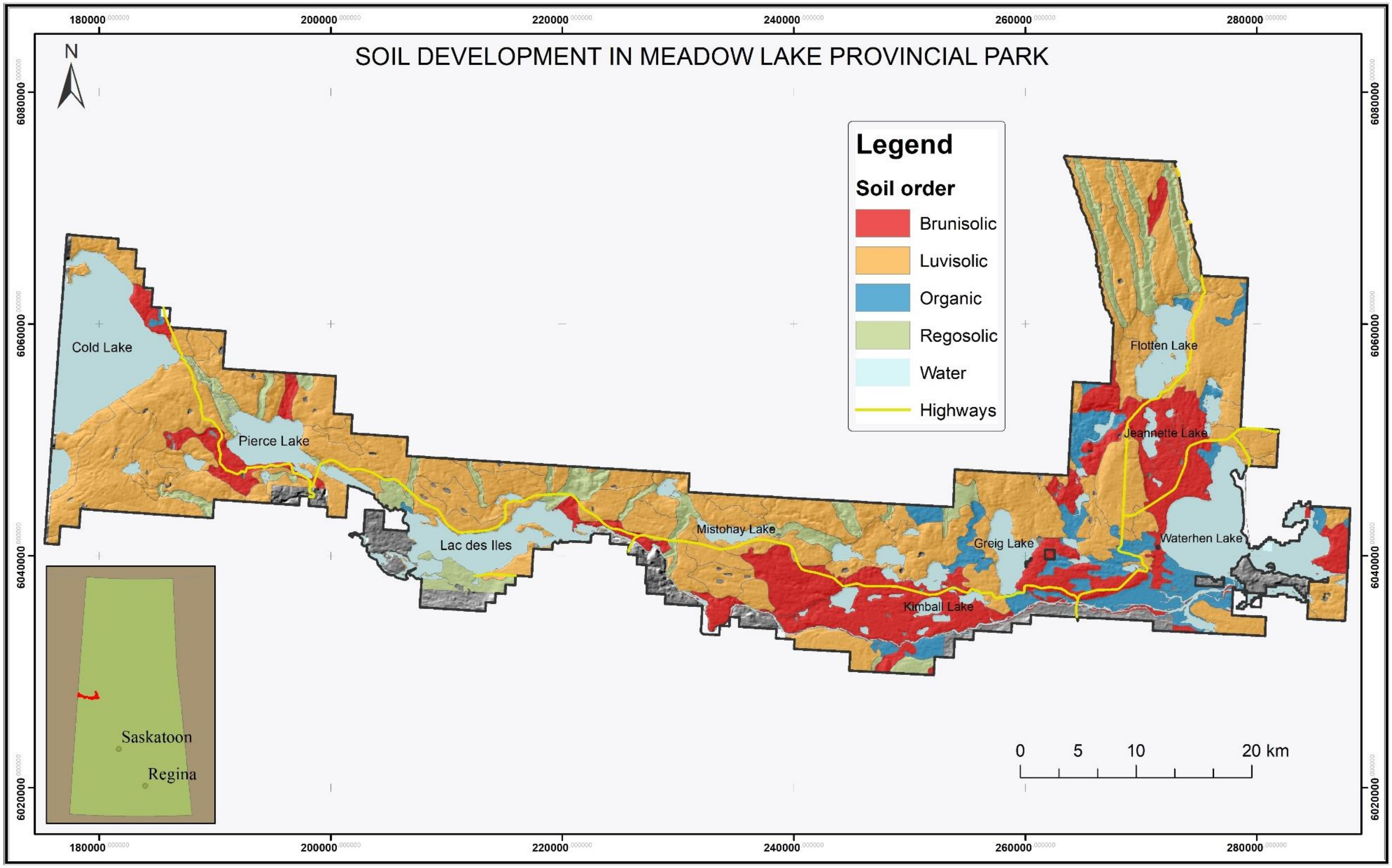

Figure 3.9 Soil development showing by soil order in MLPP

The Luvisolic soils have a paler, coarser-textured A horizon from which material has been leached, and a finer-textured B horizon in which clays have been deposited (Figure 3.10). Soil maps show Loon River association as the dominant Luvisolic soil on the loamy-textured morainal landforms of MLPP (SIP 1979). Part of the morainal area is also mapped as Bittern Lake soils, which are Luvisolic soils with a thin layer of sand overlying the loamy glacial till (i.e., brunisolic grey Luvisols).

In coarse-textured deposits there is not enough clay for the complete formation of Luvisolic soils with their clay-enriched B horizons. In the Brunisolic soils mapped in these areas, there is only a modest colour difference separating the paler A and darker B horizons (Figure 3.11). Brunisolic soils on the glacio-fluvial gravels and sands are mapped as Kewanoke soils (SIP 1979). Brunisols on the fluvial-lacustrine sands are mapped as Pine soils (SIP 1979). There are also minor amounts of Luvisolic soils (Bodmin, Sylvania, and Flotten associations) mapped on deposits of intermediate texture (coarse to moderately coarse).

Soils in peatlands are predominantly made up of plant remains and are referred to as Organic soils. Peatlands in MLPP are mapped as Bagwa Lake soils (SIP 1979). On steep valley slopes, soils result from a complex mix of erosion and deposition, and the Hillwash Complex is mapped (SIP 1979)

Figure 3.10 Luvisolic soil formed in loamy glacial till.

Figure 3.9 Brunisolic soil formed in sandy material.

3.2.3 Hydrology

Lakes are a dominant feature and make up a significant area of MLPP. About a quarter of the park is water surface, including several popular recreation lakes and the Waterhen River system. At the regional level, the Churchill River watershed encompasses the whole MLPP. Its headwaters are in the interior plains of east-central Alberta and in the Boreal Plains and Boreal Shield of west-central Saskatchewan. The Churchill River flows north east into the Hudson Bay. The lake storage within the basin serves to control flows, generally resulting in continuous flow throughout the entire year. The only significant dam in the watershed is near Sanday Bay, towards the Manitoba border, but it has a relatively small reservoir storage capacity that has little to no impact to hydrology in MLPP.

3.3 Natural Disturbance Regimes

3.3.1 Wildfire

Wildfire is the dominant natural disturbance in the boreal forest (Rowe and Scotter 1973, Heinselman 1981). Most boreal forest fires are sufficiently intense to kill all the trees in their path (Van Wagner 1983). Regeneration after these stand-destroying fires creates the mosaic of even-aged patches which characterizes most of the boreal forest. Boreal plant species have a variety of adaptations for rapid regeneration after fire, including storage of seeds in closed cones or in the soil, spreading of wind-blown seed, and resprouting from underground plant parts (Rowe 1983) (Figure 3.10). Boreal forest fires cover a range of sizes, including a few very large ones. The area burned is extremely variable from year to year, with occasional dry years accounting for most of the total (Armstrong 1999). The natural fire cycle[3] in the western boreal forest has usually been estimated at less than 50 years (Johnson 1979, Carroll and Bliss 1982, Murphy 1985, Weir et al. 2000) but stands of trees older than 50 years indicate the occurrence of groundfires or substantially longer lag periods between successive fires.

[3] The fire cycle or fire rotation is defined as the number of years required for an entire area to burn over once.

Figure 3.10 Regeneration of Jack pine 9 years after the 2009 Park fire (a) and regeneration of Jack pine two months after 2018 Tuff Fire (b).

In the region of MLPP, one large fire is documented in historical records. This "Great Fire of 1919" is thought to have consumed 2.8 million ha of western Saskatchewan and eastern Alberta, including the town of Lac la Biche (www.canadiangeographic.ca/magazine/ja03/indepth/timeline.asp). According to a "History of Meadow Lake" (www.meadowlake.ca/2008-06/history.php), this fire ended the fur trade era in the Meadow Lake area and opened it up for homesteads and agriculture. Parks staff interviewed three long-time residents who were familiar with the area at least back to the 1940s and 1950s (Cam Lockerbie, field notes, 1994). According to Albert Sharp, a former conservation officer, the 1919 fire started in May and only went out because of July rains, and covered the entire park except for damp oases and the river valley. However, John Hourie, a former park maintenance man, sketched the fire area as largely north of the Waterhen River, although it crossed in a few places. It burned most of the Air Weapons Range and the portion of the Mistik FMA north of the park. All informants indicated patches that were skipped by the fire. According to a local history publication for Pierceland (Sharp et al. no date), Eli Lepine described returning to his Pierce Lake trapping area in 1919 (after being away in World War I) and finding that the entire country had been burned over. Edward Lepine, who began work as a fire patrolman in 1949, relayed the story that this fire killed many Indians at a hunting and fishing camp on Sukaw Lake (Cam Lockerbie, field notes, 1994).

Recent fire history is better documented. Maps of eleven fires with total areas >100 ha that occurred from 1945 to 2018 were provided by Wildfire Management Branch and Park Division (Figure 3.11). Most of these fires were partly outside MLPP, except for Tuff Fire in May 2018 that consumed 6232 ha of forest within MLPP. Areas within the park are shown in Table 3.1. However, these areas are based on the overall perimeter of the fire. Some of the forest within this perimeter was skipped or only partially killed. The Saskatchewan Forest Vegetation Inventory (SFVI) map was used to estimate how much forest within the burn perimeter was actually consumed and then regenerated by fire, as indicated by a year-of-origin corresponding (at least to the nearest decade) to the date of the fire (Table 3.1). Wetlands and water were excluded because no year-of-origin was given for these areas.

The Pierceland and Gladur Lake fires regenerated most of the forest within their burn areas. The Long Lake and Moose fires also regenerated significant areas of forest, but most of the forest within the burn perimeters apparently escaped the fire as indicated by earlier year-of-origin dates. The smaller Skop, Last and Kelly fires regenerated very little forest. No year-of-origin was given for the vegetation cover after the 2006 Cold fire. It was mapped as “meadow” on the SFVI, but examination of aerial photographs showed a fairly complete tree kill which will probably give rise to a new age-class. Other fires including Park (2009), Wilson (2011) and Tuff (2018) fires post-dated the SFVI mapping in 2007. Our field observation in summer 2018 showed that most areas within Park and Wilson fires were regenerated with the dominance of jack pine seedlings (Figure 3.10a) and jack pine also started to germinate two months after Tuff fire in May 2018 (Figure 3.10b).

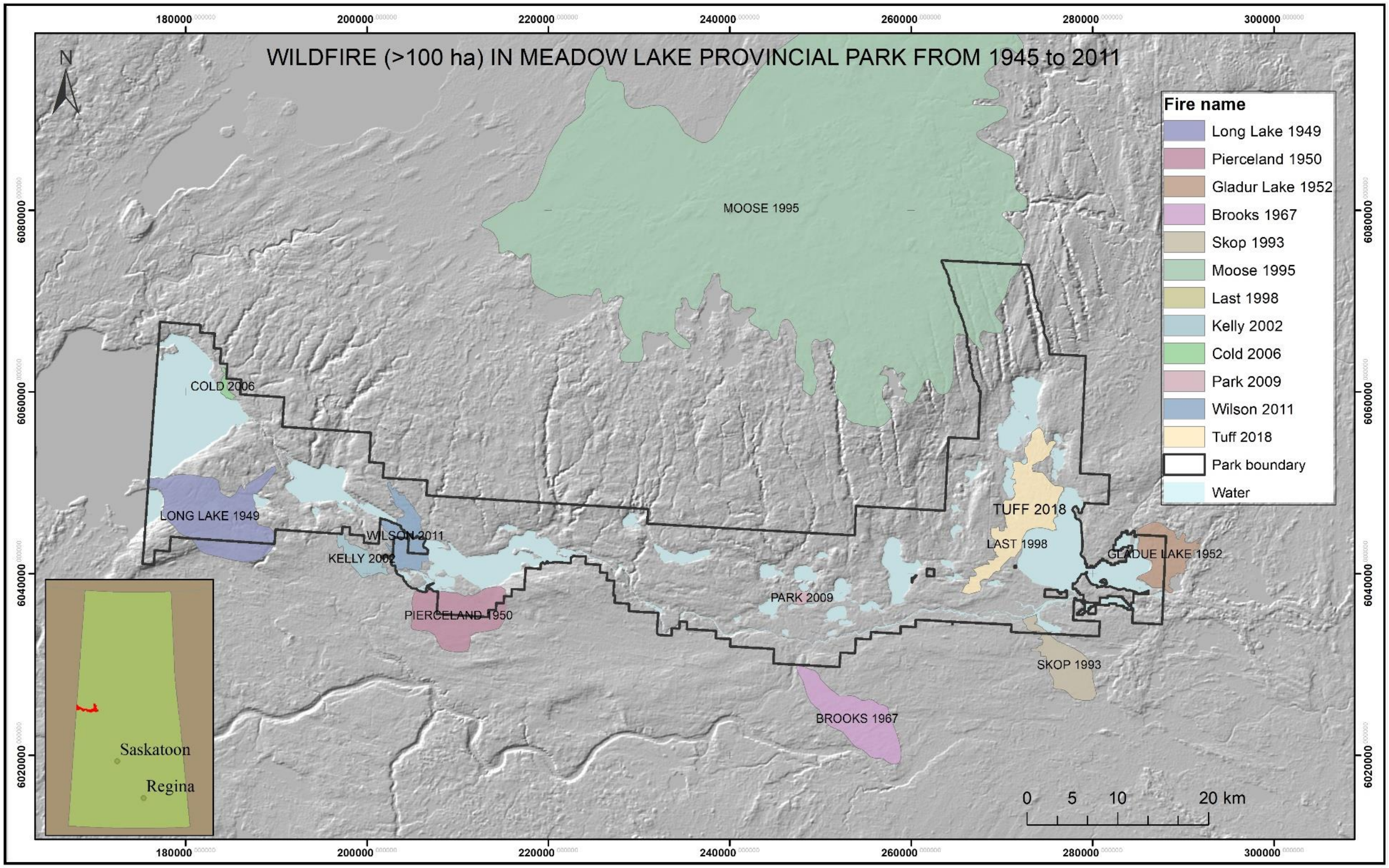

Figure 3.11 Fires with total size >100 ha that entered MLPP from 1945 to 2018.

Table 3. 1 Fires with total size >100 ha from 1945 to 2018 in MLPP region and area of forest regenerated within the park boundary.

Year	Fire name	Area (ha)			
		Total fire area within MLPP	Forest regenerated by the fire	Forest in other age classes	Wetland/ water
1949	Long Lake	7059	1449	4886	724
1950	Pierceland	1794	1164	474	156
1952	Gladue Lake	1334	999	208	126
1993	Skop	262	19	80	162
1995	Moose	4549	987	3183	379
1998	Last	2	0	2	0
2002	Kelly	5	0	1	4
2006	Cold	255	no year-of-origin on SFVI		
2009	Park	223	occurred after SFVI mapping		
2011	Wilson	1871	occurred after SFVI mapping		
2018	Tuff	6232	occurred after SFVI mapping		

One fire not shown on Figure 3.11 is the 1980 Kimball fire. Forest inventory maps show a stand of jack pine east of Kimball Lake with year-of-origin 1980. The area of this stand is 101 ha, but the fire as mapped must have been just under the 100 ha threshold for inclusion on Figure 3.11. This stand provides a good demonstration of vigorous post-fire pine regeneration, in an area which is heavily visited by the public.

Wildfires present a number of issues for ecosystem-based management. Because of the important role of wildfire in the natural dynamics of boreal forests, maintaining the biodiversity of MLPP implies either maintaining or emulating this disturbance role (see Section 3.5.4). More immediate issues include pre-fire planning, fire suppression practices, and post-fire treatment.

According to Saskatchewan Parks Division's "Provincial Park Resource Management and Recreational Activities Guidelines" (2003):

- A wildfire management plan should be prepared for each park identifying areas in terms of their fire protection priority.
- "Firesmart" techniques (e.g. harvesting to reduce continuity of fuels) are recommended for developed areas.
- In areas where protection of human values is low priority and a fire is considered to provide ecological benefits, fires should be allowed to burn naturally.
- There is a preference for low-impact fire control methods; whenever possible fires should be contained using natural barriers such as water or roads; fireguards and roads should be kept to the minimum extent consistent with safety; foam and fire retardant should not be used near water; fireguards and roads should avoid environmentally sensitive areas; these disturbances should be reclaimed to their original condition after the fire is out; windrows of knocked over trees should be reduced and broken up
- Salvage logging is not allowed unless recommended for vegetation management purposes.

The recommendation for MLPP is full response on fire starts based on the relatively high density of developments in MLPP, and the proximity to agricultural land on the south and commercial forest on the north. However, even in MLPP there may be situations in which a wildfire could be allowed to burn, in order to achieve goals of regenerating more natural forest. The first step would be to develop a wildfire management plan for MLPP that would detail the conditions (e.g. fire weather, fuel, natural barriers, values at risk and fire risk assessment) under which a "managed wildfire" approach would be acceptable.

Fuel management using "Firesmart" harvesting to reduce fuels around developed areas has been applied in some places, such as around the Kimball Lake cottage subdivision (Wildfire Management Branch). After the 2009 Park fire, bladed firelines were reclaimed by pulling soil and woody material from the edge of the line and spreading it over the disturbed area (Figure 3.12). This practice is intended to protect the soil and promote regeneration from roots and seeds in the respread material. Pulling logs over the fireline also has the advantage of preventing access by ATVs, which could quickly create a new trail. These practices appear to be beneficial and should be continued. However, any opportunities to use natural barriers such as lakes and streams should be pursued, to reduce the soil disturbance and creation of a linear disturbance associated with bladed firelines. Additionally, all temporary fireguards need to be reclaimed as soon as after the fire containment as some plants can regenerate quickly after fires (Figure 3.13). While salvage logging after fire was practised in the past, current policy is opposed to it because of the ecological value of standing and fallen dead trees (see discussion in Section 3.5.1).

Figure 3.12 This bladed fireguard, built to control the 2009 Park Fire, has been reclaimed by respreading the topsoil and woody debris that had been displaced.

Figure 3.13 Fireguard after 2018 Tuff fire that requires reclamation soon after fire containment as jack pine saplings begin to regrowth.

While suppression of wildfires is never complete, there may be a need to supplement wildfires with other kinds of disturbance for ecosystem management purposes. According to Saskatchewan Parks Division's "Prescribed Fire Policy" (2009), prescribed fire is a management option which can be applied to emulate natural wildfire disturbances and can be applied on park lands for the following purposes:

- Maintaining and improving ecosystem health and biodiversity
- Promoting nutrient recycling and energy flows
- Returning park lands closer to their historical fire regimes
- Managing insects and disease infestations
- Managing the control and spread of invasive alien plant species
- Renewal of native grasslands/forestlands
- Reduction of fuel loading – reducing wildfire hazards
- Restoration and maintenance of rangelands

Prescribed fires require a plan which details goals, responsibilities, procedures, and monitoring. Parks Division has conducted many prescribed fires in parks such as Greenwater, Duck Mountain, Moose Mountain, and Douglas Provincial Parks. Many of these have been focused on grassland remnants, and were intended to control encroachment by aspen and shrubs, as well as reducing the litter accumulations which are thought to favour invasion by smooth brome. Prescribed burns for the regeneration of decadent trembling aspens stands have been undertaken in Douglas and Fort Carlton Provincial Parks. In MLPP, one prescribed burn to regenerate and old aspen stand was done about 15 years ago inside the triangle of roads north of the bridge at the Dorintosh entrance. This burn resulted in dense aspen suckering, a typical response for boreal aspen stands (Figure 3.14).

Figure 3.14 This area of aspen forest at the road fork north of the Dorintosh entrance was treated with a prescribed burn about 15 years ago. Note the dense and vigorous suckering of the trembling aspen on the site. The site has been successfully regenerated.

Grassland remnants at MLPP should be surveyed to determine whether they would benefit from the kind of prescribed burning done in other provincial park grasslands. This determination would be based on assessing whether they are being threatened by woody encroachment, and whether litter accumulation appears to be contributing to exotic invasion. Prescribed burns should also be planned for the purpose of regenerating some of the mature forest in the park (see Section 3.5.4).

3.3.2. Windthrow

Windthrow is another common disturbance in the boreal forest, although the area affected is less than that caused by fire. According to interviews with long-time residents, intense windstorms went through the central part of the park (apparently following a path from southwest to northeast) in 1962, 1964, 1974, and 1989 (Cam Lockerbie, field notes, 1994). Wind-damaged forest in the Matheson Lake area was salvage-logged in the fall of 1989 (Cam Lockerbie, field notes, 1994). A significant wind storm went through the Lac des Isles area on July 23, 2007, felling a large number of Jack Pine and Trembling Aspen trees in the Murray Doell campground area (Figure 3.15). Although no one was hurt in the storm, one tent was destroyed by a falling tree and it took considerable effort by maintenance and fire crew staff to clean up all the fallen trees to permit campground patrons to extricate their RVs and vehicles from the sites.

Figure 3.15 Windstorm damaged in the Murray Doell campground area in July 2007

3.3.3 Insect and disease damage

Insect damage can also be an important disturbance in boreal forest. The forest tent caterpillar (*Malacosoma disstria*) is the most visible insect pest affecting aspen forests in this region (Mistik Management 1995). Forest tent caterpillar and other insects cause significant defoliation of trembling aspen in some years (Brandt 1997). Understory shrubs such as beaked hazelnut can also be affected (Mistik Management 1995). Outbreaks occur at broad 6-16 year intervals and persist for 3-4 years (Mistik Management 1995). Repeated defoliation during outbreaks causes reduced growth and increased stem mortality (Hogg and Scharz 1999). Ives (1981) found that outbreaks of forest tent caterpillar are favoured by mild winters and warm, dry summers. The synergistic effects of drought in favouring insect outbreaks and reducing tree growth can contribute to forest dieback. Hogg et al. (2005) showed that most of the growth variation in western Canadian aspen stands betwen 1951 and 2000 was explained by these interacting factors. Hogg and Schwarz (1999) studied the recent dieback of aspen in the Bronson Forest (only 60-80 km south of MLPP). They found that stands were severely defoliated by forest tent caterpillar in 1962-1964 and 1979-1990. Their analysis showed that this defoliation was the most important factor causing reduced growth, but that drought also had a significant influence. The outbreak, which peaked in 1988, extended to MLPP (Brandt 1995b). Other insect defoliators on aspen include large aspen tortrix, which caused defoliation in MLPP in 1994 (Brandt 1995a).

Defoliating insects affecting conifers in this region (Mistik Management 1995) include:

- jack pine budworm (*Choristoneura pinus*) which is the prime defoliator of jack pine; overmature stands and low vigour stands growing on poor sites are most vulnerable.
- spruce budworm (*Choristoneura fumiferana*) on white spruce; balsam fir is more vulnerable than spruce, but is uncommon in MLPP; in eastern Canada where spruce budworm outbreaks are one of the most important agents of disturbance, mortality of spruce ranges from 36% in mature stands to 13% in immature stands; however, there is less information on mortality rates in the spruce-dominated stands of western Canada.

The mountain pine beetle (*Dendroctonus ponderosae*) has recently killed large areas of lodgepole pine (*Pinus contorta*) and other pines in British Columbia (Regniere and Bentz 2007). It has spread to lodgepole stands in Alberta, and has now reached the zone of overlap and hybridization between lodgepole and jack pine, and the first successful infestation of a natural jack pine stand has recently been reported

(Cullingham et al. 2011). The impact of climate change, particularly the trend to milder winters, is thought to have allowed mountain pine beetle to spread northward and eastward (Carroll et al. 2003, Thomson 2009). The continued warming predicted for the coming century could allow mountain pine beetle to spread into the pine forests of MLPP. The Saskatchewan Forest Service is actively monitoring for this insect in the region of the park and collaborating with Albert Environment and Sustainable Resource Development and the Canadian Forest Service on strategies to slow the spread of mountain pine beetle into Saskatchewan's boreal forest, and further east.

Important tree diseases in this region (Mistik Management 1995) include:

- hypoxylon canker (*Hypoxylon mammatum*) on aspen, which has greatest effects in younger trees and low density stands
- white trunk rot (*Phellinus tremulae*) on aspen; this is the primary cause of heart rot in aspen, entering through wounds in the bark and increasing in frequency with stand age (to 100% of stems in old stands)
- armillaria root rot (*Armillaria* spp.) on a variety of species; infection of aspen increases with soil disturbance by harvesting or scarification
- a variety of root, butt, and trunk rotting fungi of white spruce and balsam fir
- dwarf mistoletoe (*Arceuthobium americanum*), a parasitic plant on jack pine; this is widespread in the boreal forest, including MLPP, and causes changes in growth form and loss of vigour, in some cases leading to tree mortality.

One of the issues for ecosystem management is whether and under what circumstances to control insect and disease outbreaks. According to Saskatchewan Parks Division's "Provincial Park Resource Management and Recreational Activities Guidelines" (2003):

- In natural areas of parks, native insect and disease outbreaks should be considered natural processes and no action should be taken to eliminate them.
- There may be a requirement to protect vegetation in high use areas, where needed for shade, to stabilize soils, or to provide attractive appearance.
- Control measures to be considered include pruning, plant removal, thinning, burning, biological controls, or where there are no alternative, chemical controls.
- Keep vegetation in high use areas healthy by traffic control, etc.

For most of the native defoliating insects such as forest tent caterpillar, spruce budworm, and jack pine budworm, outbreaks have been part of the natural disturbance history of the park, and can probably be accepted in the future. Action to increase the diversity of forest age classes (see Section 3.5.4) will reduce the susceptibility of the forest to some pests. However, there appears to be a more acute concern about the mountain pine beetle because of the recent history of devastation in B.C.'s forests. Action has been taken to control mountain pine beetle outbreaks in Cypress Hills Provincial Park. If this insect became a serious threat to boreal pine forests in Saskatchewan, as appears possible, there might be pressure to control it in the park to prevent spread to the provincial forest.

Mistletoe damage to jack pine has, in the past, been addressed by salvage-logging. It would be possible to more aggressively harvest infected stands, followed by prescribed burning of residual trees, to reduce the spread of this parasite (Mistik Management Ltd. 1995). In MLPP this would be contrary to the general policy direction of minimizing timber harvest treatments. Even thought 2018 Tuff fire striked the large area of mistletoe infected jack pine, burn severity was low to moderate resulting in fragmented and unhealthy landscape of jack pine stands. Right after the fire, jack pine saplings begin to regenerate. Therefore, without the removal of host trees the disease will continue to damage the next forest generation and threat the landscape integrity. If harvesting of infected stands is necessary to eliminate the severe spread of mistletoe, consultation process with park manager, park staff, local communities and other stakeholders must be carried out.

3.3.4 Other damage

The park supports several large **native herbivores** (moose, elk, white-tailed deer). These feed on a variety of plants, including a significant amount of browsing on shrubs. In general, the impact of native ungulates on forest vegetation is limited when populations are low, but can become significant at times of high animal density. No information is available on the particular effects in MLPP, but ungulate populations are partially controlled by hunting during regulated seasons. Beaver also have a visible effect on vegetation, through felling of trees (mostly aspen) along the margins of water bodies, and through flooding the forest behind dams.

3.4 History of Human Use of Park Ecosystems

MLPP was part of the historic use area of the Woodland Cree, after they displaced other tribes in the late 1700s (Wilson and Martin 1998). In the fur trade era, the Waterhen River became a canoe travel route, and the Northwest Company established trading posts at Cold Lake and Waterhen Lake (Wilson and Martin 1998).

The modern era of agricultural settlement began with the extension of the railroad to Meadow Lake in 1905 (Wilson and Martin 1998). However, most settlement happened in the 1930s, as drought-stricken farmers from southern Saskatchewan moved north to the moister climate of the forest fringe (Wilson and Martin 1998). Most homesteading was south of the Waterhen River, but a small area of what is now MLPP was cleared and broken (Wilson and Zielke 1997). The only current evidence of homesteading is three areas near Greig Lake totalling about 100 ha (Blood and Anweiler 1979). According to the “Meadow Lake Provincial Park Interpretive Strategy”, Lloyd Stonehocker homesteaded on the shores of Greig Lake because it was close to water and the size of the aspen trees indicated good soil. A field remaining from this homestead on the southwest shore of Greig Lake is the largest area of cleared land within the park. East of Greig Lake, near the visitor centre, is a field remaining from the homestead of Wenzel McTavish, who farmed here from the 1920s to the 1970s.

Logging also began at this time (Wilson and Zielke 1997). Parks staff interviewed long-time residents with knowledge of park forests dating back to the 1940s and 1950s (Cam Lockerbie, field notes, 1994). According to Albert Sharp, a former conservation officer, logging started north of the park in the 1920s and 1930s, with white spruce logs floated down the Martineau River to Cold Lake. According to John Hourie, a former park maintenance man, small farm permits for logging of aspen and pine were taken out along the Waterhen River starting in the 1940s. In the western part of the park, selective logging of white spruce and jack pine (for railway ties) started in 1948-50. According to Edward Lepine, a former fire patrolman, there were several sawmills on the shores of Cold Lake, Pierce Lake, and Lac des Isles. The concentration of logging on large white spruce and jack pine probably reduced the proportion of softwoods in some stands. Logging ended around 1980 (Blood and Anweler 1979 and Edward Lepine, as recorded in Cam Lockerbie’s field notes, 1994). Evidence of past logging and sawmilling includes old log piles, old cabins, sawdust piles, and many of the trails now used for recreation (Blood and Anweiler 1979).

An all-weather road to Meadow Lake was completed in 1942. In the 1940s and 1950s, the park area (then part of the Northern Provincial Forest) had permits and leases for timber harvesting, grazing, haying, fishing, trapping, and mink ranching (Wilson and Zielke 1997). It also provided recreational opportunities for people in the agricultural area to the south. Cottage development on the lakes in the park began in the early 1940s, and by 1956 there were 99 cottages, three institutional camps, and seven commercial outfitters (Wilson and Zielke 1997).

Meadow Lake Provincial Park was established in 1959. The park began massive development in the 1960s, using locally harvested timber for the lumber in park buildings. Campgrounds were expanded during this period. A Park Master Plan was completed in 1972. A golf course with hotel, recreation hall, restaurant and lounge were proposed for the west side of Greig Lake, but did not happen. Development slowed down in the 1970s, 1980s, and 1990s (Meadow Lake Provincial Park Interpretive Strategy).

3.5 Present-day Use and Composition of Park Vegetation

3.5.1 Present-day Resource Use Activities

3.5.1.2 Recreational development

Recreational development accelerated after the Provincial Park was created in 1959, to become the dominant human land use (Wilson and Martin 1998). Twelve park campgrounds with over 700 campsites have been developed (Table 3.2, Figure 3.16). There are also privately operated resorts with campsites and rental cabins at some lakes (Table 3.2, Figure 3.16). Cottage subdivisions, mainly consisting of leased crown land, but also including a few areas of deeded land, have been developed at seven of the larger lakes (Table 3.2, Figure 3.17). In addition to these developments inside the park, there are several immediately outside the park (Figure 3.17). At the east end of Lac des Isles, the park boundary runs close to the south shore of the lake, and some new housing developments have been or are being developed just outside the boundary. In addition to the attractions of the lake, these developments are close to the Northern Meadows golf course west of Goodsoil. However, the largest residential developments bordering the park are the two Indian reserves: Big Island Lake Cree Nation (population 853 in 2010) and Waterhen Lake First Nation (population 930 in 2010).

Table 3. 2 Recreational developments in MLPP.

	Cottages	Rental cabins	Campsites
Campgrounds			
Kimball Lake			209
Greig Lake			151
Murray Doell (Lac des Isles)			126
Sandy Beach (Pierce Lake)			84
Matheson Lake			46
Flotten Lake South			25
Flotten Lake North			25
Waterhen Lake			22
Mistohay Lake			20
Vivian Lake			8
Cold River			4
Hirtz Lake			4
Cottage subdivisions (leased)			
Howe Bay (Pierce Lake)	23		
Lac des Isles	23		
Greig Lake (north)	39		
Greig Lake (south)	32		
Kimball Lake	56		
Jeannette Lake	52		

Flotten Lake	13		
Cottage subdivisions (deeded)			
Waterhen Lake	30		
Resort Village of Greig Lake	53		
Greig Lake (north)	10		
Private resorts			
Flotten Lake Resort		6	
Tawaw Cabins (Waterhen lake)		17	27
Big Island Cove Resort (Lac des Isles)		14	27
Northern Cross Resort (Lac des Isles)		19	70
Total	**331**	**56**	**848**

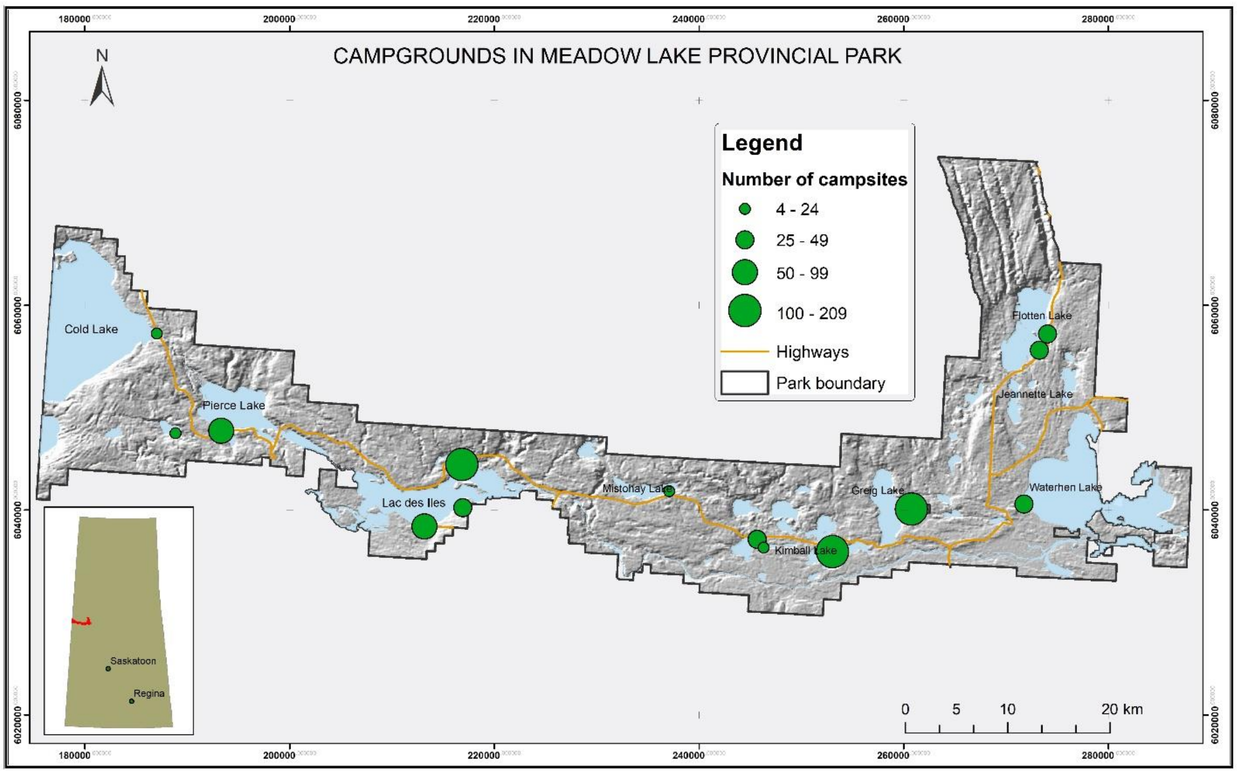

Figure 3.16 Campgrounds in MLPP (park-operated and private).

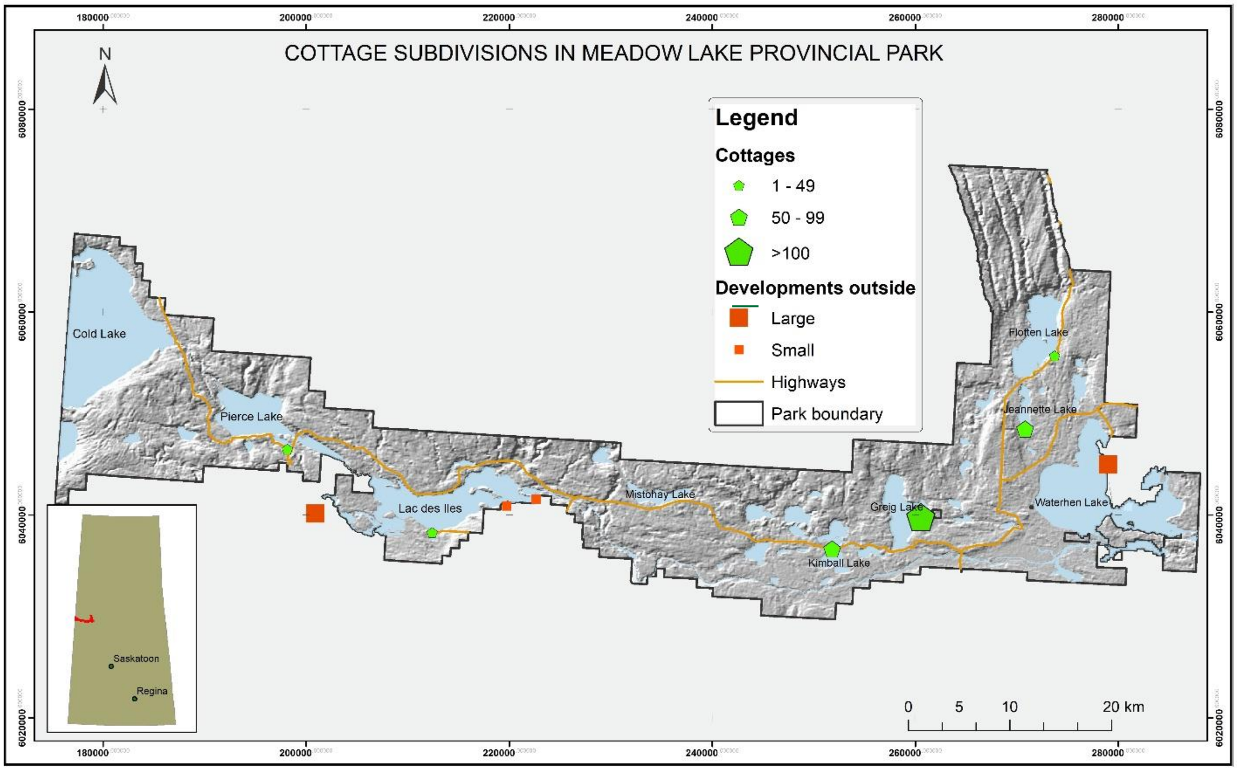

Figure 3.17 Cottage subdivisions in MLPP (leased and private).

3.5.1.2 Industrial development

Gas development includes 14 gas wells in the western part of the park, with 6 quarters where rights have been purchased but not developed (Wilson and Martin 1998). A high pressure 10" flowline comes into the park near the Pierceland entrance, crossing the Cold River between Pierce Lake and Lepine Lake, and running north out of the park to the gas wells in the Provincial Forest. From this network north of the park, a line extends to the east, then south again into the park to access the wells in the area west of Lac des Isles. Five of these wells are south of the Cold River, so the line recrosses the river and part of the Big Island Lake Cree Nation to reach these wells (Figure 3.18).

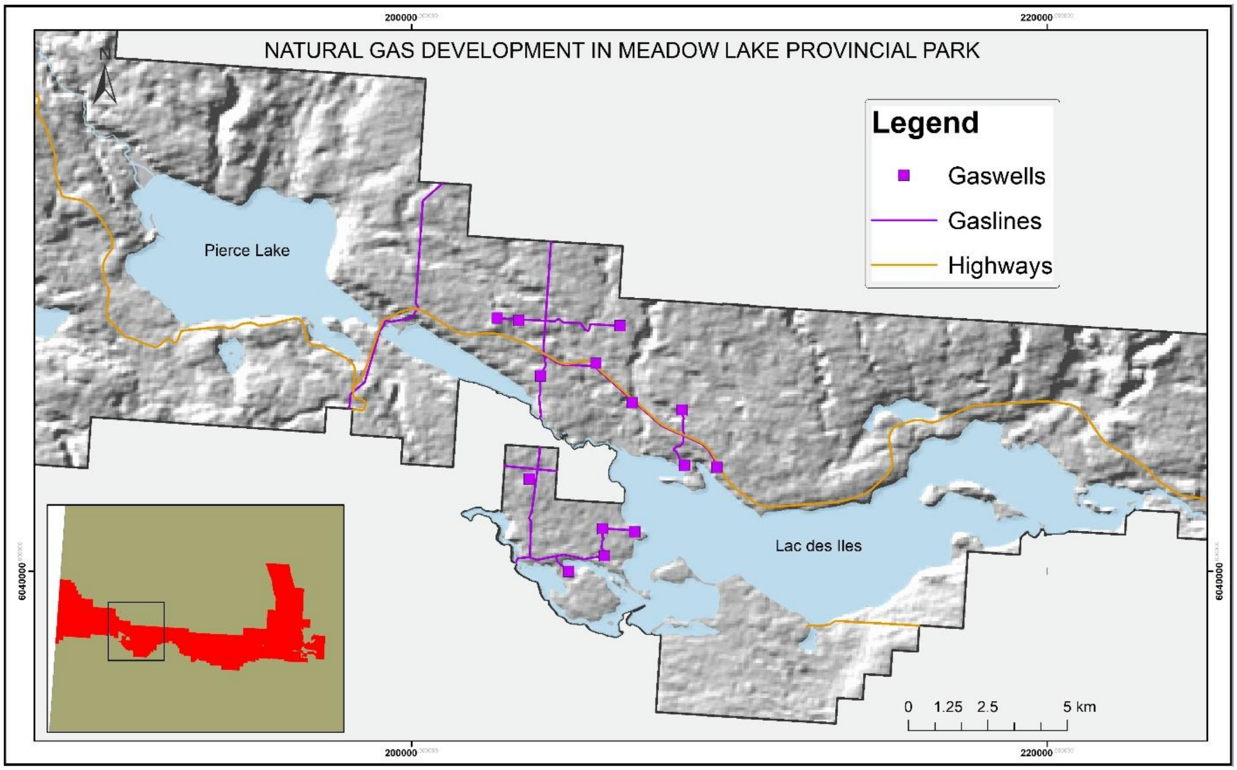

Figure 3.18 Natural gas development in the area between Pierce Lake (to the west) and Lac des Isles (to the east).

According to the "Provincial Park Resource Management and Recreational Activities Guidelines" (2003):

- In MLPP exploration and development are restricted to areas where petroleum rights were purchased prior to implementation of restrictions on surface access.
- Any requests for new postings will only be accepted with a "no surface access" condition (i.e. directional drilling).
- Seismic exploration must be done using low impact methods (lines <2.2 m, hand-cut)
- Upon abandonment, wellsites and roads must be reclaimed to as close in appearance to the original state as possible; a detailed reclamation plan is required, including restoration to the original contours, removal of roads and culverts, and reestablishment of native vegetation
- Mineral exploration is not allowed in MLPP.

Because there will be no new surface access under these guidelines, the impact of gas development is restricted to the existing pipelines and well pads, including some sites that were cleared but on which no well was installed. Some of the pipelines follow existing roads, which has tended to minimize their impact, but others are accessed via cleared corridors through the forest. Studies by Parks staff in 1994 found good revegetation on some wellsites and pipeline corridors, but not on others. Among the problems noted were exotic invasion, planting of exotics, use of soil sterilants at wellsites, compaction and rutting, and no respreading of topsoil (Wilson and Martin 1998). Adherence to the policies that were laid out in 2003 should reduce these problems, but exotic species probably persist where they were seeded in earlier days. If so, their management should be addressed in the broader exotic species policy.

A few **gravel pits** are located in the park. According to Saskatchewan Parks Division's "Policy on sand and gravel and borrow extraction" (2010):

- Gravel extraction is only permitted for park puposes or for provincial roads within parks.
- Gravel extraction is only permitted in Resource Extraction and Access zones.
- Pits should be located so park visitors cannot easily see them.
- Topsoil must be stockpiled.
- Exotic plants must be dealt with immediately.
- Depleted pits must be restored to an appearance that blends in with surrounding landforms.
- Revegetation must be by native species.
- Access roads must be restored.

The larger question is whether any gravel pits should be developed in the park. They do contribute to the development footprint in the park, but the area is small compared to roads, subdivisions, and campgrounds. Probably the greatest concern with gravel pits is aesthetic. It would be preferable for future gravel resources to be accessed outside the park. Some pits near Lac des Isles appear to have been developed on native prairies. Great care must be taken to avoid any further disturbance, by gravel operations, to the native grasslands of the park. Where these borrow pits are contiguous with native prairie remnants, control of exotic species occuring in the old pits should receive priority.

3.5.1.3 Roads and trails development

Another important type of development is for roads and trails (Figures 3.19 and 3.20). Gravel-surfaced provincial highways (#4, 21, 26, 224, 904, 919, and 951) provide the main access into and within the park, as well as being used for through-traffic to areas further north. There are also internal park roads accessing campgrounds and subdivisions, and a maze of trails, many of them dating back to early homesteading and logging (Wilson and Martin 1998). The total length of roads and trails is 912 km, and the area of right-of-way is about 1,000 ha, or 0.8% of the land area in the park (Table 3.3).

Apart from the actual land area directly affected by road surfaces and right-of-ways, roads and trails are considered to be the main cause of habitat fragmentation (Boulanger et al. 2014). Research from other areas has shown that some species of insects and small mammals are prevented from movement by road barriers, even narrow unpaved roads through forest or grassland (Noss and Cooperrider 1994, Brown and Wright 1988). In a study of recreational trails in Colorado forest and grassland, Miller et al. (1998) found that generalist bird species were more common near trails, while specialist species were less common near trails. For some species-at-risk, mortality by vehicle collisions is thought to be a significant threat (Thorpe and Godwin 1999). The rare woodland caribou tends to avoid areas close to roads and other linear corridors, especially if there is active traffic and noise (Bradshaw et al. 1998, Chubbs et al. 1993, Cumming and Hyer 1998, Adams and Stuart-Smith 2000, Dyer 1999). Adams and Stuart-Smith (2000) studied an area in northeastern Alberta (close to MLPP), and found that the density of roads, seismic lines, powerlines, and pipelines resulted in a substantial loss of woodland caribou habitat. Roads also contribute significantly to the dispersal of exotic plants. A road network is a network of open-soil habitats, which allow exotics to establish and spread anywhere the roads go. Exotics such as smooth brome (*Bromus inermis*) spread quickly along ditches, providing a source for slower invasion of adjacent native habitats. Belcher and Wilson (1989) found that almost all of the leafy spurge (*Euphorbia esula*) infestations they studied in southern Manitoba were centred on roads, trails, or fireguards. Anecdotal observations in Greenwater Lake Provincial Park show that several exotic invasive plants are found along trails, presumably spread mainly by ATV traffic (Rob Wright, Parks Service Plant Ecologist, personal communication, 2012)

Figure 3.19 The main access to the park is by gravel-surfaced roads such as Highway 224.

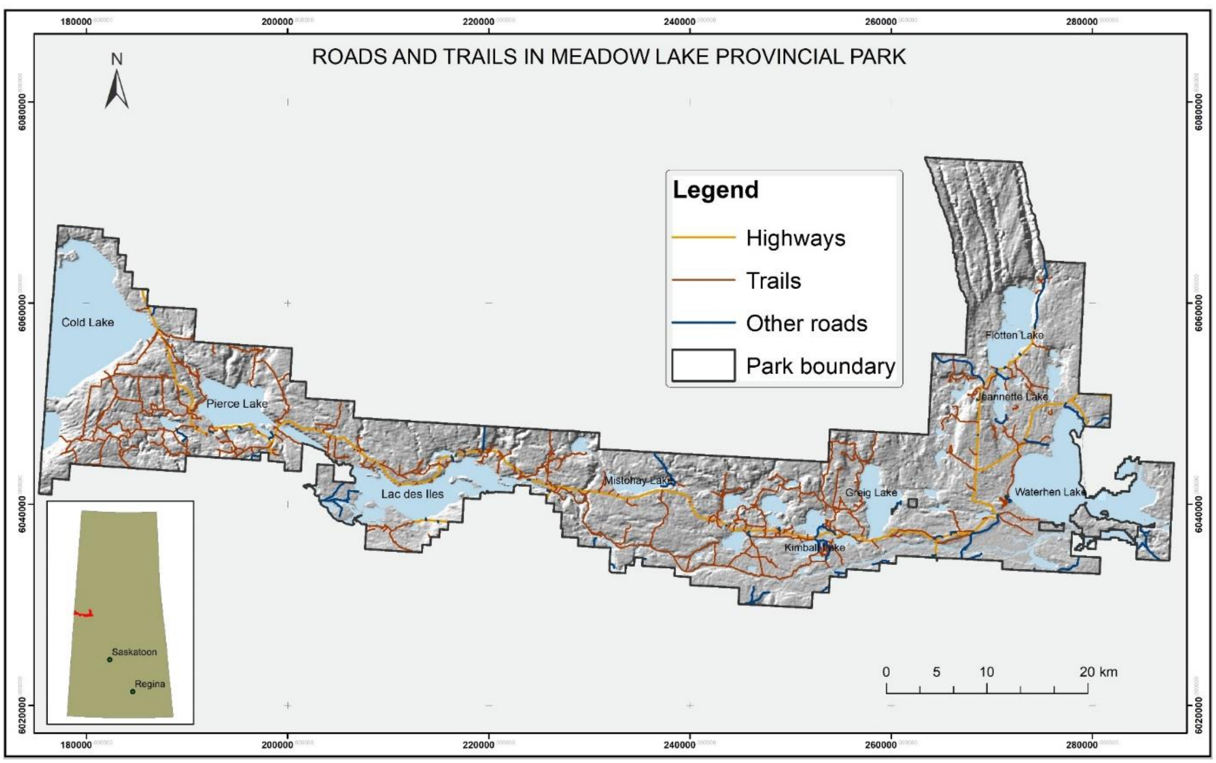

Figure 3.20 Roads and trails in MLPP.

Table 3. 3 Length and area of roads and trails in MLPP.

Type	Length (km)	Assumed ROW width (m)	ROW area (ha)
Highways	168.5	30	505
Other roads	126.5	20	253
Trails	616.6	4	247
Total	911.6		1,005
Approx. land area of park			133,964
% of land area in roads and trails			0.8%

According to Saskatchewan Parks Division's "Provincial Park Resource Management and Recreational Activities Guidelines" (2003):

- Vehicle use on roads and trails can lead to environmental damage, increased hunting pressure, and opening up of previously inaccessible areas.
- Roads and trails should be inventoried and assessed for their importance.
- Roads and trails that are necessary for resource management or for access to park facilities should be designated.
- Roads and trails that are not required should be closed.

Because of the high density of roads and trails in MLPP, inventory and assessment as described in the Guidelines should be done. A program should be developed to close any roads and trails that are found to be unnecesary, and reclamation practices should be applied to return them to native vegetation and prevent access by recreational vehicles. Roads and trails should also be included in the monitoring program for exotic species, described elsewhere in this plan. The feasibility of controlling smooth brome grass along road ditches should also be assessed, because of its high potential to invade adjacent open woodlands and native prairie or meadow ecosystems.

Figure 3.21 shows the overall development footprint on MLPP, considering all of the types of development discussed above. All linear development was combined and calculated linear development density (km/km^2). While no attempt has been made to weight the various types of development (e.g. roads, cottages and campsites), Figure 3.21 gives a strong visual impression that development has impacted most parts of MLPP. The Salt Creek extension at the northeast corner of the park appears to be the largest development-free area, probably because the rugged terrain discouraged roads and other sources of fragmentation. This relatively development-free portion of the park should be considered for designation as wilderness zone. This analysis supports the conclusion that MLPP already shows a relatively high development footprint for a natural environment park, and that the emphasis in future should be on restricting development to protect the natural capital of the park.

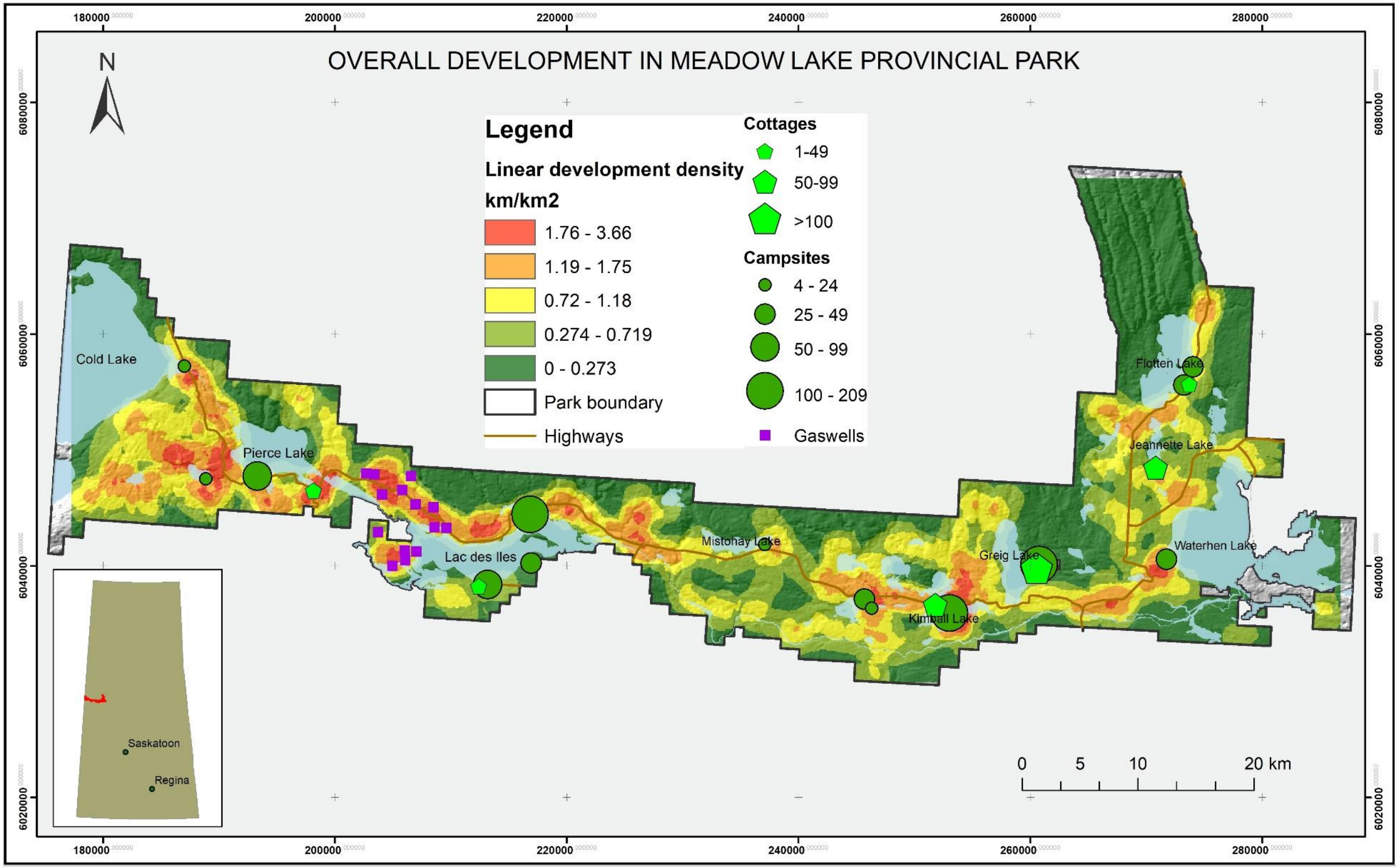

Figure 3.21 Overall development footprint on MLPP.

The recreational developments discussed above support a variety of dispersed **recreational activities**. The water bodies are used for boating and fishing, and there is recreational use of the network of trails by hikers, birdwatcher, and hunters. In addition to short (less than 10 km) hiking and interpretive trails, the park has recently developed the 113 km Boreal Trail as a backpacking route running east-west over most of the length of the park. Recreational ATV use, which would probably be a popular use, is not allowed on the park trails, although ATVs are used by park staff and hunting outfitters and unauthorized ATV use is known to occur from time to time. In winter, snowmobiling is a major use of the park trails. As a result, density analysis of linear development shows very high density of roads and trails in some areas (i.e. up to 3.6 km/km^2) such as near Kimbal Lake, Pierce Lake and Lac des lles Lake (Figure 3.21).

According to Saskatchewan Parks Service's "Provincial Park Resource Management and Recreational Activities Guidelines (2003), ATVs should only be allowed on designated single-purpose trails; should not be allowed in most provincial parks; can only be justified in parks large enough to contain an ATV-only trail system, which should be laid out to minimize environmental impact. The Guidelines also state that snowmobiles should only be allowed on designated single-purpose trails.

Wright and Dodge (2010) studied the impacts of ATV use in Saskatchewan provincial parks. Ecological impacts include soil erosion and compaction, damage to vegetation, road-kill and noise disturbance to wildlife, air and water pollution, and introduction of weeds. Physical impacts are particularly great on wet soils, sandy soils, and steep slopes. The authors surveyed 20 sites in MLPP, and found

- 12% early stage impacts (only an occasional trip)
- 31% continual stage impacts (use over many years with soil compaction and loss of vegetation along the tracks)
- 27% heavy stage impacts (severe loss of vegetation and rutting, compaction, or erosion)
- 19% intentional stage impacts (willful damage to the ecosystem)

Wright and Dodge (2010) reported that introduction of exotic weeds along back-country trails has been observed in many areas, because of the transport of seeds in mud on machines, and the soil disturbance which provides a seedbed for weedy species. Introduction of exotics along ATV trails through grassland patches, which are otherwise largely natural in species composition, has been observed in MLPP (see Section 3.5.5). A variety of practices have been recommended for reducing these ecological impacts, especially limiting use to designated trails which are designed to avoid wet, steep, sandy or beach terrain, and use appropriate creek crossings. However, field observations in Saskatchewan parks show that users often do not stick to designated trails (Wright and Dodge 2010). The authors recommend a five-year moratorium on ATV use in Saskatchewan parks while the necessary legislation, regulation and planning is undertaken, focusing on sensitive areas.

An internal policy review of the ATV issue in provincial parks (Anonymous 2009) concluded that recreation ATV use should not be allowed, but that permits will have to be issued for commercial outfitters (accessing bait sites), sport hunters retrieving game, oil and gas workers, and trappers.

3.5.1.4 Hunting and baiting

Under current policy, sport hunting is allowed in MLPP. MLPP is included in Wildlife Management Zone 69, in which there are hunting seasons for moose, white-tailed deer, elk, black bear, and upland game birds, and waterfowl. There is a Road Corridor Game Preserve along Highway 919, which crosses the park from Pierce Lake to Cold Lake, as well as on the forestry road leading north out of the park near Lac des Isles. These Preserves prohibit hunting within 400 m of the road. Hunting has been a traditional recreational activity in MLPP, and is considered to cause little conflict with other recreational users because it occurs in fall (except for aboriginal hunting which may occur in any month). However, it is a part of the larger issue of ATV use in the park.

Commercial outfitting for sport hunters is also practised by 13 white-tailed deer and seven black bear hunting businesses (Anonymous 2009). Commercial outfitters sell an opportunity to shoot deer or bear, by placing their clients in an elevated stand over a bait station, which is maintained prior to and during the hunting season to attract animals. A large number of bait stations have been mapped in MLPP (Figure 3.22). Hunting over baits leads to higher hunter success, which could affect animal populations, and could affect the genetic pool though selective killing of larger animals (Dunkley and Cattet 2003). Baiting can also lead to conflict among hunters, with complaints that placing of permanent baiting stations by outfitters ties up the area and discourages others from hunting there.

Perhaps the greatest concern for the ecosystem-based management plan is that baiting contributes to the overall threats of fragmentation and exotic invasion. Hauling bait material to stations prior to and during the hunting season, and transporting outfitters' clients back and forth, is all done by ATV, for which outfitters are permitted (Anonymous 2009). This increases the overall ATV traffic in the park, which could have negative physical impacts and spread exotic plants (see above). Baits themselves could be a source of exotics. Baits for deer consist of grain, which may contain seeds of exotic weeds. According to Dunkley and Cattet (2003), exotic plants have been introduced into communities from ungulate baits in numerous areas of Saskatchewan and Manitoba. Spread of these species is facilitated by subsequent deer movement as well as by transport of seeds on ATVs. However, it is not clear what species might be introduced by baiting. If the exotics are largely annual weeds associated with grain crops, their potential to invade native vegetation in the absence of disturbance may be limited. However, if the baits contain more invasive perennial species such as smooth brome grass, then the threat would be greater. A recent study by Parks Division staff (Karst and Wright, 2012) showed that active baiting sites have a higher incidence of bait piles, garbage accumulation, shooting lanes, hunting tree stands, vegetation disturbance, exotic plant species, and access trails. The greater incidence of these factors degrading park lands is of real concern in the management of park lands for the conservation of ecological integrity. Several of the weed species found at active bait sites are highly invasive perennial exotics (e.g., Canada Thistle, Smooth Brome grass, Kentucky Bluegrass).

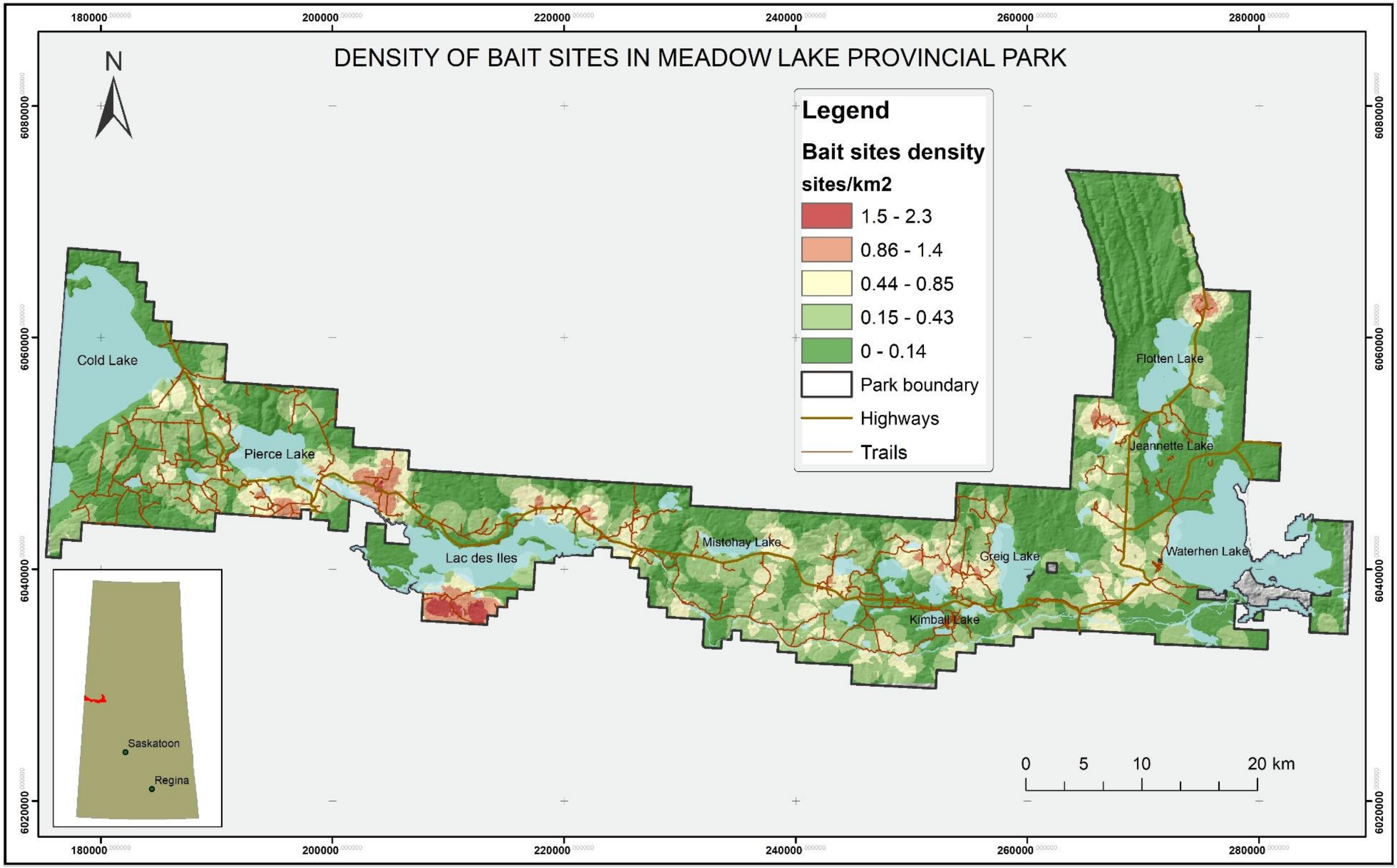

Figure 3.22 Density of bait stations for bear and ungulate hunting in MLPP. Although permitted, over 50 % of the sites are thought to be inactive (Karst and Wright 2012).

Commercial trapping is also practised, with parts of the park included in four Fur Conservation Areas (Wilson and Martin 1998). Animals trapped include bear, lynx, fox, coyote, wolf, beaver, mink, muskrat, otter, marten, squirrel and weasel (Wilson and Martin 1998). More details on trapping can be found in Section 3.6.3. The removal of top predators from the park is likely to have negative impacts on ecosystem composition and structure (Stolzenburg 2008)

3.5.1.5 Sport fishing

Spot fishing is practised on many lakes and streams. Ten waterbodies have been stocked since 1985, some with walleye (a native fish), but some with exotic species (splake, cut-throat trout, rainbow trout, brown trout, brook trout) (Wilson and Martin 1998). Wilson and Zielke (1997) reported that commercial fishing is also practised on Cold Lake. Wilson and Zielke (1997) recommended that commercial fishing be eliminated, but that fish-stocking for sport fishing be continued. However, Wilson and Martin (1998) recommended that stocking of non-native species be discontinued. Given the emphasis on natural biodiversity in current policies, stocking of non-native fish seems out of place – a relic of traditional resource management which emphasized a single use (in this case sport-fishing) at the expense of the larger ecosystem.

3.5.1.6 Forest harvesting

Forest harvesting has been extremely limited in recent decades. Even after most commercial timber harvesting was removed from the park, there was some harvesting for salvage of damaged trees. Results of such harvests were studied by Parks staff in 1994 (Cam Lockerbie, field notes, 1994). A 1985 cutover north of Highway 224 near Matheson Lake was apparently harvested to salvage mistletoe-damaged pine. It was planted to jack pine with no site preparation. Several areas north and south of Highway 224 in the Matheson Lake area were logged in 1989 for salvage of pine damaged by a violent windstorm earlier that year. In some cases, site preparation (either power disk trencher or barrel/chain scarification) was applied to these cutovers, followed by planting of jack pine seedlings. Field studies showed higher shrub cover (especially green alder) in a cutover with no site preparation compared to a cutover treated by power disk trencher. These salvage cutovers appear on the UTM forest cover map as stands with year-of-origin 1990.

Forestry Canada, as part of a 1994 research project, harvested two one-hectare plots in aspen forest near Waterhen and Raspberry Lakes, with several other one-hectare plots used as controls. Measurements for three years' post-harvest showed dense aspen regeneration, little change in understory vegetation, and little change in soil nutrients (Maynard and MacIsaac 1998). This study confirms that aspen forests can be easily and safely regenerated by clearcutting. There was apparently also a 10-acre research harvest in pine forest east of Jeannette Lake (Wilson and Zielke 1997).

No recent harvests are shown on the SFVI forest cover map which dates from 2007. Recent Parks Service policies tend to restrict timber harvesting. According to the Saskatchewan Parks Division's "Provincial Park Resource Management and Recreational Activities Guidelines" (2003):

- forest harvesting can be used to achieve vegetation management goals.
- harvesting for strictly commercial purposes will not be allowed, but commercial operations will be considered to meet vegetation management goals.
- cutting of personal use firewood is only allowed if it meets vegetation management goals, and only if access is by an existing trail, road right-of-way, or utility easement; winter cutting only.
- gathering of dead/down wood for personal-use firewood will be allowed provided it meets the park's vegetation management objectives, but only at approved locations and using designated trails.

- cutting Christmas trees is not allowed unless for vegetation management purposes (e.g. utility corridors).
- salvage logging of burned or windthrown timber is not allowed except to ensure public safety or protect infrastructure; however small-scale fuelwood salvaging for use within the park is allowed.

The policy against the type of salvage logging practiced in the 1980s is based on evidence of the ecological values lost as a result of this practice. Wright (2007) reviewed the literature on effects of salvage logging after fire. Snags are important for woodpeckers and cavity-nesting birds. Coarse woody debris is important to invertebrates, lichens, and bryophytes, and as nurse logs for white spruce seedlings. Even in the commercial forest, Saskatchewan has adopted a standard of leaving 20% of each burned area unharvested to offset the negative effects of salvage logging.

3.5.1.7 Livestock grazing

Livestock grazing has been a long-standing use along the southern edge of the park at the interface with agricultural land. In the 1990s there were eight grazing units in MLPP, varying in area from 65 ha to 4197 ha, but five of these have since been given up, leaving three active grazing units as of 2018 (Figure 3.23). Under Saskatchewan Parks Division's "Grazing Management Policy", grazing is authorized by a disposition of one to five years. Such dispositions are allocated with preference to nearby neighbours with year-round engagement in livestock production. Cattle are put into fenced units in spring and taken out in fall, with management being the responsibility of the producer.

The potential negative effects of this kind of grazing on MLPP's forests have been summarized by PCAP (2008):

> Heavy livestock grazing in poplar forests causes a number of changes. Natural forests have several layers of understory vegetation, including tall and short shrubs, tall and short herbs, and mosses and lichens. Under heavy grazing, shrub and herb layers become shorter and more open. Some plant species are preferred by grazers, so they gradually decrease in abundance (decreaser species), while other species that are less prefered gradually increase (increaser species). Livestock trampling can compact or remove the protective layer of surface organic matter, exposing bare soil and promoting erosion. Both the lowering of plant cover and the exposure of bare soil can encourage non-native species to move into the site. These plants are not part of the natural forest, and some of them are highly invasive, aggressively crowding out the native species.

These negative impacts relate particularly to heavy livestock grazing. Therefore one approach to assessing a grazing unit is to determine whether the actual stocking rate[4] is higher or lower than the recommended stocking rate for the site and vegetation type. The other approach is to assess the condition or health of the forest, with reduced condition showing that grazing has been too heavy.

[4] "Stocking rate" refers to the number of grazing animals on a unit area of land for a specied time period. It is measured in Animal Unit Months per hectare, where one Animal Unit Month is the equivalent of a 1000-pound cow grazing for one month.

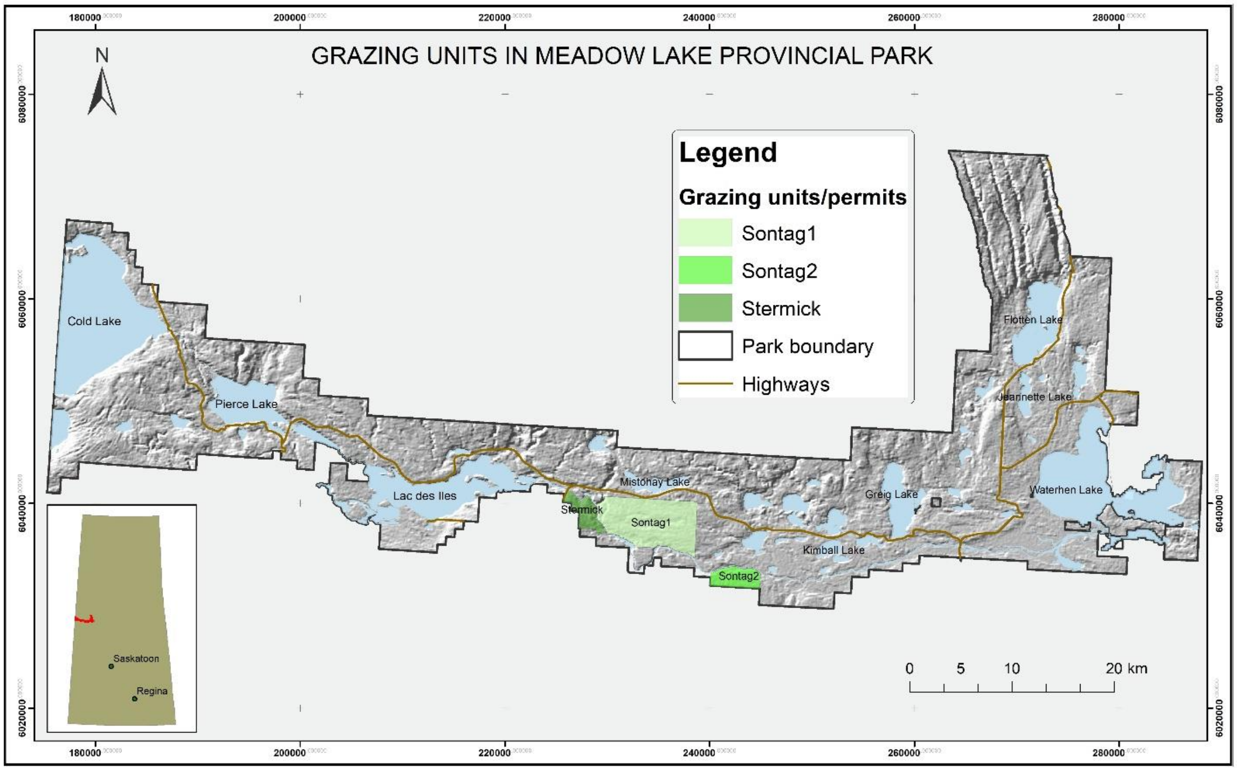

Figure 3.23 Grazing units (in green) in MLPP.

Thorpe and Godwin (1994) compared actual stocking rates to recommended rates provided by Saskatchewan Forestry Branch. They found that three units were overstocked, two were stocked at approximately the recommended rate, and three were at less than the recommended rate. The units that were found to have been overstocked are among those grazing units that have since been discontinued.

Both overstocked and appropriately stocked units were found to have areas of poor to fair range condition. However, the understocked units were found to be in fair to good condition. Even where the overall stocking rate for a unit is low, local areas of overgrazing appear because cattle are not uniformly distributed over the unit. The overall recommendation from Thorpe and Godwin (1994) was as follows:

> Grazing at light stocking rates which maintains "good" range condition is probably compatible with maintenance of overall biodiversity and wildlife habitat, although there may be local areas of negative impact. However, grazing at higher stocking rates which lead to "fair" or "poor" range condition has unacceptable impacts on other biological values of the parks, and should not continue.
>
> If we assume good management which is compatible with biological values, the role of grazing hinges on values to human users. Park grazing provides economic benefits to the holders of the leases, many of whose families have used the land for this purpose for many decades. On the other hand, grazing may lead to negative impacts for the recreational users of the parks. Park managers must weigh these benefits and impacts, and decide on the acceptability of grazing.

In 1994, Wright and Lockerbie (unpublished data) assessed the effect of grazing on plant diversity in MLPP. Their study included nine plots in aspen forest (three ungrazed, three moderately grazed, and three heavily grazed) and six plots in riparian areas (four grazed and two ungrazed). In aspen stands, the diversity of native plants was higher under moderate grazing than either no grazing or heavy grazing. However, some exotic species appeared in moderately grazed stands, and more of them in heavily grazed stands. In riparian areas, grazed areas had lower native diversity and higher exotic diversity than ungrazed areas. Shrub cover decreased with grazing in both aspen stands and riparian areas. They concluded that riparian forest grazing is fundamentally incompatible with a natural park setting. In aspen stands, the only grazing that might be acceptable is at moderate levels. However, even moderately stocked leases tend to have heavy impact close to water bodies and little impact further away. Achieving better livestock distribution would require extensive cross-fencing, which would detract from the appearance of the park.

Recently, Park Division – LPU conducted range assessment in all active grazing units in MLPP and reported that health ratings range from "Unhealthy" to "Healthy" with the overall rating of "Heathy with Problems". The soil and vegetation within the permit areas has been altered, and exotic invasive plants have established in many primary use areas by cattle. The riparian area adjacent to a primary use area was also sampled and determined as "Unheathy" (Figure 3.24 & 3.25). All of grazing units are adjacent to the Waterhen River at some point. In some of them, fence has been built to separate them from the river, to reduce riparian impacts and visibility to canoeists. However, there is existing sign of cattle access to adjacent creeks (Figure 3.24d).

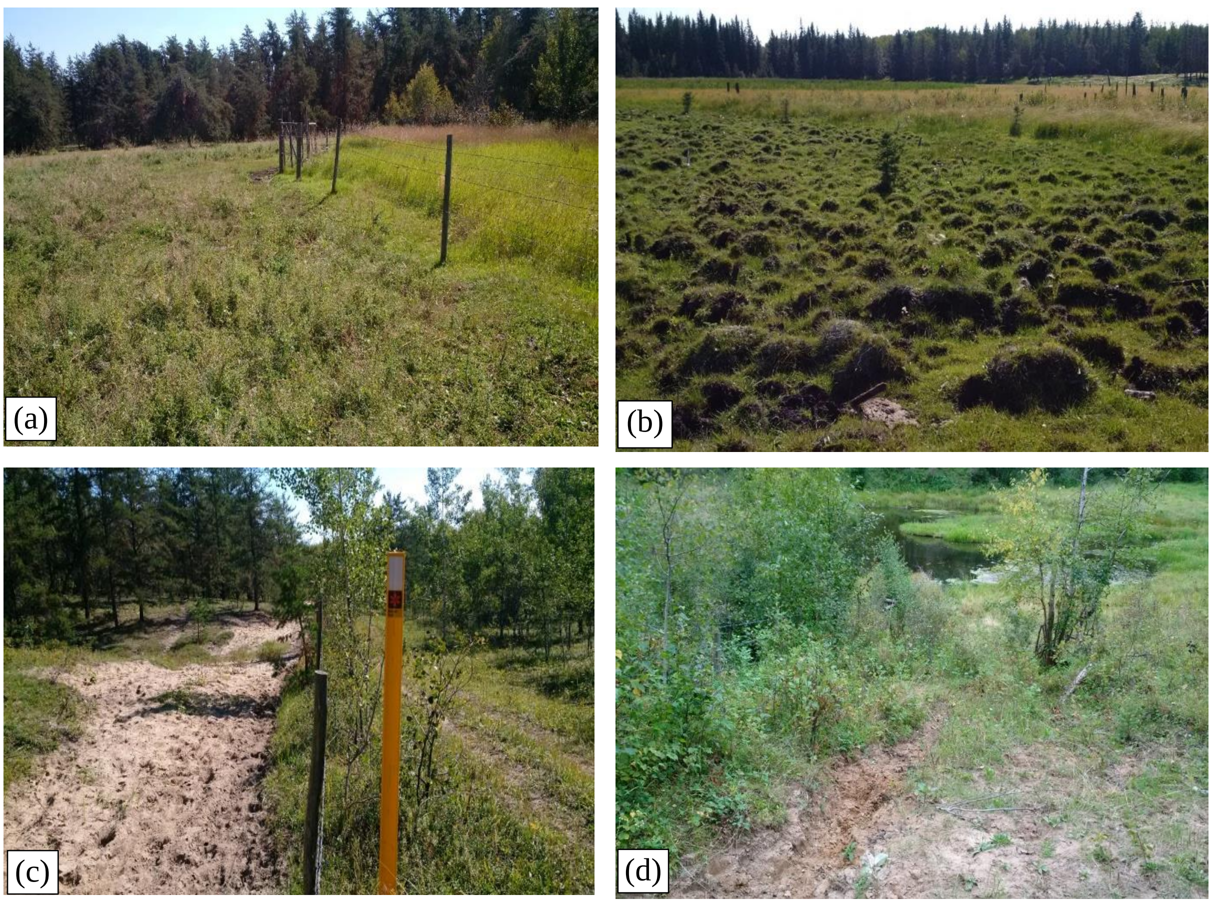

Figure 3.24 Impacts of grazing on soil, vegetation and riparian area in MLPP (Tremblay 2018); Shepard's purse (*Capsella bursa-pastoris*) has largely replaced native grasses on the primary use area within Sontag 2 grazing permit area (a); Pugging and hummocking of soil due to high concentration of livestock on wet soils (b); Excessive livestock grazing on primary use area damaged top-soil layer and thus altered vegetation composition (c); signs of cattle access to Mistohay Creek was clearly indicated, even though a fence is installed to separate livestock from watercourse (d).

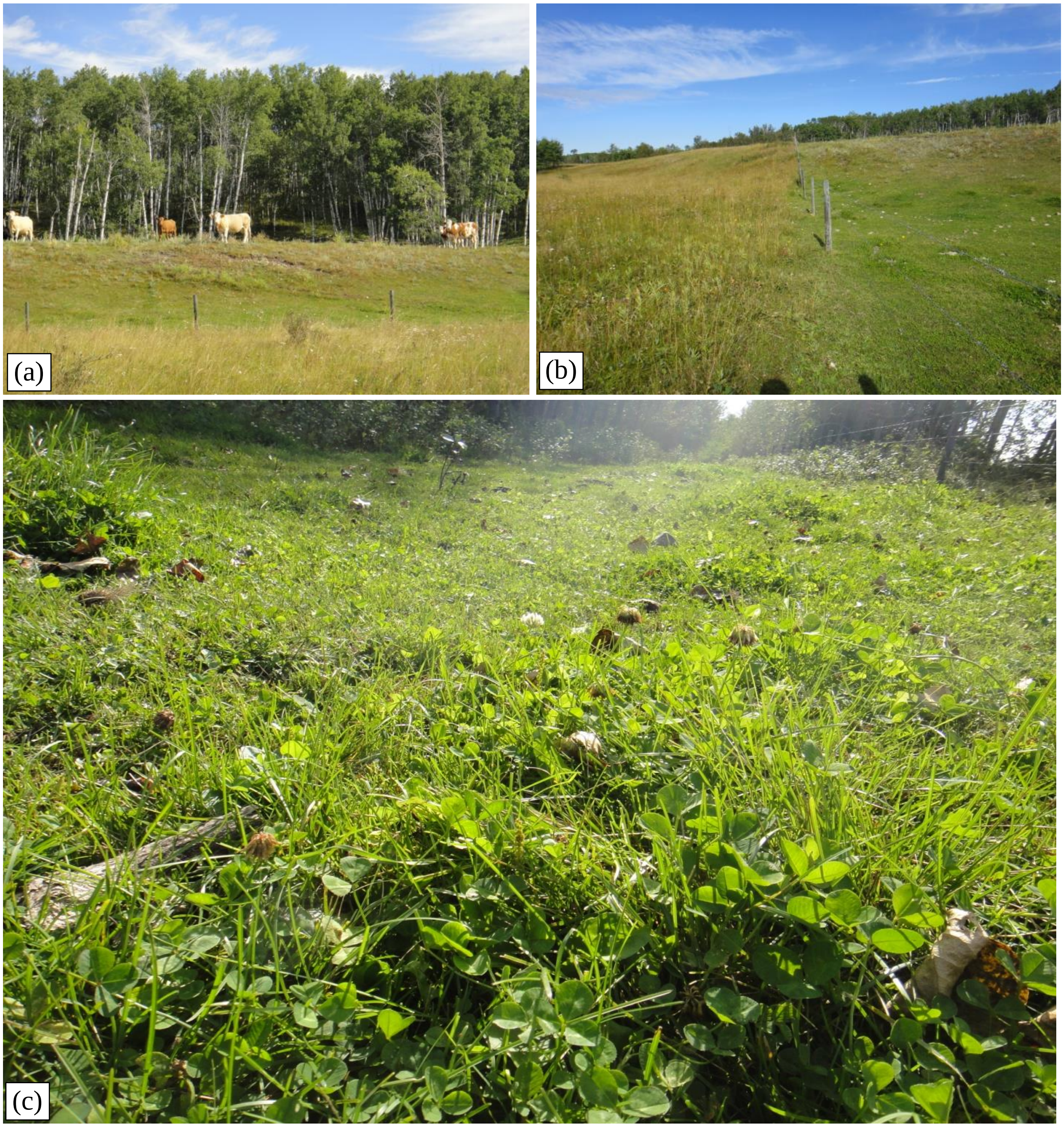

Figure 3.25 Cattle grazing occurrs in a few leases on the southern edge of MLPP (a); grazing on the right side of the fence has an obvious effect on the vegetation (b); and heavily grazed patches often show an increase in exotic species, such as the clover and Kentucky bluegrass as seen in (c).

In summary, although the remaining grazing units in MLPP probably have appropriate stocking rates relative to their overall carrying capacity, the presence of cattle in the park does not meet the park mandate to provide outdoor recreation experiences compatible with the conservation of natural landscapes. There is nothing natural about cattle in the boreal forest as it has significant impact on the vegetation diversity, soil condition and riparian integrity. The overall range condition may be fair to good but because of uneven cattle distribution, they include both ungrazed patches and heavily grazed patches. Serious impacts occur close to water bodies, even though some portion of the Waterhen River bordering the leases has been protected by buffer strips. Heavily grazed patches tend to have reduced shrub cover, reducing their value for certain kinds of wildlife such as browsing ungulates. These patches are also invaded by exotic invasive plants. The appearance of the grazed vegetation, and the presence of cattle, cattle dung, salt-blocks, and fences, all detract from the experience of recreational park users. While most park users in the core areas probably never see cattle, the back-country users along the Waterhen River are likely to encounter them. This is particularly likely because the grazing leases are concentrated along the Waterhen River, which is the most popular canoe route in the park, and also has part of the new Boreal Trail running alongside it.

According to Saskatchewan Parks Division's "Grazing Management Policy", grazing is allowed where it is recommended, in plans, to achieve vegetation management goals. Cattle grazing is often recommended in grassland parks as a substitute for the bison grazing that occurred prior to settlement. Cattle grazing in forests has little to offer in the way of natural disturbance emulation. There may be some similarities to historic bison grazing, but bison browse more than cattle, so the similarity to cattle grazing is likely to be only partial in nature.

One of the most significant differences between the presettlement and modern situations is the presence of exotic invasive plant species. Disturbance, which in pre-settlement times would have favoured early-successional native species, now favours invasive exotics (Figure 3.25). Agricultural areas such as those found immediately south of the park create a huge reservoir of invasive species. Movement of cattle from these agricultural areas into the park brings in exotic seed, while grazing creates disturbed habitats for this seed to become established. One of the key components of the natural capital of MLPP is its largely natural vegetation. The agricultural interface along the south edge of the park creates a threat to this natural capital through exotic invasion. The role of livestock grazing as the catalyst for this invasion may be the strongest argument for phasing out this land use practice in MLPP.

3.5.2 Present-day Vegetation

3.5.2.1 Vegetation classes and forest types

About 62% (105,060.6 ha) of the park land area supports upland terrestrial vegetation. The remaining 38% (63,903 ha) of the park is composed of poorly-drained lowlands. The Provincial Forest Inventory described these two broad types of ecosystems as productive forest land (i.e. the uplands) and non-productive lands (i.e. wetlands). This classification is not very useful in the conceptualization of management approaches in park lands as wetlands (i.e. classified as non-productive lands of commercial forestry) are very important in providing environmental services (e.g. wildlife biodiversity, rare plants habitats, water security, and landscape diversity and view).

The provincial forest types in MLPP is a mosaic of hardwood, mixedwood and pure coniferous forest stands (Table 3.4 & Figure 3.26), showing full representation of the diverisy of forest types found across the middle boreal upland and boreal transition in boreal plain ecozone. Trembling aspen dominated stands (TAB) are the most common hardwood forest cover types in the park with 65,292.3 ha. The most common softwood types in MLPP are jack pine and spruce (black and white spruce) dominated stands (BSJ, BSL, JLP & WSF). Jack pine and spruce dominated mixedwood stands are also common in the park. The pure coniferous forests of MLPP are predominantly jack pine or black spruce.

As ecosystem-based management is a holistic approach that requires some detail knowledge of a site's ecological conditions, the relationship amongst different sites, and the response of those sites to disturbance and time, further classification of vegetation classes and forest types into ecosites (i.e. ecosystems) is necessary to achieve that knowledge (McLaughlan et al. 2010). Defining an ecosystem's characteristics is also the initial step to implement eocystem-based management (Slocombe, 1998). Details on the classification of all ecosistes in MLPP are presented in the following section.

Table 3. 4 Area by Provincial Forest Type (PFT) in MLPP

PFT	Description of PFT	Total Area (ha)
BSJ	Black spruce and Jack pine dominated mixed softwood stands	3,124.6
BSL	Black spruce or tamarack/larch dominated softwood stands	2,345.7
HPM	Hardwood with pine mixedwood	4,249.6
HSM	Hardwood with spruce (bS, wS, bF, and tL) mixedwood	10,247.6
JLP	Jack or lodgepole pine dominated softwood stands	8,286.8
PMW	Pine dominated mixedwood stands	4,907.2
SMW	Spruce dominated mixedwood stands	5,114.4
TAB	Trembling aspen or white birch dominated hardwood stands	65,292.3
WSF	White spruce or balsam fir dominated softwood stands	1,492.4
Total		**105,060.6**

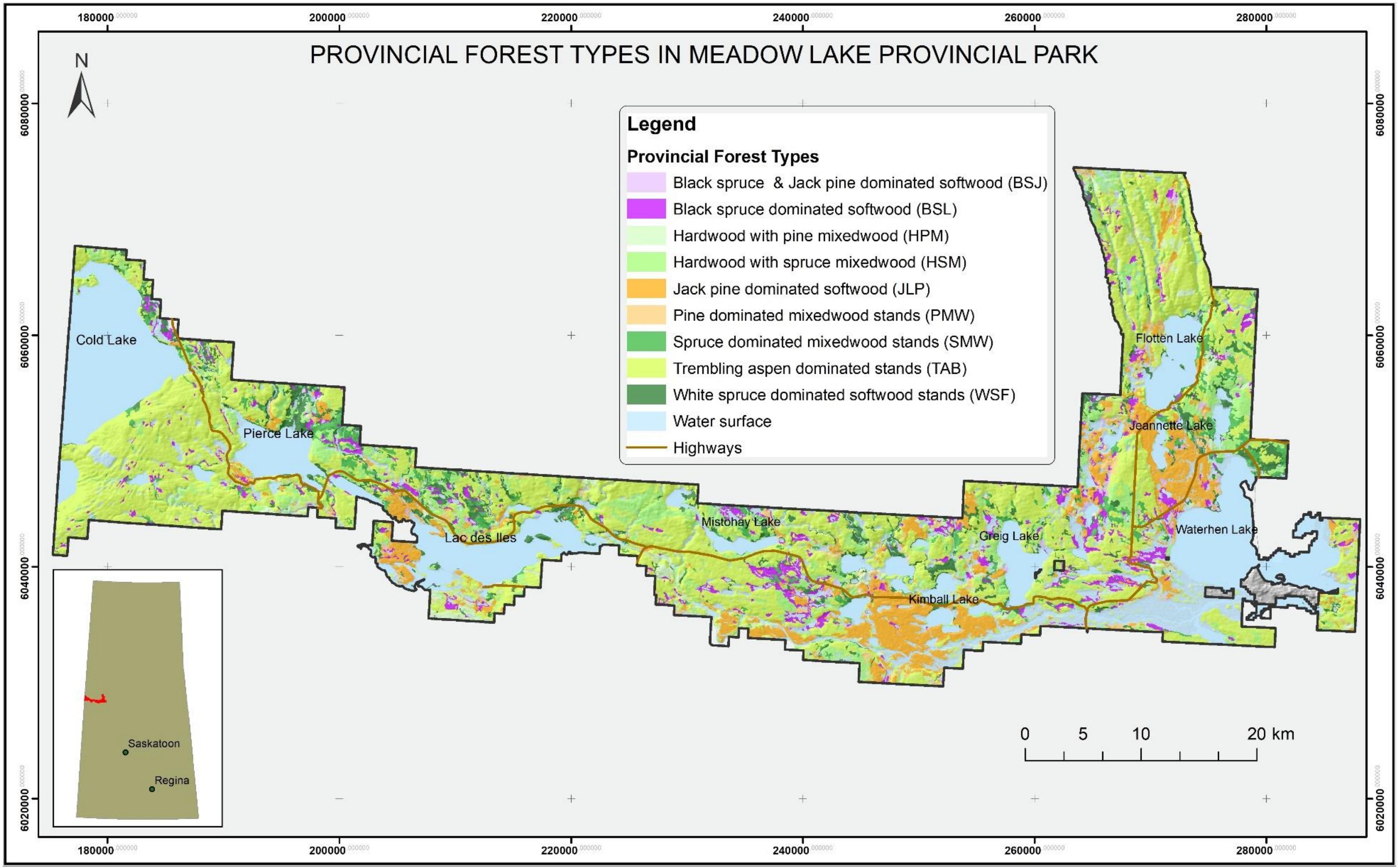

Figure 3.26 Provincial forest types in Meadow Lake Provincial Park

3.5.2.2 Ecosite classification

The description of present-day vegetation made use of the Saskatchewan Forest Vegetation Inventory (SFVI) forest cover maps, and the new forest ecosite classification for Saskatchewan (McLaughlan, Wright and Jiricka. 2010). Relationships between these data sources were used to predictively map the ecosites of MLPP (Figure 3.27). Mapping of all ecosites individually results in an excessively complicated map, so related ecosites have been combined to give a more interpretable product. Table 3.5 gives a summary of the ecosites and their areas. Details of methods are provided in Appendix 1.

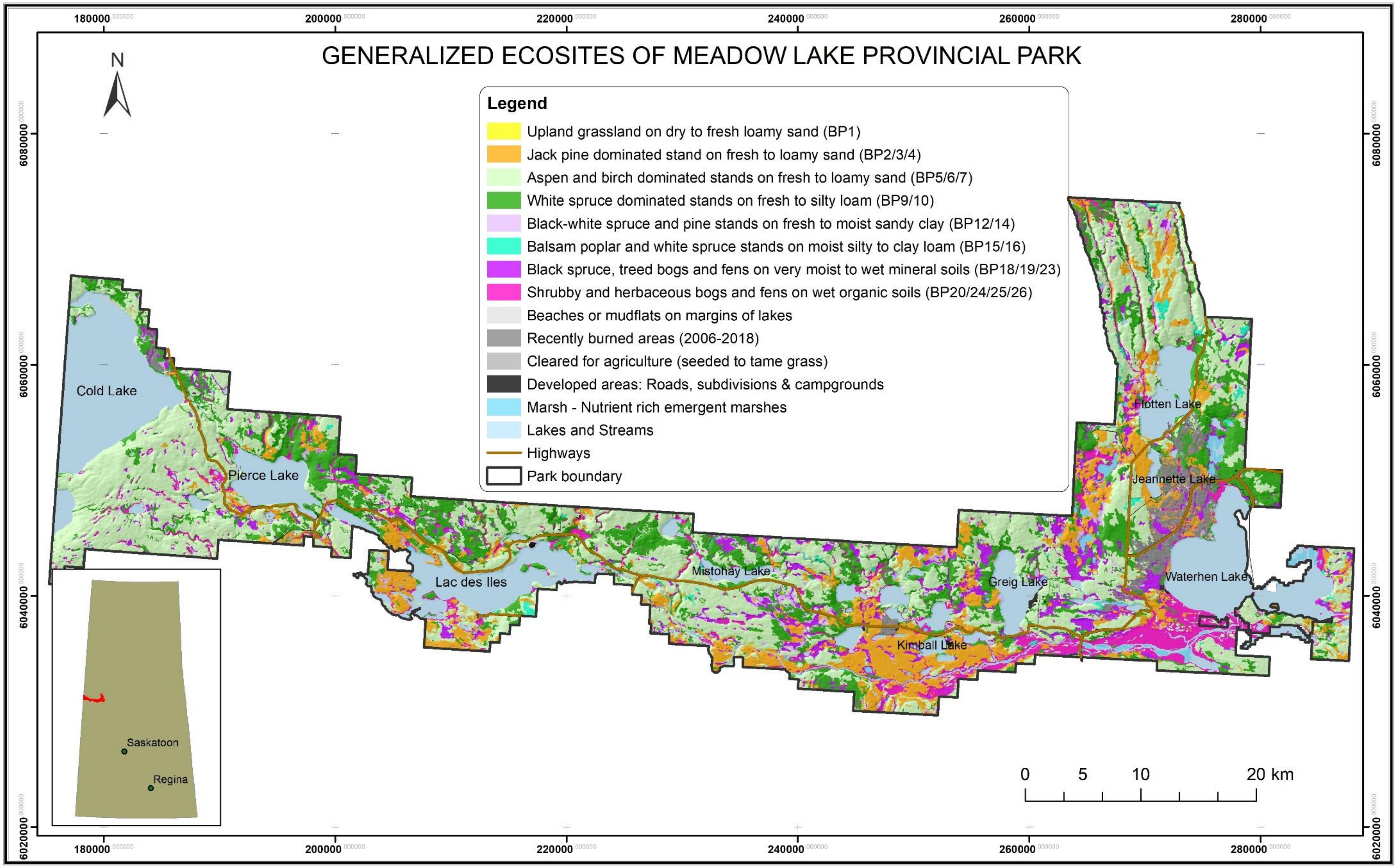

Figure 3.27 Ecosites of Meadow Lake Provincial Park.

Table 3. 5 Summary of ecosites and other mapped types.

Ecosite	Description in MLPP	Area (ha)
Upland Grassland		
BP1	patches of native prairie on dry to fresh* loamy sand on south-facing slopes	59
Jack pine softwood and mixedwood types		
BP2	jack pine stands on moderately fresh sand	194
BP3	jack pine stands on moderately fresh loamy sand	12177
BP4	mixedwoods of pine and aspen (moderately fresh sand)	6218
BP12	pine-white spruce/black spruce stands (variable, from fresh to moist)	246
Hardwood types		
BP5	aspen stands on fresh to moderately dry sand	741
BP6	aspen stands on fresh loamy sand	57,403
BP7	birch stands on fresh loamy sand	1,286
BP16	balsam poplar stands on fresh to moist loams	835
White spruce softwood and mixedwood types		
BP9	white spruce-dominated stands of variable moisture regime and soil ttexture.	12,369
BP10	mixedwoods of aspen and white spruce on fresh loamy sand	14,747
BP15	mixedwoods of balsam poplar and white spruce on fresh to moist sand, silt, or loam	125
Black spruce softwood types		
BP14	black spruce stands on very moist mineral soils	2,377
BP18	open black spruce-tamarack swamps on shallow peatlands (wet to moderately wet sites)	4,096
Treed bogs and fens		3830
BP19	black spruce treed bogs on wet organic soils	
BP23	tamarack treed fens on wet shallow organic soils	
Shrubby and herbaceous bogs and fens		10378
BP20	Labrador tea bogs on wet deep organic soils	
BP24	Leatherleaf nutrient poor fens with wet organic soils	
BP25	Willow dominated nutrient rich fens on shallow, wet organic soils	
BP26	graminoid (i.e., sedges and/or grasses) on wet organic soils	
Marsh	nutrient rich emergent marshes (very wet sites) with organic bottoms	1,787
Other mapped types		
Beach	beaches or mudflats on margins of lakes	103
Burns	recently burned areas	3774
Cleared	cleared for agriculture, usually seeded to tame grass	115
Developed	developed areas such as roads, subdivisions, and campgrounds	1,115
Water	lakes and streams	36,599
	Total	**170,576**

- "fresh" refers to sites that are intermediate to dry and moist/wet sites – sites of moderate moisture regime.

For the forested types, the composition of the various tree species in each ecosite are shown in Table 3.6. Data was extracted from SFVI database.

Table 3. 6 Average percentage cover of tree species over the area mapped in each forested ecosite.

Ecosite	Description	Jack pine	Trembling aspen	White birch	Balsam poplar	White spruce	Black spruce	Tamarack
BP2	jack pine stands on dry sandy sites	88	6	0	0	4	1	0
BP3	jack pine stands on moderately dry sandy sites	89	6	0	0	5	1	0
BP4	mixedwoods of pine and aspen	38	54	4	0	4	0	0
BP12	pine-white spruce and pine-black spruce stands	50	6	1	0	16	24	3
BP5	aspen stands on moderately dry sandy sites	2	95	0	0	3	0	0
BP6	aspen stands on mesic* loamy sites	1	93	0	0	3	0	0
BP7	aspen-birch stands on mesic loamy sites	1	51	41	2	3	1	0
BP16	aspen-balsam poplar stands on moist sites	0	52	4	39	4	0	0
BP10	mixedwoods of aspen and white spruce	3	68	4	1	23	2	0
BP15	mixedwoods of balsam poplar and white spruce	0	9	4	60	18	4	5
BP9	white spruce-dominated stands	4	18	2	1	70	5	1
BP14	black spruce stands on moist mineral soils	10	4	1	0	8	63	14
BP18	black spruce-tamarack stands on marginal peatlands	1	1	0	0	5	53	40

Ecosites are clearly related to the broad landforms descriped in Section 3.2.2 (Table 3.7). Jack pine types are concentrated on the coarse-textured glaciofluvial and glaciolacustrine landforms. Hardwood types (mainly the dominant BP5 ecosite) are concentrated on the loamy-textured morainal landforms. White spruce and black spruce types are more evenly distributed between morainal and glaciofluvial/glaciolacustrine landforms, because locally moist sites resulting from a high water table can occur on either group of landforms. Many small peatlands are evenly distributed, in the sense of being embedded in, a larger surrounding morainal, or glaciofluvial/glaciolacustrine, landscape matrix. They occur on organic soils but are often small in areal extent and are not mappable at the scale shown in Figure 3.27. Only the larger areas of peatland/organic soils are shown on the landform map in Section 3.2.2.

Table 3. 7 Distribution of ecosites in relation to landform. Percentages are relative to the total area of each group of ecosites. Peatland types are often embedded in a larger landscape matrix of upland ecosites.

Ecosite groups	Landform				
	Morainal - loamy	Fluvial & lacustrine - coarse	Organic - peatland	Eroded - valley slopes	Alluvial
Jack pine types (BP 2/3/4)	22%	66%	10%	2%	0%
Hardwood types (BP 5/6/7/16)	67%	24%	2%	5%	1%
White spruce types (BP9/10/15)	50%	39%	5%	5%	1%
Black spruce types on mineral soil (BP12/14)	36%	52%	9%	3%	0%
Peatland types (BP18/19/20/23/24/25/26/marsh)	30%	35%	32%	4%	0%

BP1 – Grassland on moderately fresh loamy sand

Grassland (BP1) is a relatively minor type occurring as small patches surrounded by forest, often on warm south-facing slopes (Figure 3.28). Discussion of the origin, composition, and significance of these grasslands is in Section 3.5.5.

Figure 3.28 Native grassland patch (BP1) on a south-facing slope. This grassland is dominated by awned wheatgrass.

BP2, BP3, BP4 & BP12 – Jack pine dominated stands on dry to fresh loamy sand

Jack pine stands occupy a large area, and are assigned to two types that are related to soil moisture. The drier type (BP2) is characterized by an open understory with only scattered shrubs and herbs, and a ground-cover of pale-coloured reindeer lichens (Figure 3.29a). The somewhat moister type (BP3) shows a denser understorey of herbs and shrubs, usually with scattered clumps of the tall shrub green alder (Figure 3.29b). The ground cover consists of "feather mosses", a group of fine green mosses including redstem moss, stairstep moss, and knight's-plume moss. Most of the pine stands in the park are mapped in BP3, but our field observations suggest that the drier BP2 is more widespread than indicated by Table 3.5. These discrepancies result from limitations in the source photo-intrepreted inventory data.

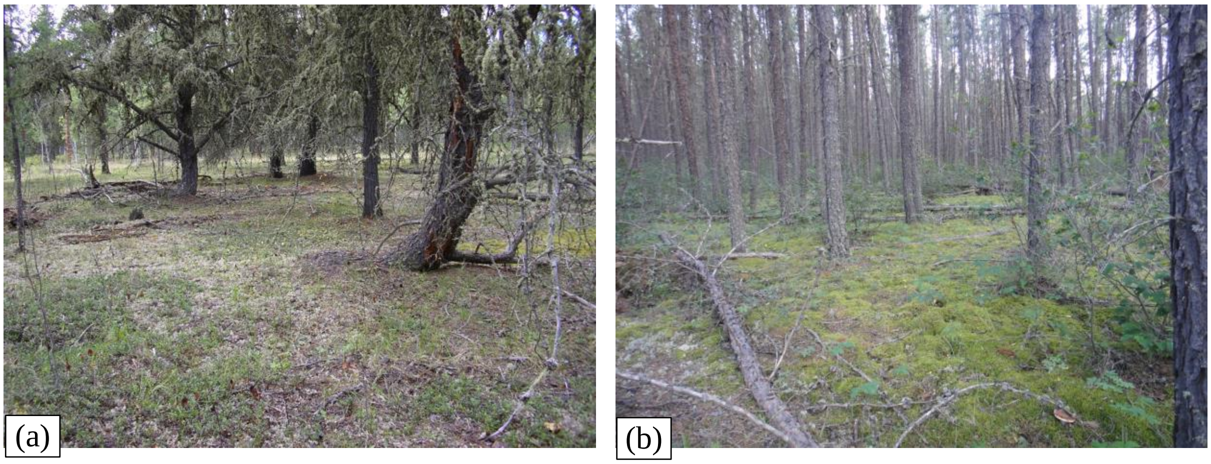

Figure 3.29 Open stand of jack pine on a dry sandy soil (BP2) (a) and closed jack pine stand on moderately dry sandy soil (BP3) (b). The pale ground cover on BP2 site is reindeer lichen, while the green creeping shrub is bearberry. The green ground cover on BP3 site is feather mosses, while the scattered tall shrubs are green alder.

Mixed stands of jack pine and trembling aspen, which occupy a significant area on somewhat moister sands, are placed in BP4. A small area of pine/spruce mixtures (BP12) occurs on a variety of sites (Figure 3.30). Jack pine and black spruce stands often occur on sandy soils which are moister because of a water table in the rooting zone, and represent a transition to the black spruce-dominated type (BP14) on moist sands.

Figure 3.30 Mixture of jack pine and black spruce on moderately well drained sand over till (BP12). The ground cover is feather moss and the low shrub is Labrador-tea.

BP5, BP6, BP7 & BP16 – Hardwood dominated stands on fresh to fresh loamy sand

Hardwood stands occupy the largest area in MLPP, with the predominant aspen type (BP6) accounting for more than half of the upland vegetation. This type usually occurs on fresh, loamy-textured, morainal areas, widespread throughout the park. These aspen stands typically have dense shrub layers (beaked hazelnut, saskatoon, pincherry), and abundant herbs (sarsaparilla, peavine, and many other leafy herbs) (Figure 3.31a). Aspen stands on somewhat drier, sandier sites are placed in BP5. These are shown as a relatively small area in Table 3.5, but our field observations suggest that the true area is larger, again because of limitations in the source data on which the predictive mapping was based. The drier aspen stands are somewhat more open, and usually have sand-indicator species such as blueberry and bearberry, along with the usual aspen understory shrubs and herbs (Figure 3.31b). The dense shrub layer on BP6 site is dominated by beaked hazelnut, with a variety of other shrubs and herbs also present. Blueberry and bearberry are abundant on BP5 site, indicating that the underlying soil is sandy and well-drained. A variety of shrubs and herbs typical of aspen stands is also present on BP5 site.

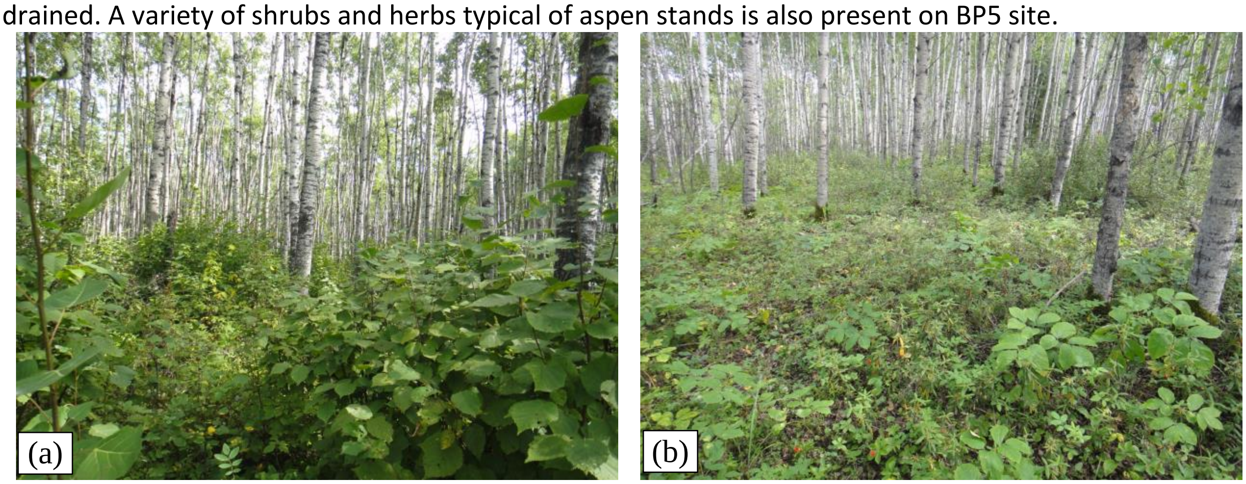

Figure 3.31 Aspen stand on a well-drained loamy soil (BP6), the most widespread ecosite in MLPP (a), and aspen stand on a moderately dry sandy soil (BP5) (b).

Stands trembling aspen - white birch (BP7) (usually found on fresh sites similar to BP6), and balsam poplar – trembling aspen (BP16) (usually on moist sites), similarly appear to be mapped over smaller areas than their actual occurrence. Birch stands are fairly widespread in places, particularly on the valley slopes of the Mostoos Escarpment (Figure 3.32), while balsam poplar stands appear regularly in moist depressions throughout the park. The understory vegetation of balsam poplar stands is often similar to that of aspen stands, but there may be moisture-indicating species such as red-osier dogwood, marsh reed-grass, bishop's cap, and others.

Figure 3.32 Mixed stands of white birch and trembling aspen (BP7) are common on valley slopes on the Mostoos Escarpment.

BP9, BP10, BP14, BP15 & BP18 – Black and white spruce dominated stands on fresh loamy sand to wet organic/mineral soil

Mixedwood and softwood stands with white spruce occur across the same range of soils as hardwood stands. The degree to which white spruce is dominant is determined by fire history and stand succession. After fire, aspen suckers from the root system, and grows rapidly, forming the dense hardwood stands that is common in the park. These aspen stands may have no conifer component if sufficient mineral soil was not exposed by the fire or no white spruce seed source occurred in the area.

The severity or duration of the burn determines how well mineral soil is exposed in a post-fire stand with high severity/fire duration leading to greater combustion of the duff layer at the soil surface and a higher degree of exposure of mineral soil. Mineral soil seed beds are necessary for a good catch of white spruce seedlings in the first few years following fire.

White spruce may also fail to appear in the stand if no white spruce, bearing a good seed crop, occurs in the vicinity of the burn. Without adequate seed rain, white spruce fails to establish and the aspen stand will develop without a spruce component. However, if a nearby and unburned white spruce stand develops comes into maturity or produces good seed crops in the decades following the burn, a new cohort of white spruce may establish on rotting logs or stumps on the forest floor (Kabzems and Garcia

2004). Establishment of this white spruce cohort may lag the burn date by four to seven decades. Understory white spruce in aspen stands grow more slowly than the dominant aspen stems but they have the potential to live longer than aspen. As aspen stands mature and exceed 100 years of age, they enter a phase of stand breakdown as the old stems die, rot and fall to the forest floor and the stand canopy opens up. The understory white spruce then accelerates their growth in the thinning aspen stand, thriving in the sunny environment. Eventually they come to form, with the remaining aspen, the mature white spruce- aspen mixedwoods (BP10) so common across the park (Figure 3.33). As the aspen completely die out in such a stand the forest may succeed to a pure white spruce stand (BP9 or BP13).

Similar successional processes in moister balsam poplar-dominated stands result in balsam poplar- white spruce mixedwoods (BP15). Eventually enough of the hardwood component dies that the white spruce softwood type (BP9 or BP13) remains (Figure 3.34). As the spruce content increases from hardwood to mixedwood to softwood stands, shade increases, and the shrub and herb layers are gradually replaced by a feather moss ground cover.

Figure 3.33 Mixedwood of trembling aspen and white spruce on a mesic loamy site (BP10)

Figure 3.34 Dense white spruce stands on a moist sandy soil (BP9).

Black spruce stands occur on moist to wet sites, especially on nutrient-poor soils (e.g. sands with a high water-table). Black spruce stands on moist mineral soils are assigned to BP14. These may have a secondary component of jack pine that established at the origin of the stand but die out in middle age as the black spruce canopy closes and the irradiance becomes too low to support jack pine growth. These stands usually have a ground-cover of feather mosses and Labrador-tea. Under wetter conditions, peat accumulation produces organic soils. On the margins of wetlands, where the peat is thin, black spruce and tamarack (*Larix laricina*) may form forest stands referred to as swamps (BP18) (Figure 3.35). On sites with thicker peat and less influence of mineral rich groundwaters, ecosites are classified as sparsely wooded and non-wooded bogs and fens.

Figure 3.35 Dense black spruce-tamarack swamp on a thin organic layer, underlain by very moist to wet mineral soils (BP18). The hummocky ground is covered with feather moss and scattered Labrador-tea.

BP19, BP20, BP23, BP24, BP25 & BP26 – Treed bogs and fens, shrubby and herbaceous bogs and fens on wet organic soil

In peatlands the water table is near the surface and drainage is poor. The composition of the vegetation is controlled by nutrient supply, cool soil temperatures (which depresses growth rates) and the seasonal pruning of roots by high water tables. Fens are relatively nutrient-rich because they receive some water flow from adjacent mineral soils in higher landscape positions. Bogs are nutrient-poor because they are isolated from these mineral flows, and receive only the nutrients from precipitation. Bogs typically have a ground cover of *Sphagnum* moss, with feather mosses on drier hummocks, and with Labrador-tea and other ericaceous shrubs.

Fens may have more nutrient-demanding species of *Sphagnum* or a variety of "brown mosses" associated with rich sites. Wooded fens often have a mixture of tamarack-and black spruce but may occasionally support only tamarack (BP23) (Figures 3.36). In wooded bogs black spruce is the dominant tree (BP19) but tamarack may be present with low cover (Figure 3.37). While it was not possible to separate wooded bogs from wooded fens on the map, field observations suggest that both are reasonably common. The poorest bogs sometimes do not even support black spruce trees, but are dominated by ericaceous shrubs, including Labrador tea (BP20). Fens may be untreed because of disturbance or flooding frequency. Treeless fens may be dominated by short shrubs such as leatherleaf and swamp birch (BP 24) (Figure 3.38), tall willows (BP 25) (Figure 3.39), or sedges and grasses (BP 26) (Figure 3.39). These non-wooded peatland types are also not separable on the map but do account for a large area of the park. Based on field observations, the various shrubby and herbaceous fen ecosites appear to be much more widespread than shrubby bog ecosites.

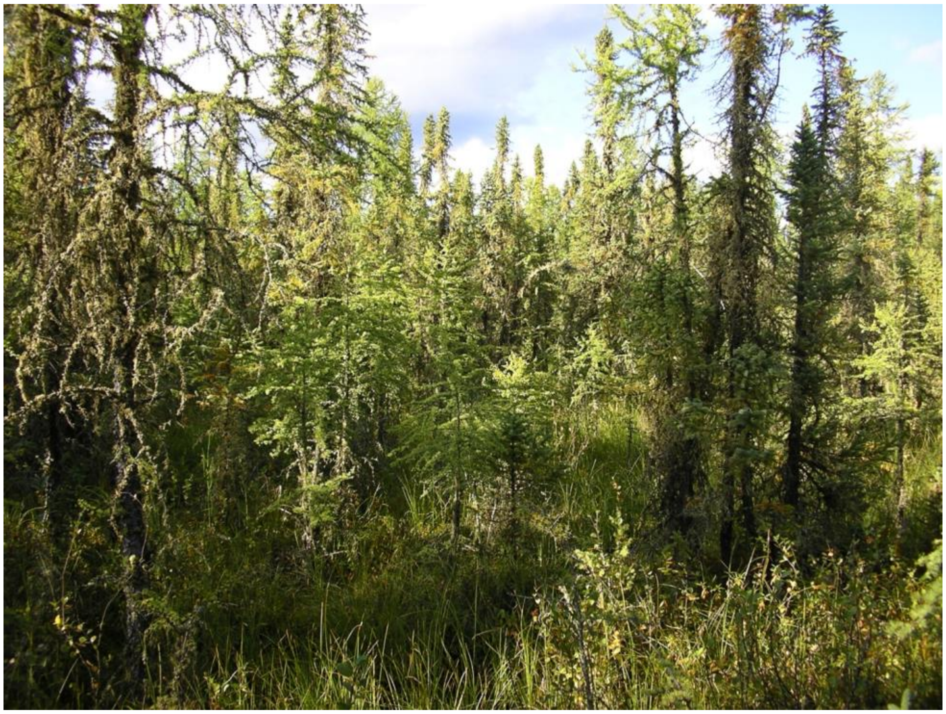

Figure 3.36 Slow-growing black spruce and tamarack on a fen peatland (BP23). Most of the ground cover is Sphagnum moss, but the scattered pools with sedges indicate fen conditions.

Figure 3.37 Hummocky ground cover in a black spruce bog (BP19), with Labrador-tea and mosses.

Figure 3.38 Shrubby poor fen with swamp birch and leatherleaf as well as grasses and sedges (BP24)

Figure 3.39 Graminoid fen (BP26) in the foreground, with sedges and narrow reedgrass. Shrubby rich fen with tall willows (BP 25) in the middle ground, and forest on mineral soil in the background.

The final vegetation type mapped was Marsh. This includes the deep-water emergent marshes that border the Waterhen River and other slow-moving streams (Figure 3.40). The largest areas appear to be dominated by giant reedgrass, but there are also cattail and bulrush marshes. Marshes usually have a mineral substrate, and are subject to fluctuating water levels.

Figure 3.40 Open water with patches of giant reedgrass marsh along the lower Waterhen River

Other mapped types occupying relatively small areas include:

- Beaches along the shores of some lakes.
- Recent burns – these should, in principle, be assigned to ecosites, but there is no information on the forest inventory map to allow a prediction. This can be updated when the new forest inventory database is available.
- Areas that have been cleared for agriculture at some time in the past, mostly along the southern edge of the park, but including a former homestead on the west side of Greig Lake; the portion of this homestead mapped as "cleared" is 34 ha, but it probably originally included a larger area now mapped as young forest.
- Developed areas, including roads, campgrounds, cottage subdivisions, and park administrative areas.

Finally, about 21% of the park is open water. This is somewhat less than the 23% given by Wilson and Zielke (1997), because the area mapped as marsh has been removed from the water total.

3.5.3 Summary of Overall Park Flora

Lists of vascular plant species from various sources (Wilson and Martin 1998, Remarchuk and Cota-Sánchez 2005, observations by SRC staff) have been compiled in Appendix 2. The total is 376 species in 71 families. This list is likely incomplete and would be expanded by further surveys. A few families such as the Asters, Grasses, Sedges, and Roses account for most of the species, while there are many families with only 1 or 2 species (Appendix 2). The largest numbers of species are herbaceous (graminoids and forbs), with a smaller number of shrubs and only eight trees (white and black spruce, jack pine, balsam fir, tamarack, trembling aspen, balsam poplar, and white birch) (Table 3.8). Remarchuk and Cota-Sánchez (2005) found that diversity is evenly distributed throughout MLPP, with no particular species-rich areas.

Table 3. 8 Number of vascular plant species by growth form (see Appendix 2).

Growth Form	Number of Species
Trees	8
Erect shrubs	44
Prostrate shrubs	4
Graminoids (grass-like herbs)	69
Forbs (broad-leaved herbs)	251

The species list includes 31 exotic species (i.e. those which were introduced from Europe or Asia), about 8% of the total. Remarchuk and Cota-Sánchez (2005) listed the following exotics as widely distributed along roadsides: smooth brome grass (*Bromus inermis*) (Figure 3.41), alfalfa (*Medicago sativa*), white sweetclover (*Melilotus alba*), yellow sweetclover (*Melilotus officinalis*), and alsike clover (*Trifolium hybridum*). Other widespread exotic species observed by SRC staff include Kentucky bluegrass (*Poa pratensis*), dandelion (*Taraxacum officinale*), and common plantain (*Plantago major*). There are also conspicuous but localized invasions of caragana (*Caragana arborescens*) (Figures 3.41 and 3.42), common tansy (*Tanacetum vulgare*) (Figure 3.43), and Canada thistle (*Cirsium arvense*). Caragana was planted at a former homestead near Raspberry Lake, and has since invaded the understory of a patch of forest. Both caragana and smooth brome grass are extremely invasive into natural vegetation. These lists do not include ornamental plantings in the park core area.

Figure 3.41 Smooth brome grass (foreground) and caragana (background) at a former homestead on the west shore of Greig Lake.

Figure 3.42 The shrub with the many small leaflets is caragana.

Figure 3.43 A small patch of common tansy, an exotic herb that was accidentally introduced into disturbed land near the sewage lagoon at Greig Lake. This species is very invasive and hard to control.

Exotic tree species have been intentionally introduced into MLPP in a few cases. There are a few Scots pine (*Pinus sylvestris*) in the park headquarters area. These should probably be replaced by native trees such as white spruce, as part of the park's message to other users. Cottage owners are being encouraged to use native species in landscaping, so the park should practise this as well. Trial plots for growth and survival of white spruce, lodgepole pine, jack pine, red pine were established near Greig Lake (Wilson and Zielke 1997). White spruce and jack pine are native to MLPP, whereas lodgepole pine and red pine have been introduced from other parts of Canada. It has been argued that these trial plots should be maintained for their information value. One of the strategies that has been proposed for adaptation to climate change is to introduce tree species that will be better adapted to the warmer future climate (Sauchyn et al, 2009).

The first stage in this process is to establish trial plantations under controlled conditions, to evaluate survival and growth, as well as any ecological problems resulting from introductions. Plantations for this purpose, using not only North American trees (e.g. lodgepole, ponderosa, and red pines), but also Eurasian trees (e.g. Scots pine, Siberian larch), have been established in other parts of Saskatchewan (Bendzsak 2006). However, even if this approach is accepted, some would argue that protected areas, in which the highest priority is placed on natural biodiversity, are the least appropriate location for such trials (Thorpe et al. 2006). One concern is with invasion of adjacent ecosystems, and Scots pine, for example, can be very invasive unless there is careful control of volunteer seedlings on the periphery of plantations. There is probably less concern about the trial plantations in MLPP, but eradicating the plantations of lodgepole and red pines would be consistent with an overall park strategy of low tolerance for exotics.

Most exotic species become established on heavily disturbed sites such as roadsides. Some species, including most of the annuals, rely on continued availability of these heavily disturbed sites. If they do spread into natural vegetation, they are usually short-lived. The worst invasives are those that form dense stands, crowding out the native species. Smooth brome grass and caragana are two such species, forming monodominant stands with very little diversity of native plants.

Caragana presents a more difficult management challenge, because the largest existing invasion near Raspberry Lake is under aspen, preventing mechanized mowing or spraying, and the patch is large enough that considerable labour will be required for control. However, because it is a discrete patch, and because of caragana's invasive potential, a high priority should be placed on control of this problem. Methods for caragana control include mowing and herbicides (Godwin and Hoover 2010, Neufeld 2010b). However, because of resprouting, mowing would have to be repeated frequently, which would be very laborious using hand-tools under aspen. The preferred approach is application of a herbicide such as triclopyr, either to stumps following cutting, or to the basal bark of the standing shrub. Where there are caragana patches in open areas, it may be practicable to control them by repeated mowing. It may be worthwhile to consider a small-scale prescribed burn, beforehand, to allow easier control of the species. Alternatively, the site could be clearcut, treated with herbicides for several years and then planted to native trees. Controlling emergence of new seedlings from the existing soil seed bank of caragana on this site may present a long-term management challenge.

The infestation of common tansy at Greig Lake may be less complicated because it is out in the open. Methods for tansy control include mowing or hand-pulling prior to flowering, or herbicide application.

One of the questions around exotic plant management is the appropriateness of using herbicides in a natural environment park. The "Provincial Park Resource Management and Recreational Activities Guidelines" recommend that herbicides be avoided wherever possible to minimize environmental impacts. However, commonly used herbicides such as 2,4-D, glyphosate, and tricopyr break down fairly quickly in the environment and have low toxicity to animals (Godwin and Hoover 2010). The threat to natural biodiversity posed by exotic invasion appears much greater than the risk of adverse chemical effects from herbicide residues. One of the most valuable assets in the natural capital of MLPP is its natural species composition. Most exotic problems are small at present. But the future risk is large, because of the high fragmentation of the park by roads and other developments, and because of the proximity of a huge source of exotic propagules in the agricultural land to the south. Controlling exotic populations so challenging that the most efficacious methods must be brought to bear. This usually means herbicides must be given serious consideration in the design of exotic invasive plant management protocols.

According to Saskatchewan Parks Division's "Provincial Park Resource Management and Recreational Activities Guidelines" (2003):

- Exotic plant and animal species should not knowingly be introduced onto park land.
- Efforts should be made to naturalize developed areas using native plantings wherever possible.
- Native species should be used to revegetate disturbed areas.
- Information should be provided to cottagers and lessees suggesting alternative native material.
- Control measures should be selected to minimize environmental impact; use of herbicides should be avoided wherever possible.
- Periodic inventory should be done to identify areas affected by exotics and monitor progress in controlling them.
- Ecosystem management plans should include strategies to prevent new invasion, control existing populations, and restore invaded areas to native species.

One component of exotic management is to reduce opportunities for new invasions, by practices such as:

- eliminating livestock grazing
- closing and reclaiming unnecessary roads and trails
- restricting ATV traffic
- using strictly native species in landscaping and erosion control
- requiring that heavy equipment be washed to remove seed-bearing mud before being brought into the park

3.5.4 Ecological Disturbance and Age-since-last-disturbance Profiles

Most boreal forests originate from regeneration after stand-replacing disturbances such as wildfire and logging. Therefore, the boreal forest is a patchwork of stands originating from different disturbance events (see Section 3.4). Forests in MLPP show three peaks in stand origin at approximately 1940, 1920, and 1880-1900[5] (Figure 3.44). For forests overall, and for hardwood and pine stands, 1940 and 1920 were both large peaks, whereas for black spruce stands the 1920 peak is clearly more significant. For white spruce stands, the peak decades of origin were 1880-1900.

[5] These years represent the surrounding decade: e.g. 1920 represents the decade from 1916 to 1925.

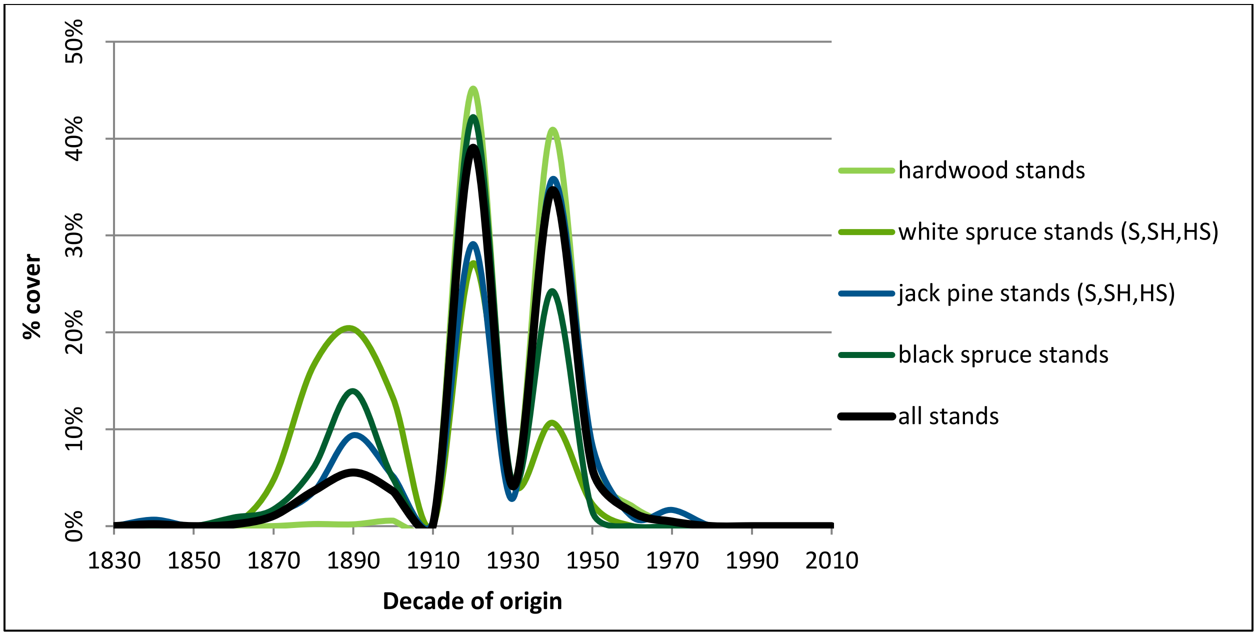

Figure 3.44 Decade of origin for forest stands in MLPP summarized from SFVI database. Percentage cover shows the area of a given forest type in each age class. S- softwood; HS – hardwood-dominated mixedwood; SH – softwood-dominated mixedwood.

This distribution can be compared to the fire history discussed in Section 3.4. The peak at 1920 represents forest regenerated by the "Great Fire of 1919", and not affected by any subsequent disturbance. This 98-year-old cohort represents 39% of the park's forest in which hardwood stands and black spruce stands account for 45% and 42%, respectively. The peak at 1940, about 78 years old at present, probably represents forest regenerated by early logging (see Section 3.3). The 78-year-old cohort comprises of 41% of hardwood stands, 36% of jack pine stands and 24% of black spruce stands. The detailed mapping of forest fires (Section 3.4) did not start until 1945. However, interviews with long-time residents (Cam Lockerbie, field notes, 1994), which yielded information about the 1919 fire, did not identify any major fires around 1940. The peak around 1880-1900, 118 to 138 years old at present, probably represents a wildfire (or more than one) on which we have no information. White spruce stands represent the highest percentage cover (20%) of old age class originated from 1880-1900 forest.

Most of the park aspen stands are in the 75- to 100-year-old age classes, meaning that most of the park hardwood forest is at least 15 years away from serious stand breakdown and much of it is over 35 years away from the onset of significant stand breakdown. This gives the Parks Division some time to plan large-scale regeneration efforts for these extensive hardwood forests.

Aspen stands, aspen-spruce mixedwoods, and white spruce stands often occur on similar sites, and are linked in a successional sequence (see Section 3.5.2). Figure 3.45 shows that if we analyze these types as a group, the more recent age classes (mostly originating in 1920 and 1940) are predominantly hardwood. By contrast, the earlier classes (mostly originating in 1880-1900) are a mix of hardwood-dominated mixedwood (HS), softwood-dominated mixedwood (SH), and softwood (S) stands. These older stands may have been hardwood at a younger age, and went through succession to mixedwood or softwood types.

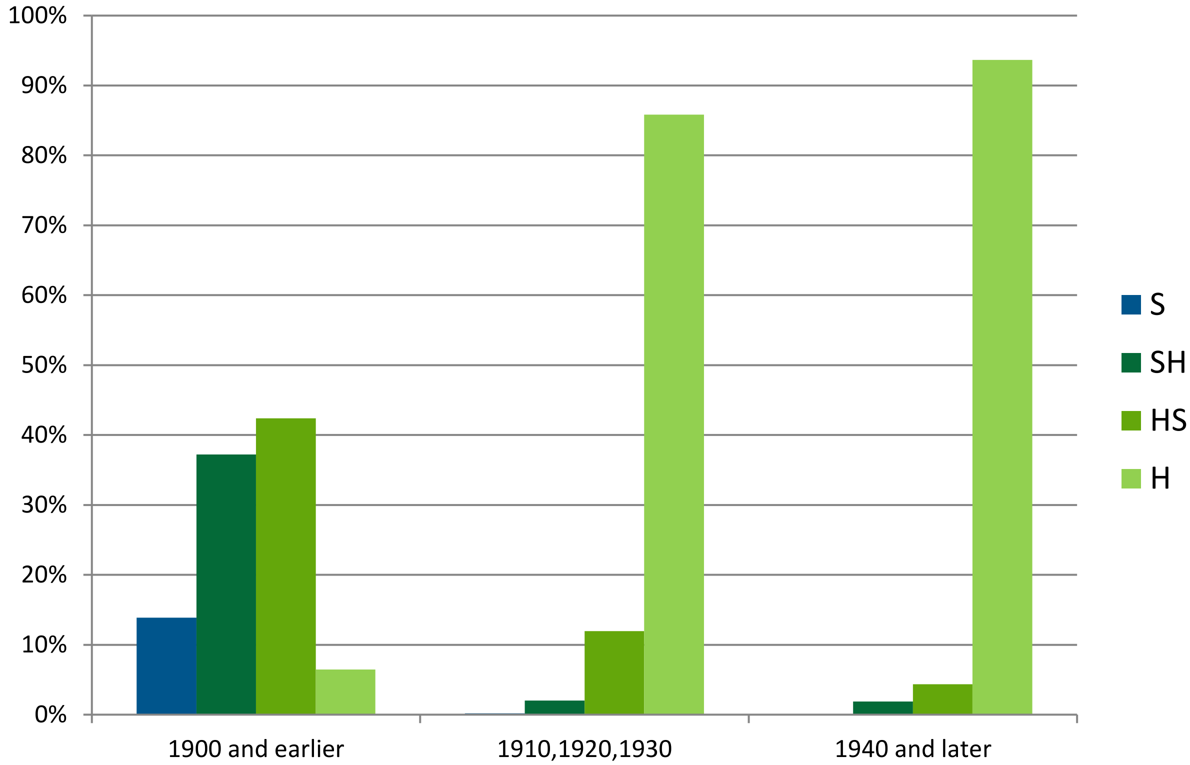

Figure 3.45 Distribution of stands in three broad age classes in relation to the proportions of hardwoods and softwoods. S- softwood; HS – hardwood-dominated mixedwood; SH – softwood-dominated mixedwood; H – hardwood. This analysis is based on stands with aspen and white spruce; black spruce and jack pine stands are excluded.

The year-of-origin data for all stands in Figure 3.44 was used to generate the cumulative distribution of age-since-last-disturbance (Figure 3.46). This shows the proportion of forest (by area) that has survived up to a given age, calculated as of 2010. For example, only 5% of the forest has survived to an age of 130 years, but 98% of the forest has survived up to an age of at least 60 years. This cumulative distribution is compared with the negative exponential curve (Figure 3.46), representing the theoretical distribution that would occur if fires (or other stand-replacing disturbances) occur randomly, with equal probability in any stand (Van Wagner 1978). The shape of these theoretical curves depends on the fire cycle (the number of years required for the entire study area to burn over once). Two curves are shown, one for a fire cycle of 25 years, and the other for a fire cycle of 50 years. Research on fire history supports a natural fire cycle for western boreal forests of less than 50 years (Johnson 1979, Carroll and Bliss 1982, Murphy 1985, Weir et al. 2000). Figure 3.46 shows that such a regime would result in a very different distribution of stand ages that is observed in the actual park forest.

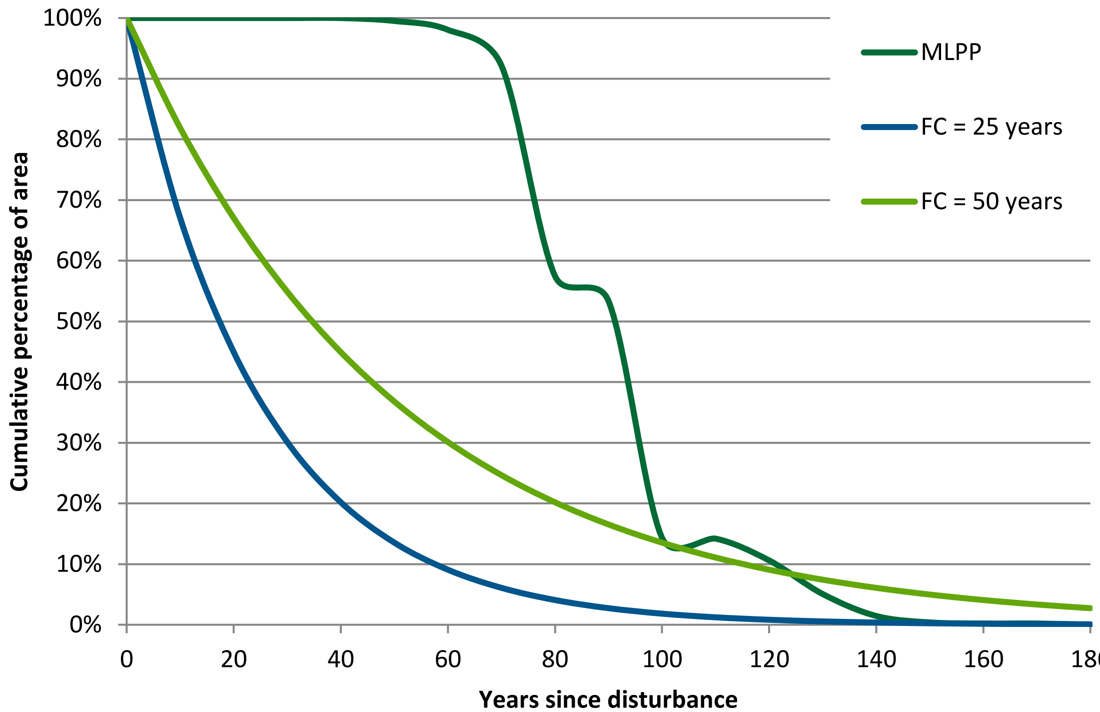

Figure 3.46 Cumulative distribution of age-since-last-disturbance in MLPP, compared with theoretical distributions for fire cycles (FC) of 25 and 50 years.

Overall, 70% of the forest in MLPP originated between 1918 and 1948. The resulting stands, 70 to 100 years old, are in the stage that foresters would classify as "mature" to "old". About 25% of the forest originated between 1948 and 1998 that would classify as "immature" (i.e. 21 to 70 years old). There is relatively very little forest in either young (i.e. originated 1998 or later) or very old stages (i.e. originated 1917 or earlier). In the cumulative distribution (Figure 3.46), this can be seen in the fact that the curve for MLPP approached 100% 70 years ago, with little additional rise since then. By contrast, the theoretical curves show substantial increases in the younger ages, indicating an expectation, under the negative exponential model, of a larger proportion of stands being renewed in the recent past. The relative lack of young to immature forest in MLPP most likely reflects the effectiveness of fire suppression and the limited amount of logging since the 1940s.

We should not attach too much weight to the exact match of the current proportion of old forest to any particular natural fire cycle. It may be impossible to define a "natural" fire cycle for an area, because fire cycles may change from one climatic period to another (Johnson et al. 1998, Whitlock et al. 2003). Simulation models show that under characteristic boreal forest fire regimes, the age distribution can vary widely over time because of random variation in occurrence of fires (Boychuk and Perera 1997, Armstrong 1999). This is particularly the case for an area as small as MLPP, although even much larger areas can fluctuate in age distribution through time (Boychuk and Perera 1997). This implies that the age distribution that we find in MLPP at present could be within the range of variation that would occur under a natural disturbance regime.

Because of the uncertainty about applying any particular age-since-disturbance profile to an area the size of MLPP, it is probably more useful to consider the role of forest age distribution in conserving biodiversity. The analysis of animal communities in Section 3.6.1 shows that some biodiversity components require young forest, some require mature forest, and some require old forest. Moreover, different ecosites are important for different species. Therefore, if the park is to fulfill its role of representing the full range of regional biodiversity, management ought to be designed to maintain reasonable areas of young, mature and old forest distributed over many different ecosites.

Based on the analysis shown here, there is a large area of mature to old forest, but limited areas of young and very old forest. For very old forest, regardless of whether there is a little more or a little less than expected under a natural fire regime, we can argue for maintaining it in order to support the biodiversity components that depend on it. Very old forests include much of the white spruce mixedwood and softwood stands, as well as the "over-mature" aspen stands (Figure 3.45). Maintaining these stands implies avoiding them in regeneration treatments such as harvesting and/or prescribed burning. The suppression of most wildfires (see Section 3.4) will help to protect these old stands, but some will inevitably be consumed by wildfires.

There should be an ample supply of mature forest which, as it ages, will add new cohorts of old forest to the park. However, it may be desirable to exempt mature forests with a spruce component from regeneration treatments, so they have the opportunity to transition into the old mixedwood/softwood stands which are important for some components of biodiversity (see Section 3.6), and which are valued parts of the scenery of the park. Considering a broader regional landscape, including both the park and the swath of commercial forest to the north, strengthens the case for maintaining old to very old stands in the park, as older stands are likely to be harvested in the adjacent FMA. Older aspen stands may be the exception to this rule. Parks Service staff have observed in Greenwater, Duck Mountain, and Moose Mountain Provincial Parks that very old aspen stands (i.e., >110 years old) are transitioning into open upland shrublands and could be lost to forest cover unless actively regenerated by fire or logging. Consequently, it may be prudent to target a significant proportion of old to very old aspen stands, those containing no white spruce component, for regeneration by prescribed fire or ecologically-appropriate logging, over the next decade.

The shortage of young forest within a park appears to provide a justification for renewing some of the mature forest, to increase the supply of young forest habitat. However, this analysis is restricted to forest within the park. The broader landscape includes the commercial forest to the north, in which there has been a considerable amount of recent clearcutting (see Section 3.1). It would be desirable to analyze the age distribution over this broader landscape, to quantify the overall rate of renewal. But it is clear that this analyis would show a higher rate of recent renewal than the analysis restricted to the park. In terms of conserving biodiversity, plants and animals do not recognize the park boundary, so this broader landscape view is ecologically appropriate. Because of this, while renewal treatments within the park may eventually be desirable, they are less urgent than they would be in the absence of the recent logging that has occurred, and continues to occur, to the north of the park.

Forest renewal within the park could be done by ecologically-appropriate harvesting, prescribed burning, or "managed wildfire" (i.e. allowing a wildfire to burn under prescribed conditions). From an ecological perspective, burning (of either type) is preferred over logging, because fire is the predominant stand-replacement disturbance in boreal forest (see Section 3.4). Additionally, fire creates better seed beds for white spruce and jack pine than does logging. While there has been much progress in modifying logging practices to better emulate natural disturbance (Johnstone et al. 2011, Parks Service Natural Disturbance Emulation Guidelines 2011), for MLPP the preferred method of stand renewal is prescribed fire. Fire is more natural for the park setting, and there is already lots of renewal by logging in the larger landscape including the FMA.

Figure 3.47 shows areas that could be considered for regeneration treatments in MLPP. These areas are restricted to forests in the mature to old class (i.e. originating in the 1920, 1930, or 1940 decades), and excluding white spruce mixedwood and softwood types. This map shows that there are ample areas of such forests throughout the park, so that there is no basis for restricting renewal treatments to a particular part of the park. The one consideration is that it would be desirable to renew some areas of both aspen-dominated (BP5/6/7) and pine-dominated (BP2/3/4) forests. Renewal by the "managed wildfire" approach can be pursued opportunistically; in addition to the usual considerations of safety and values-at-risk, fire managers should consider whether there are old or mature white spruce stands which warrant protection from fire. Prescribed burning can be pursued in any area of the park where there are suitable situations, and should be directed at both aspen and pine systems.

The recent literature review by Johnstone et al. (2011) outlines the advantages of a natural disturbance emulation (NDE) strategy for management of Saskatchewan provincial park lands. The reviewers were quite cautious in their recommendations but noted that more work needs to be undertaken to find methodologies for fully implementing an NDE strategy in parks. However, the literature reviewed in the report makes it clear that the use of the NDE paradigm has real potential for application to the management of park lands.

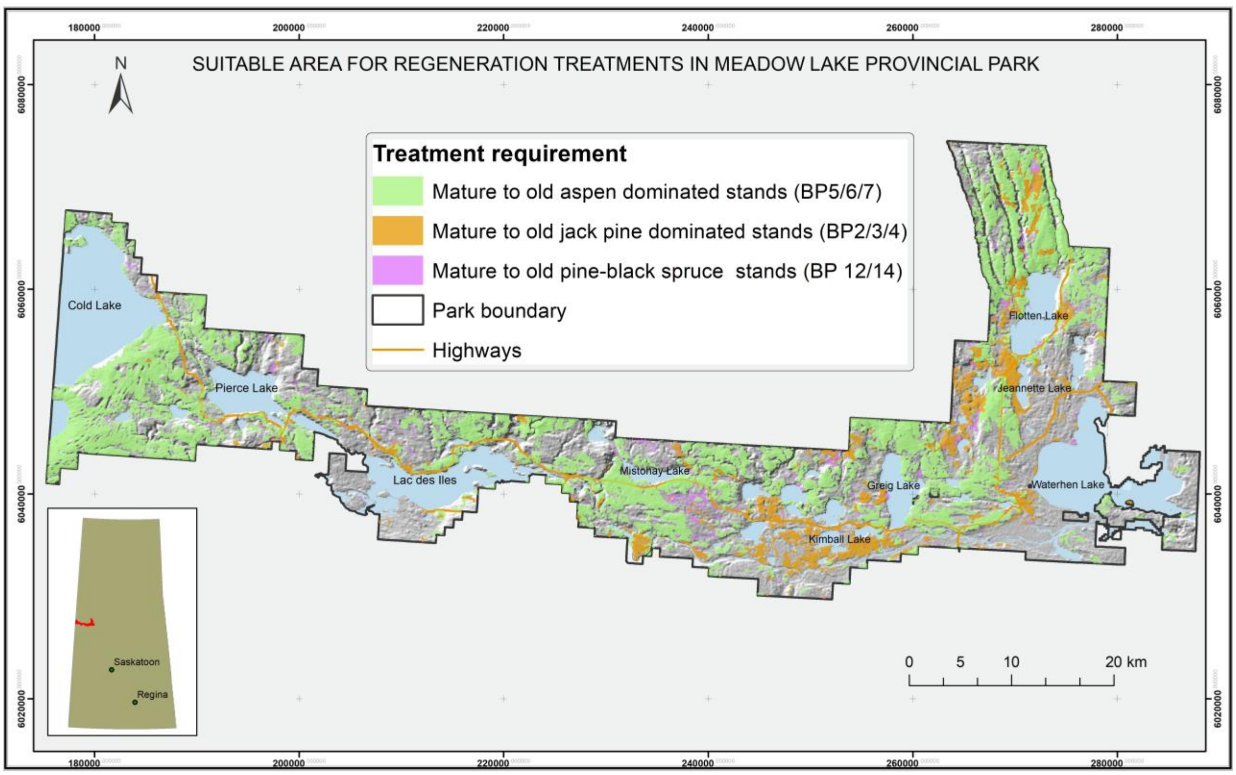

Figure 3.47 Areas suitable for regeneration treatments in MLPP.

3.5.5 Rare and Unusual Ecosystems, Vegetation and Plant Species

Most of the vegetation types discussed in Secction 3.5.2 are common types that are widely represented in the southern boreal forest of Saskatchewan. The only type that can be considered rare or unusual in the context of MLPP is native grassland (Figure 3.48). This occurs in small patches surrounded by forest, often on warm south-facing slopes. Grassland appears as BP1 on the ecosite map (Figure 3.27), with about 59 ha mapped in this type, but there are many patches of grassland that are too small to map at this scale.

Figure 3.48 A patch of grassland along the north shore of the Waterhen River.

These small grassland patches could be interpreted in two ways: as temporary openings in the forest, or as outliers of the prairie grassland of southern Saskatchewan. The first interpretation would seem most reasonable if the grasslands are made up mostly of forest species, while the presence of prairie species would support the second interpretation. As a preliminary assessment, several grassland patches were examined in the field, with notes on the species present (Appendix 3). Awned wheatgrass is the most widespread species, often the dominant one (Figure 3.49). It can occur in both prairie and forest habitats, as can timber oatgrass, Rocky Mountain fescue, hay sedge, and northern ricegrass. The patches on the right side of the table have mainly these species, so it is not clear whether they were originally forest or grassland. However, the patches on the left side of the table have species that are only found in grassland (e.g. plains rough fescue, June grass, western porcupine grass, Hooker’s oatgrass) (Figure 3.50). For these patches at least, it seems clear that they are outliers of the prairie.

An examination of the soil profile underlying these grasslands could help to determine their origin. If the remnants are on chernozemic soils, they likely have been prairie grasslands for centuries. If they are on luvisolic or brunisolic soils, then sites were probably forested within the last 50 years.

Figure 3.49 The seedheads of awned wheatgrass, the dominant species of grasslands in MLPP, can be seen in this photo.

Figure 3.50 The presence of plains rough fescue and other prairie grasses shows the affinity of grasslands in MLPP with the prairies of southern Saskatchewan

To understand these grassland patches, we have to consider the broader landscape surrounding MLPP. As discussed in Section 3.1, MLPP is at the southern edge of the main body of boreal forest in Saskatchewan. From the Park southward is the Transition Ecoregion, the ecological zone transition from forest to prairie. In this transitional zone, grassland goes from being restricted to tiny patches (as we see in MLPP) to being a significant part of the landscape in the Aspen Parkland. The extent of grasslands in this zone has been dynamic over time, fluctuating up and down over the centuries, depending on climate cycles and fire regime. In the Aspen Parkland, there is good evidence that, before settlement when prairie fires occurred frequently, grasslands were of greater extent and aspen groves were smaller than they are now. For example, at Stettler, Alberta, Bailey and Wroe (1974) found that woody cover increased from 4.8% to 8.0% from 1907 to 1966. At Kinsella, Alberta, Scheffer and Bailey (1972) found that poplar cover increased from 7% to 52% from 1903 to 1963. Maini found that aspen groves in Saskatchewan parkland expanded into grassland by 44 to 76 cm per year during the 20th Century. Studies in the Qu'Appelle Valley showed higher levels of poplar pollen since settlement (Campbell et al. 1994). Vegetation management plans in Duck Mountain, Greenwater Lake, and Moose Mountain Provincial Parks have all shown that trees and shrubs have extensively invaded the grasslands of those parks over the last century. The same processes are likely at play in MLPP. Older residents of the area report that the landscape was more open in the early days (Nancy Carberry, MLPP, personal communication). The patches that we see now are probably remnants of a prior period when grasslands were more extensive because of frequent fire. With the fire suppression efforts of the 20th Century, forest probably encroached onto these shrinking grasslands. The extent to which this has occurred could be determined by examining the extent of chernozemic soil profile development in forest stands bordering the park grassland remnants.

However, climate change will probably push this dynamic in the opposite direction. As discussed in Section 3.2.1, the climate of MLPP is expected to become more suitable for grassland and less suitable for forest. The current grassland patches will be the source areas for grassland expansion. Therefore, the health of these patches is critical to the future integrity of evolving park ecosystems and will be instrumental in determining the future dynamics and pathways of vegetation development in the park. .

Many of the patches are healthy, with a good diversity of native species. However, some of them are threatened by exotic invasion. The largest patch of grassland along the north bank of the Waterhen River near the largest grazing permit, is threatened by an infestation of smooth brome grass at the west end (Figure 3.51). This species could easily spread over the rest of the patch and degrade the natural composition of this native prairie vegetation community. Cattle grazing appears to play a role in introducing exotics, and heavily grazed areas are often dominated by exotics such as Kentucky bluegrass, dandelion, and clover. The second largest patch in Table 10, along the trail to de Balinhard Lake, has a good diversity of native species, but exotics have apparently been introduced along the ATV tracks bordering the patch. Protecting grassland patches from the kinds of disturbance that introduce exotics, and directly controlling discrete infestations such as the smooth brome grass patch mentioned above, are actions necessary for the maintenance of the ecological health of these grassland remnants.

There are a number of unusual ecosystem types in Salt Creek Canyon, located in the northeast extension of the park, north of Flotten Lake. An unusally extensive iron spring occurs on the west bank of the creek, downslope and west of the old fire tower site. This iron spring is characterized by a floating vegetation of wet site herbs and bryophytes on a substratum of water-saturated, iron-rich muck. The site is about 50 by 20 m in extent.

The forest surrounding the spring is an extensive, mature pure white birch stand that classifies as ecosite BP11 – White birch-white spruce-balsam fir on fresth sandy clay loam, as described in McLaughlan, Wright, and Jiricka (2010). What is unusual about this ecosite is that there is no white spruce in the stand. A plausible explanation for the establishment of this unusual forest is that a stand fire history of two wildfires, in close succession sometime in the last decade of the 19th century may have eliminated white spruce from the site. This hypothesis is concordant with the fact that much of the park burned in the extensive fires of 1880 to 1900 and then again in the "great fire" of 1919. Because white spruce takes about 30 years to reach cone-bearing age, if two fires follow one another by less than 30 years, the entire seed source for white spruce may be wiped out over an extensive area. This scenario could have led to the establishment of the anomalous pure white birch stand in the valley of Salt Creek Canyon. The vigor of the stand should be monitored, as it may require regeneration in the next few decades.

Figure 3.51 A patch of smooth brome has invaded the native grassland in an area used for cattle grazing along the Waterhen River

Figure 3.52 This grassland patch is almost entirely native species, but exotics have been introduced along the ATV trail at the foot of the hill

With respect to rare plants, abundance ratings by Harms (2006) indicate that 21 of the vascular plant species listed in Appendix 2 are endangered, threatened, or vulnerable in Saskatchewan in which 8 species are found in MLPP with the rare ranking from extreme rarity (S1) to very rare (S3) under Species at Risk Act (SARA) (Table 3.9). Figure 3.53 shows locations of both rare plants and animals inhabited MLPPthat obtained from the Saskatchewan Conservation Centre. Detail investigations on the precise quantity and locations of those species at risk in MLPP are necessary to propose specific management measures as well as avoid any negative effects due to recreation and development activities in the park on SARs.

Table 3. 9 Rare plant species in MLPP

Scientific Name	Common Name	Global Rank	National Rank	Provincial Rank	COSEWIC Status
Canadanthus modestus	Large Northern Aster	G5	N5	S3	-
Carex leptonervia	Pleasing Sedge	G5	N5	S1	-
Cirsium drummondii	Short-stemmed Thistle	G5	N4N5	S3	-
Cypridedium passerinum	Sparrow's-egg Lary's-slipper	G5	N5	S3	-
Erigeron elatus	Tall White Fleabane	G4G5	N4N5	S3	-
Erigeron strigosus	White-top	G5	N5	S3	-

Luzula acuminate var. acuminate	Hairy Wood-rush	G5T5	N5	S1	-
Spiranthes lacera var. lacera	Northern Slender Ladies'-tresses	G5T5	N5	S3	-

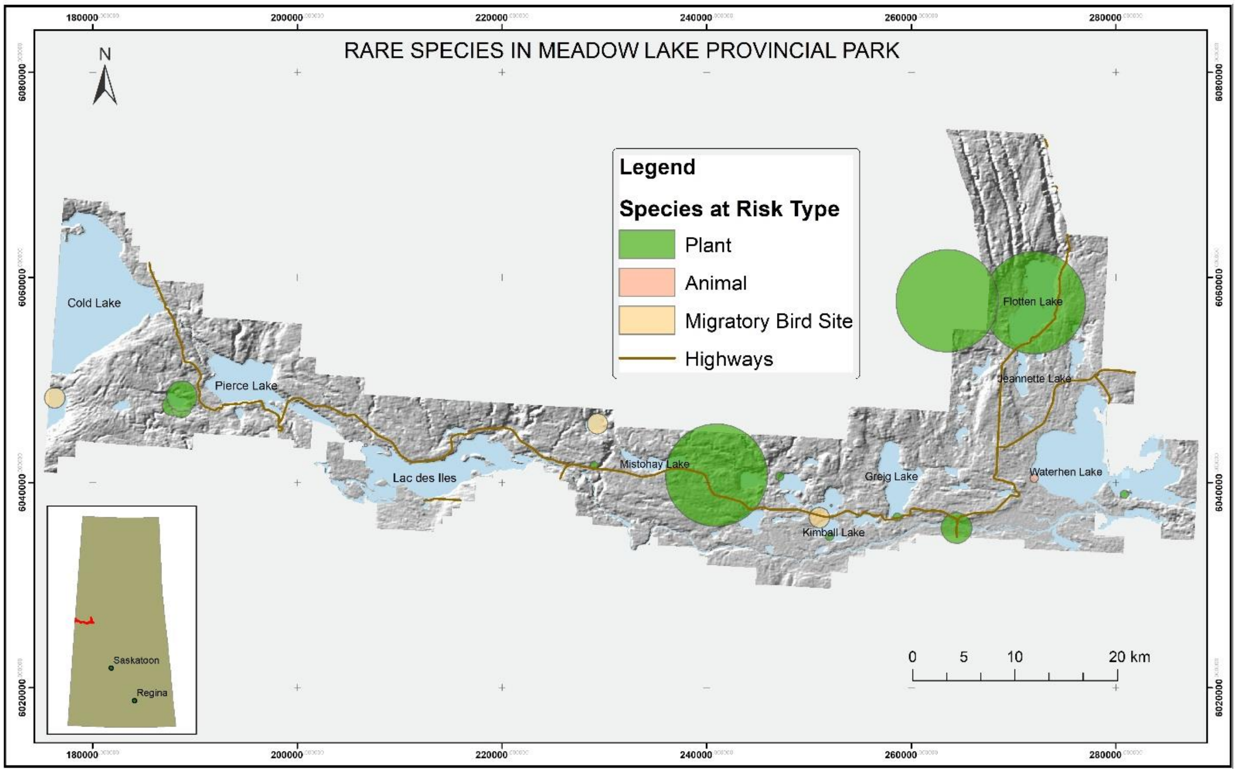

Figure 3.53 Distribution of rare species in MLPP

3.5.6 Core Area Vegetation

There has been substantial development of core area facilities, including campgrounds, beaches, boat-launches, and cottage subdivisions, in MLPP (see Section 3.5.1). Core area facilities are needed to accommodate most of the recreational users of the park. However, management of the core area should fit in as much as possible in accordance with the natural assets of the park, and environmental impacts from development should be minimized. All proposed developments in the park must be consulted with the Landscape Protection and Planning Unit of the Parks Service for environmental screening and review.

Most core areas include natural vegetation. For example, the campgrounds are largely carved out of the natural forest, which provides shelter, shade, and the feeling of being close to nature (Figure 3.54). However, the "real" natural forest undergoes aging, mortality, and renewal (see Section 3.5.4). Allowing these stand development processes to proceed in an unmanaged fashion is not acceptable in the core area of a provincial park.

The short-term issue it that dying or dead trees present a safety hazard for park users. According to Saskatchewan Parks Division's "Policy on managing risk/hazardous vegetation in core areas of provincial parks and recreation sites" (2009):

- Tree maintenance and risk tree removal are acceptable when required for human safety, to protect infrastructure, to accommodate approved development and for managing forest health
- A form has been developed for assessing risk trees.
- Risk assessment should lead to remedial action: pruning, cabling, tree removal; moving the target (e.g., the infrastructure); or excluding visitors from hazardous sites.

The longer-term issue is forest renewal. Removal of forest cover, whether by natural mortality or renewal treatments, may at first glance appear to be undesirable because it leaves campsites exposed to the wind and sun. However, the forest in the core area cannot live forever. Mature aspen and balsam poplar trees are prone to increasing heart-rot, often leading to breakage during windstorms. A particular issue in some core areas is the dieback of aging birch trees. If renewal treatments are not applied, the number of risk trees will inevitably increase as the forest ages. Gradual removal of risk trees can lead to undesirable consquences, especially in hardwood stands. Good poplar regeneration requires clearcutting to expose the soil to full sunlight and to remove the apical dominance of the previous generation of trees. Therefore, the park must develop a plan for forest renewal around core-area facilities and must continue an aggressive risk-tree management program.

The core area vegetation management plan would encompass inventory of core area stands, followed by prioritized harvest treatments. Priorities would reflect stand age, stand type, assessment of forest health, and objectives for visitor accommodation. Treatments would be done in winter to minimize the impact on recreational users. Regeneration of hardwood stands following harvest will occur by natural sprouting, supplemented by planting of white spruce seedlings (in some stands). Regeneration of conifer stands will require the planting of seedlings. Seed source for conifer plantings should come from the park. Regenerating stands must be protected from human traffic and ungulate browsing for a number of years, until the trees are tall enough that they cannot be damaged by these agents.

Figure 3.54 Campsites at MLPP are largely surrounded by natural forest

The need to keep exotic plant species out of the park has been emphasized in Section 3.5.3. There has been a limited amount of planting of exotic conifers in park campgrounds (Wilson and Martin 2008). Exotic species are also used in some of the landscaping around cottages. While the exotics in these controlled situations usually do not present a threat to surrounding native vegetation, core area facilities should be included in surveillance programs, to detect any planted exotics that could pose a threat of becoming invasive. Even where there is little invasion risk, there is an argument for ending the planting of exotics, and removing the ones that are there already. This reduces the unnatural feel of the core area, and helps to emphasize the park's overall commitment to conserving and showcasing the natural species and vegetation communities of the park ecoregion.

Managing the environmental impacts of recreational users presents another challenge in core areas. Foot traffic often leads to trampling of vegetation in the spaces between campsites, or on routes down to the beach. In places this may expose the soil to erosion. Shorelines are focal points of recreational traffic, sometimes leading to vegetation damage and exposure of the shoreline to wave erosion. Inventories should be conducted to identify locations of these types of environmental damage, and prioritize them for remedial work or fencing to allow recovery. Excessive use of pesticides associated with "urban-style" yard maintenance should also be eliminated in a natural environment park. Careful management of foreshore vegetation near cottage developments fronting on lakes will be required to prevent the conversion of native shoreline vegetation communities to exotic planted landscapes.

3.6 Present-day Use and Composition of Park Animal Communities

3.6.1 Animal Communities and their Relationships with Vegetation

Vegetation, which is the usual focus of ecosystem-based management, creates the habitats for other wildlife. MLPP supports approximately 191 birds, 48 mammals, 4 amphibians, and 1 reptile (complete lists of species are given in Appendices 4, 5, and 6).

Analysis of the relationship of animal communities to vegetation focused on bird communities. In the boreal forest there is a greater diversity of birds than of any other group of vertebrates, and they have been more thoroughly studied because they are easy to survey during the breeding season. Several studies from the southern boreal forest of the Prairie Provinces are particularly relevant to MLPP. Most of the birds using the upland ecosystems of MLPP are passerines (order Passeriformes) or perching birds, which are sometimes referred to as songbirds. These species are generally small and occur at high densities, providing excellent study subjects.

While bird species can be related to ecosite types, analysis has also shown relationships with stand age, and individual tree species. Kirk et al. (1996) compiled census block data from 80 plots across the western boreal forest of Canada and found a strong relationship between stand age (and thus the proportion of coniferous cover) and composition of the bird communities. Wright et al. (1995) found distinctive bird assemblages in young, middle-aged, and old aspen forests in Duck Mountain Provincial Parks. Old forests (>100 years) supported the most unique bird assemblage, followed by the young age classes. Middle-aged aspen forests had the least unique bird assemblage. The same pattern was found in the various age classes of forest in Narrow Hills Provincial Park (Wright et al. unpublished manuscript). In general, young forests are dominated by short-distance migrants, while old forests are occupied mainly by Neotropical (i.e. long-distance) migrants. The birds of old forests are largely upper-canopy insectivores (insect-eaters), while those of young forests are largely ground-foragers, both insectivores and granivores (seed-eaters). Species associated mainly or only with old stands include Cape May and Blackburnian Warbler. Brown Creeper is associated with old conifer-dominated stands while Bay-breasted Warbler and Red-breasted Nuthatch are concentrated in mature or old mixedwood stands. Winter Wren and Pileated Woodpecker occurred in old mixedwood stands. According to Erskine (1977), no birds are restricted to the early shrub stages of succession, with the commonly occurring species in these stages also occurring in openings or the understory of older conifer stands and in shrubby bogs.

These findings agree with those of Hobson and Bayne (1999), who also studied western boreal forests. Avian species richness was highest in stands of 80 to 110 years of age. The increased number of species in old stands was largely attributable to increases in canopy-nesting and cavity-nesting species, and occurred at both stand and landscape levels.

Bird survey data from two Saskatchewan studies were used to relate bird species to forest ecosites. These data were collected for the NorSask (Mistik Management Ltd. 1995) and Weyerhauser (Kirk et al. 1996) Forest Management Plans, and illustrate the species that can be expected in the major upland forests of MLPP. Because the Mistik FMA is adjacent to MLPP, this study probably provides the best representation of bird communities within the park, although general bird patterns across the Mid-Boreal Upland Ecoregion of Saskatchewan and Alberta are similar (Cumming 1995, Kirk et al. 1996). Maximum numbers of bird species were recorded in closed white spruce ecosystems and minimum numbers in jack pine-lichen ecosystems (Mistik Management Ltd. 1995). Certain species were found to be associated with either spruce or aspen dominated systems (Table 3.10).

Table 3. 10 Bird species associated with aspen-dominated and white spruce-dominated stands (Mistik Management Ltd. 1995).

Aspen-dominated stands	White Spruce-dominated stands
Alder Flycatcher	Bay-breasted Warbler
American Redstart	Boreal Chickadee
Brown-headed Cowbird	Chipping Sparrow
Canada Warbler	Gray Jay
Chestnut-sided Warbler	Magnolia Warbler
Connecticut Warbler	Pine Siskin
Hairy Woodpecker	Red-breasted Nuthatch
Mourning Warbler	Ruby-crowned Kinglet
Red-eyed Vireo	Solitary Vireo
Rose-breasted Grosbeak	Swainson's Thrush
Ruffed Grouse	Western Tanager
Yellow-bellied Sapsucker	White-winged Crossbill
	Winter Wren
	Yellow-rumped Warbler

Data from the NorSask and Weyerhauser studies were assigned to the ecosite types used in MLPP (see Section 3.5.2), based on the vegetation information provided in these studies (Table 3.11). Because the data collection methods and presentation of the data were not identical between the two studies some summarization has been done. For the Weyerhauser study, mapping of bird territories provided bird densities. We used data only for species which occurred at a density of at least 1.5 birds per 100 m^2 as reported by Kirk et al. (1996). The NorSask study provided lists of species typical of different ecosystems. The data included surveys from very young post-fire and post-harvest stands. These are shown separately in Table 3.11 because their structure provides habitat for a unique group of species. In the NorSask data, closed and open white spruce stands were separated, showing some minor differences in bird communities.

Table 3. 11 Distribution of bird species in relation to upland forest ecosites in MLPP (after Mistik Management Ltd. 1995 and Kirk et al. 1996).

Species	Young (0-9 yrs)	Young (15-20 yrs)	Ecosites for older stands						
			BP3 BP4	BP6	BP12	BP10	BP9 open	BP9 closed	BP2
American Robin	x								
Eastern Kingbird	x								
Le Conte's Sparrow	x								
Song Sparrow	x								
Warbling Vireo	x								
American Goldfinch	x								
Palm Warbler	x								
Clay-colored Sparrow	x	x							
Common Yellowthroat	x	x							
Lincoln's Sparrow	x	x							
Orange-crowned Warbler	x	x							
Alder Flycatcher	x	x	x						
Yellow-bellied Flycatcher			x						x
Northern Oriole				x					
Hermit Thrush	x		x	x					
Least Flycatcher	x	x		x					x
Connecticut Warbler		x		x					
Blue Jay	x		x			x			
White-throated Sparrow	x	x	x	x		x			
American Redstart	x	x		x		x			
Chestnut-sided Warbler	x			x		x			
Magnolia warbler	x	x	x	x		x			x
Mourning Warbler	x	x				x			
Northern Flicker	x	x				x			
Tennessee Warbler	x	x	x	x		x			
Ovenbird		x	x	x	x	x			
Philadelphia Vireo		x		x		x			
Red-eyed Vireo	x	x		x		x			
Rose-breasted Grosbeak				x		x			
Ruffed Grouse	x		x	x		x			
Solitary Vireo				x	x	x			x
Chipping Sparrow	x	x		x	x	x	x	x	
Swainson's Thrush		x	x	x	x	x	x	x	
Yellow-bellied Sapsucker		x				x			x
Yellow-rumped Warbler		x	x	x	x	x	x		x
Black-capped Chickadee		x		x		x			
Bay-breasted Warbler				x		x		x	
Ruby-crowned Kinglet				x	x	x	x	x	
Gray Jay		x		x	x	x	x	x	x

Species	Young (0 - 9 yrs)	Young (15-20 yrs)	Ecosites for older stands						
			BP3 BP4	BP6	BP12	BP10	BP9 open	BP9 closed	BP2
Red-breasted Nuthatch				x	x	x		x	
Cape May Warbler				x		x			
Blackburnian Warbler				x		x	x	x	
Black-throated Green Warbler					x	x	x	x	
Pine Siskin					x	x	x	x	
White-winged Crossbill					x	x	x	x	x
Brown-headed Cowbird						x			
Brown Creeper						x		x	
Canada Warbler						x			
Hairy Woodpecker						x			
Golden-crowned Kinglet						x			
Winter Wren						x		x	
Boreal Chickadee							x		
Pileated Woodpecker							x		
Three-toed Woodpecker									x
Dark-eyed Junco									x
Olive-sided Flycatcher									x
species count	25	22	11	25	11	34	11	12	11

Some of the species of the young post-fire or post-harvest stands, including LeConte's Sparrow, Song Sparrow, Common Yellowthroat, Lincoln's Sparrow, Alder Flycatcher and Palm Warbler, would normally occur in wetlands. The young regenerating forest apparently mimics the structure of wetland vegetation. Others in these young stands, including Eastern Kingbird, Warbling Vireo, American Goldfinch, Clay-colored Sparrow, and Northern Oriole, are more common in the Prairie Ecozone or more southern forest regions.

Many of the species are found in more than one ecosite, with several generalist species occurring across a wide range of ecosites. Pine stands generally have fewer bird species than other forest type. Of interest is that Olive-sided Flycatcher, newly included as a Species at Risk, was listed only for the drier pine sites (BP2) in these studies. Dark-eyed Juncos were also most strongly associated with the BP2 pine stands. The bird community of ecosite BP12, a pine-spruce forest type, appears to be more closely affiliated with spruce than with pine forests.

Perhaps of greatest interest are the species found in older forests with a significant white spruce component. These are generally associated with the larger spruce trees. Examples are Black-throated Green, Blackburnian and Cape May Warblers, Golden-crowned Kinglets, White-winged Crossbill, Brown Creeper, and Winter Wren (because of association with woody debris as well as large trees). Cumming (2004) found that Blackburnian and Black-throated Green Warblers forage high in coniferous trees, and cited Morse (1994) who indicated that Blackburnian Warblers are unlikely to be found in forests without at least some conifers greater than 18 m tall.

The greatest diversity of species was found in the spruce-aspen mixedwood stands (ecosite BP10). Hobson and Bayne (1999) found avian species richness was highest in stands of 80 to 110 years of age, generally consisting of mixewood stands with large spruce trees. Hobson and Bayne (2000) indicated that the higher species richness was not simply a result of mixing of bird species found in hardwood and softwood forest types, but that several species were more abundant in mixedwood stands than pure stands.

The Brown-headed Cowbird, a nest parasite, while included as a bird of the spruce-aspen mixewood ecosite (BP10), is generally considered to be a Prairie Ecozone species which has moved into the boreal forest as a result of human activities such as logging, with the associated disturbances possibly creating critical habitat components.

The results presented so far emphasize the succession from hardwood (ecosite BP6) to mixedwood (ecosite BP10) to softwood (ecosite BP9) stands. However, Schieck et al. (1995) focused on aspen-dominated stands (all of which would fall into ecosite BP6) of different ages: young (23-26 years old), mature (51-63 years old), and old (>120 years old). This study was done in the area of Lac La Biche, Alberta, about 130 km west of MLPP. They found that species richness was greatest in old stands, intermediate in young forests, and lowest in mature forests. The number of species that showed their highest abundance in each age class showed the same pattern. Of particular note is that two-thirds of the bird species had their highest abundance in old forests, and three-quarters of these were more than twice as abundant in old forests compared to the other ages. Species that normally show a preference for coniferous forest tend to be most abundant in old aspen forests. Cavity nesters also tend to be most abundant in old forests, because cavities occur most often in large, diseased trees. These findings highlight the importance of maintaining old to very old growth stands in MLPP with regards to wildlife biodiversity.

The detailed studies discussed above focused on birds of upland forests. A variety of other bird species in MLPP use wetland ecosites (Table 3.12). It should be noted that those bird species use wetland ecosites more often than other species, and they still can be found in other ecosites. For example, during our field survey in summer 2018 Great Blue Heron was found nesting on the BP3 ecosite (i.e. jack pine dominated stand) near Kimball Lake. The use of ecosites by other bird species is shown in Appendix 7. Taken together, the results of these bird community studies show the importance of maintaining a variety of age classes in a variety of ecosites to support the full range of biodiversity in MLPP.

Forest harvesting is a possible tool for managing forests in provincial parks. Van Wilgenburg and Hobson (2008) studied the effects of harvesting in relation to bird community structure. They examined three boreal forest harvest scenarios and compared bird communities to the natural range of variation occurring in burned but unharvested sites. In looking at single-pass harvest sites, multi-pass sites with residuals and salvage-logged post-fire sites with variable harvest intensity, they found that bird community similarity to the natural range of variation was maximized with single-pass harvests. The model they created indicated harvesting 66 to 88% of the timber in the planning unit with retention of 5 to 19% as live residual patches, and with 50% of harvests having at least 9% of the area in residuals provided the best similarity to natural fire systems. The largest difference was that post-fire bird communities are dominated by cavity-nesters, while post-harvest areas are dominated by ground and shrub-nesting species and habitat generalists.

This discrepancy can be ameliorated by leaving high levels of residuals in cutblocks. The residual mature trees will ensure a steady supply of snags capable of supporting populations of cavity-nesting birds over a span of several decades. The residual islands in such natural pattern harvest patches should be of sufficient extent (>1 ha) to minimize the occurrence of windthrow. Windthrow becomes more prevalent in residual islands as the ratio between perimeter length and island area increases, which increases the proportion of non-wind-firm trees that are exposed to high wind shear at the residual patch edge. Trees which have grown and matured in a continuous canopy are known to be prone to windthrow when exposed, by harvest, at the edge of a patch. This is due to their propensity to have poorly developed prop roots as the result of being protected from wind shear by the surrounding extensive and even-aged forest canopy.

Table 3. 12 Birds of wetland ecosites. M indicates species that migrate through MLPP but do not breed.

Species	Ecosite							
	BP19	BP23	BP24	BP25	BP26	Marsh	Beach	Water
Blackpoll Warbler	X							
Nashville Warbler	X	X						
Palm Warbler	X	X						
Solitary Sandpiper		X						
Lesser Yellowlegs		X						
Lincoln's Sparrow		X	X					
Virginia Rail			X					
Alder Flycatcher			X	X				
Wilson's Warbler			X	X				
Sandhill Crane			X		X			
Black and White Warbler				X				
Common Yellowthroat				X				
Yellow Rail					X			
Sedge Wren					X			
LeConte's Sparrow					X			
Bonaparte's Gull	X	X				X		
Rusty Blackbird		X		X	X	X		X
Sora					X	X		
Swamp Sparrow					X	X		
Red-necked Grebe						X		
Horned Grebe						X		
Pied-billed Grebe						X		
American Bittern						X		
Tundra Swan						M		
Mallard						X		
Gadwall						X		
Green-winged Teal						X		
Blue-winged Teal						X		
American Wigeon						X		
Redhead						X		
Ring-necked Duck						X		
Canvasback						X		
Lesser Scaup						X		
Common Goldeneye						X		
Bufflehead						X		
Ruddy Duck						X		
Common Merganser						X		
American Coot						X		

Common Snipe						X		
Forster's Tern						X		
Black Tern						X		
Marsh Wren						X		
Yellow-headed Blackbird						X		
Red-winged Blackbird						X		
Semipalmated Plover							M	
Least Sandpiper							M	
Spotted Sandpiper							X	
Great Blue Heron						X		X
Canada Goose						X		X
Song Sparrow						X		X
Killdeer							X	X
Western Grebe								X
American White Pelican								X
Double-crested Cormorant								X
Belted Kingfisher								X
Northern Waterthrush								X

3.6.2 Ungulates and Furbearers

The ungulate population within the region of MLPP is dominated by two species: moose and white-tailed deer. Other species such as elk, mule deer and woodland caribou are either absent or present in low numbers or as occasional visitors.

Moose are commonly associated with early successional habitats. Fire and timber-harvesting create productive feeding habitats with high quantities of browse. However, moose require a variety of habitats for cover and feeding, and consequently a mosaic of cover types is preferred. Moose habitat has been described in terms of primary and secondary winter and summer foraging habitats as well as thermal cover habitats (Rock et al. 1997), and this information has been related to ecosites in Table 3.13. The important ecosites comprise 65% of the total park area. Summer thermal habitats differ from winter thermal habitats. Summer areas are usually wet sites which facilitate cooling. Winter thermal habitats have conifer cover which reduces radiative heat loss. Calving areas are generally associated with water, such as islands, peninsulas and bog complexes.

Table 3. 13 Moose habitat requirements by ecosite type.

Ecosite	**Description in MLPP**	Moose summer habitat			Moose winter habitat		
		Prim. Forage	Sec. Forage	Thermal	Prim. Forage	Sec. Forage	Thermal
Hardwood types							
BP5	aspen stands on moderately dry sandy sites	X					
BP6	aspen stands on mesic* loamy sites	X			X		
BP7	birch stands on mesic loamy sites	X			X		
BP16	balsam poplar stands on moist sites	X			X		
White spruce softwood and mixedwood types							

BP9	white spruce-dominated stands (variable sites)						X
BP10	mixedwoods of aspen and white spruce (mesic loamy sites)	X			X		X
BP15	mixedwoods of balsam poplar and white spruce (moist sites)	X			X		X
Black spruce softwood types							
BP14	black spruce stands on moist mineral soils			X			
BP18	black spruce-tamarack stands on marginal peatlands (moderately wet sites)			X			
Treed bogs and fens							
BP19	black spruce bogs (wet sites)			X			
BP23	tamarack fens (wet sites)		X	X		X	
Shrubby and herbaceous bogs and fens							
BP20	bogs with low shrubs (wet sites)		X			X	
BP24	poor fens with low shrubs (wet sites)		X			X	
BP25	rich fens with tall willows (wet sites)	X			X		
BP26	fens with sedges and grasses (wet sites)		X			X	
Marsh	emergent marshes (very wet sites)	X					
Burns	recently burned areas	X			X		
	Young (<15 yrs) cutovers (not in MLPP)	X			X		

A Provincial Moose Survey Block includes approximately the eastern half of MLPP. The park comprises approximately a quarter of the survey block. Mistik Management Ltd. (1995) summarized the survey data up to the early 1990s. During the 1960s, the highest moose densities occurred in the western portion of the survey block, with the park comprising about half of this high-density area. This included the area around Greig Lake and angling up to Flotten Lake and north from there in the Salt Creek area. However, this area had low densities during the early 1970s, with moderate densities reported for the area west from Greig Lake in the late 1970s. Low densities were reported for this area through the 1980s. The general trend through the period however is a peak in the moose populations in the 1960s with a steady decline to the 1990s. These population changes were attributed to changing ages of the forest throughout the region (Mistik Management Ltd. 1995).

Another survey block included the western portion of the Park. This block showed similar trends to the survey block on the east side of the Park, with pockets of high density in the early 1960s and diminishing numbers of moose through to the early 1990s. The pockets of higher moose densities were related to recent fires (Mistik Management Ltd. 1995).

Park managers should be aware that moose will have a detrimental effect on post-disturbance suckering in small-scale cutovers (<10 ha). Field observations in Greenwater Lake Provincial Park (R. A. Wright, personal observation) and observations recorded in small cutovers in the Duck Mountain Provincial Park Vegetation Management Plan (Wright et al. 1995) show that moose aggregate, with their calves, in such openings and browse off most of the regenerating aspen, birch, or balsam poplar. For this reason, all regeneration prescribed fires or harvest events in hardwood forest in the park should be large enough to avoid this effect (i.e., >50 ha, and preferably >100 ha). Sucker numbers are so huge in larger cutovers and burns that aggregating moose cannot consume more than a small proportion of the cohort of new suckers.

The influx of **white-tailed deer** has added to the complexity of the ungulate community and may have resulted in higher wolf populations than existed prior to their flourishing. Deer utilize some of the early successional habitats that moose (and elk) prefer, but tend to prefer smaller openings (Rock et al. 1997). Young and very old forest stands with their higher levels of browse availability are preferred. Diets of deer in the forest tends to have higher diversity of plant groups than the larger ungulates, with greater shifts among browse, forbs and graminoids as the seasons change (Rock et al. 1997).

White-tailed deer habitat has been described in terms of primary and secondary winter and summer foraging habitats as well as thermal cover habitats (Rock et al. 1997), and this information has been related to ecosites in Table 3.14. The important ecosites for deer comprise 58% of the total park area, slightly less than that for moose. Unlike moose which have different thermal habitat requirements for winter and summer, white-tailed deer's main requirement is for thermal protection during cold weather.

Table 3. 14 White-tailed deer habitat requirements by ecosite.

Ecosite	Description in MLPP	Primary Foraging	Secondary foraging	Thermal
Upland Grassland				
BP1	patches of prairie on south-facing slopes		X	
Jack pine softwood and mixedwood types				
BP3	jack pine stands on moderately dry sandy sites		X	
BP4	mixedwoods of pine and aspen (moderately dry sandy sites)		X	
BP12	pine-white spruce and pine-black spruce stands (variable sites)		X	X
Hardwood types				
BP5	aspen stands on moderately dry sandy sites	X < 90 years	X other than closed	
BP6	aspen stands on mesic* loamy sites	X < 90 years	X other than closed	
BP7	birch stands on mesic loamy sites	X < 90 years	X other than closed	
BP16	balsam poplar stands on moist sites	X < 90 years	X other than closed	
White spruce softwood and mixedwood types				
BP9	white spruce-dominated stands (variable sites)			X
BP10	mixedwoods of aspen and white spruce (mesic loamy sites)		X	X
BP15	mixedwoods of balsam poplar and white spruce (moist sites)		X	X
Shrubby and herbaceous bogs and fens				
BP26	fens/meadows with sedges and grasses (wet sites)		X	
Other mapped types				
burns	recently burned areas	X		
cleared	cleared for agriculture, usually seeded to tame grass		X	

	Young (<15 yrs) cutovers (not in Park)	X within 250 m of forest		

White-tailed deer occur near the northern limits of their range at MLPP, and climate/weather factors play a large role in population control. Winters are the major controlling factor, with numbers reduced to low levels following a severe winter and climbing until the next unfavourable winter. Currently the Meadow Lake region has high populations compared to much of the rest of Saskatchewan because the region has missed some of the deep and protracted snow conditions that have occurred elsewhere (A. Schmidt, Fish and Wildlife Branch, pers. comm.). Population trends for white-tailed deer for the Waterhen Deer Management Unit predicted by Saskatchewan Ministry of Environment (A. Arsenault, Fish and Wildlife Branch, pers.comm.) show that the population has been increasing since the mid-1990s. While the trend numbers end at 2004, Fish and Wildlife staff feel that the population is as high as it has ever been because of many years without severe winters.

Elk populations are limited in MLPP (B. Tether, Fish and Wildlife Branch, pers. comm.). Elk are largely restricted to the east side of the park, occupying the dissected upland in the northeast corner (Salt Creek area), as well as areas along the south boundary (Dorintosh area) where they have been travelling into the farmlands to feed. A small population may occur in the western portion of the park (B. Tether, Fish and Wildlife Branch, pers. comm.).

Mule deer were formerly the deer of the southern boreal forest in Saskatchewan, but largely disappeared and were replaced by white-tailed deer, this happening as recently as the late 1960s to early 1970s in some areas. While mule deer are currently expanding their range northwards and occur in the farmlands a short distance to the south, they are currently absent or of minor importance within the park (B. Tether, Fish and Wildlife Branch, pers. comm.).

Woodland caribou has recently been included under Schedule 1 of the Federal Species at Risk Act. Caribou populations are at low levels Canada-wide, and populations are now fragmented within the southern boreal forest (Godwin and Thorpe 2000). The preferred habitat for woodland caribou is described as including mature jack pine or black spruce with lichen ground cover, open and forested peatlands, sedge meadows, south-facing slopes of conifer-dominated lakeshores, and islands with dense conifer forest (Godwin and Thorpe 2000), with many studies indicating positive preference for peatlands. This may because lichens are the dominant food item of caribou, with the greatest availability of lichens occurring in peatlands which are better protected from fire than uplands. The selection for areas with lichen ground cover may also be related to reduced predation risk in these habitats (Cumming 1992, Rock 1992).

Habitat for woodland caribou is limited within MLPP with most suitable habitat in the region occurring to the north and east of the park (Mistik Management Ltd. 1995). The closest population of caribou to MLPP (potentially consisting of 200 animals) occurs in the Muskeg Lake region on the south of the Cold Lake Air Weapons Range (Godwin and Thorpe 2000). This is on the Moostoos upland plateau, separated from the park by the long south-facing slopes which are dominated by hardwood forest unsuitable as caribou habitat. Therefore, woodland caribou is only observed in the park as occasional wanderers. Caribou are reported to have occurred about 30 years ago in winter along the flats at the north edge of the park, but there is no evidence of this happening recently (B. Tether, Fish and Wildlife Branch, pers. comm.). These were likely animals that had wandered from the normal caribou habitat of the hills to the north.

Twenty-two species of animals are listed as **furbearers** in Saskatchewan (Gollop 2006), although not all of these are found in MLPP. Since royalties must be paid on fur sales, the provincial government records numbers and types of pelts sold along with the area in which they were taken. These documents provide a rough record of the relative abundance of furbearing animals within the park.

MLPP falls within four Fur Conservation Areas: M-38, M-38B, M-94, and M-37 (Figure 3.55). Fur sales data for the 12-year period from 1999 to 2011 have been summarized for the four areas (Table 3.15).

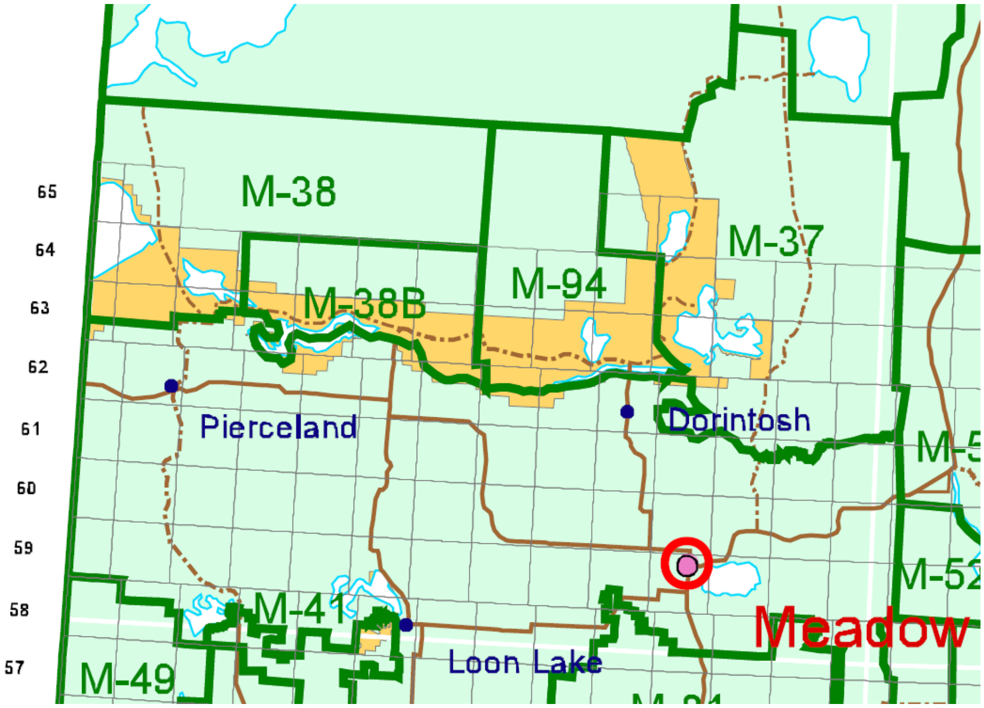

Figure 3.55 Fur Conservation Areas overlapping MLPP

Table 3. 15 Number of furs sold by species and Fur Conservation Area for the period from 1999 to 2011.

Species	Fur Conservation Area				Total	Avg/yr
	M38B	M38	M94	M37		
Arctic fox			2		2	0
Badger		21	1		22	2
Bear		421	9	2	432	36
Beaver	177	1923	898	487	3485	290
Coyote	10	1499	230	36	1775	148
Fisher	14	742	134	192	1082	90
Red fox	3	175	25	28	231	19
Lynx	3	301	24	42	370	31
Marten		4	14	19	37	3
Mink	11	113	63	32	219	18
Muskrat	5	1006	257	607	1875	156
Otter	35	236	117	78	466	39
Squirrel	129	2410	266	90	2895	241
Weasel	1	549	96	50	696	58
Wolf	1	132	37	10	180	15
Wolverine				1	1	0
Total	389	9532	2173	1674	13768	

Sixteen or more species of furbearers have been trapped in the vicinity of the Park (weasel are not separated by individual species). Wolverine was the rarest, with only a single wolverine pelt traded in the past 12 years. The data for an earlier period (1973 -1977) were also examined, and showed four wolverine trapped. Another species of interest is the Arctic fox, for which two pelts were traded in the 12-year period (both from the same year). This probably reflects a year with low small mammal populations in the north, resulting in dispersal of individuals southward in search of food. However, it could also be a recording error where a number was entered in the wrong column on the recording sheets (R. Tether, Fish and Wildlife Branch, pers.comm.). Marten are surprisingly rare given that habitat requirements are not thought to be greatly different from that of the fisher, a much more commonly trapped species. Badger is uncommon, but this is expected because it is a grassland species. Skunks are not reported.

While these fur harvest data give a general impression of how common the various species are, the relative abundances must be interpreted with caution. The number of furs harvested depends not just on animal numbers, but also on the amount of trapping effort. Trapping has been declining over a number of years (R. Tether, Fish and Wildlife Branch, pers.comm.). This may be the result of several factors, including societal changes and declining fur prices. While trapping effort may have declined over the last decade, comparison of numbers of pelts sold during the first decade of the 21st century with the mid 1970s shows interesting patterns.

Habitat requirements for three furbearer species (i.e black bear, fisher, red squirrel) were described by Rock et al. (1997), and these have been related to the ecosites of MLPP in Tables 3.16 to 3.18. The percentage of the park included in these ecosites is 65% for black bear, 55% for fisher, and 68% for red squirrel.

Table 3. 16 Black bear habitat requirements by ecosite.

Ecosite	Description in MLPP	Primary	Secondary
Jack pine softwood and mixedwood types			
BP2	jack pine stands on dry sandy sites		X
BP3	jack pine stands on moderately dry sandy sites		X
BP4	mixedwoods of pine and aspen (moderately dry sandy sites)		X
BP12	pine-white spruce and pine-black spruce stands (variable sites)		X
Hardwood types			
BP5	aspen stands on moderately dry sandy sites	X within 100 m water	X
BP6	aspen stands on mesic* loamy sites	X within 100 m water	X
BP7	birch stands on mesic loamy sites	X within 100 m water	X
BP16	balsam poplar stands on moist sites	X within 100 m water	X
White spruce softwood and mixedwood types			
BP10	mixedwoods of aspen and white spruce (mesic loamy sites)	X	X
BP15	mixedwoods of balsam poplar and white spruce (moist sites)	X	X

Treed bogs and fens			
BP19	black spruce bogs (wet sites)		X
Shrubby and herbaceous bogs and fens			
BP20	bogs with low shrubs (wet sites)		X
BP24	poor fens with low shrubs (wet sites)		X
BP25	rich fens with tall willows (wet sites)		X
BP26	fens/meadows with sedges and grasses (wet sites)	X	
Other mapped types			
burns	recently burned areas	X	
cleared	cleared for agriculture, usually seeded to tame grass	X	
	Young (<15 yrs) cutovers/burns (not in Park)	X	

Table 3. 17 Fisher habitat requirements by ecosite.

Ecosite	Description in MLPP	Primary	Secondary	Tertiary
Jack pine softwood and mixedwood types				
BP2	jack pine stands on dry sandy sites	X within 100m of streams or lakes		
Hardwood types				
BP6	aspen stands on mesic* loamy sites			X >90 yrs with denser canopy
BP7	birch stands on mesic loamy sites			X >90 yrs with denser canopy
BP16	balsam poplar stands on moist sites			X >90 yrs with denser canopy
White spruce softwood and mixedwood types				
BP9	white spruce-dominated stands (variable sites)	X > 70 yrs		
BP10	mixedwoods of aspen and white spruce (mesic loamy sites)	X > 70 yrs, softwood dominated	X hardwood dominated >90 yrs	
BP15	mixedwoods of balsam poplar and white spruce (moist sites)	X > 70 yrs, softwood dominated	X hardwood dominated >90 yrs	
Black spruce softwood types				
BP14	black spruce stands on moist mineral soils	X > 70 yrs		
BP18	black spruce-tamarack stands on marginal peatlands (moderately wet sites)	X > 70 yrs		

Table 3. 18 Red squirrel habitat requirements by ecosite.

Ecosite	Description in MLPP	Primary	Secondary	Tertiary
Jack pine softwood and mixedwood types				
BP2	jack pine stands on dry sandy sites		X	
BP3	jack pine stands on moderately dry sandy sites		X	
BP4	mixedwoods of pine and aspen (moderately dry sandy sites)		X	
BP12	pine-white spruce and pine-black spruce stands (variable sites)		X	
Hardwood types				
BP5	aspen stands on moderately dry sandy sites			X
BP6	aspen stands on mesic* loamy sites			X
BP7	birch stands on mesic loamy sites			X
BP16	balsam poplar stands on moist sites			X
White spruce softwood and mixedwood types				
BP9	white spruce-dominated stands (variable sites)	X		
BP10	mixedwoods of aspen and white spruce (mesic loamy sites)	X		
BP15	mixedwoods of balsam poplar and white spruce (moist sites)	X		
Black spruce softwood types				
BP14	black spruce stands on moist mineral soils	X		
Treed bogs and fens				
BP19	black spruce bogs (wet sites)		X	

Black bears reach their highest densities in Saskatchewan in the southern boreal forest. Berry crops are a critical component of black bear diets in the fall. An abundant berry crop ensures adequate reserves of energy can be stored for winter. A higher diversity of berry-producing species in the southern forest may be a reason for the higher bear densities here. Saskatoons, strawberries and raspberries are available early in the summer, with pin cherries, blueberries and high bush-cranberries being important later. Bearberry, dry ground cranberry and Canada buffaloberry can also be important species locally. These plant species are found in a variety of ecosites, and diversity of ecosites within the landscape is beneficial in ensuring a pre-winter food supply.

3.6.3 Animal Species-at-Risk

Complete lists of birds, mammals, and reptiles/amphibians are given in Appendices 4, 5 and 6 (after Wilson and Martin 1998). Based on the data provided by the Conservation Data Centre (http://www.biodiversity.sk.ca/HABISask.htm), occurrence of animal species-at-risk with specific locations in MLPP was given in Table 3.19 and Figure 3.53. Compared to the lists of wildlife in Appendices 4, 5 and 6 many endangered species are not identified and mapped in the CDC database that requires further inventory to update the list of endangered animals in MLPP.

Table 3. 19 Animal species at risk in MLPP

Scientific Name	Common Name	Global Rank	National Rank	Provincial Rank	COSEWIC Status
Aechmophorus accidentalis	Wester Grebe	G5	N5B, N3N	S3B,S3M	Special Concern
Ardea Herodias	Great Blue Heron	G5	N5B	S5B	Special Concern
Rangifer tarandus caribou	Woodland Caribou	G5T5	N5	S3	Threatened

Another federally listed mammals that has the potential to occur in MLPP: wolverine. Similar to woodland caribou, wolverine is wide-ranging species that probably has only a portion of their territory in the Park when they do occur here.

Several of other bird species are federally listed such as Peregrine Falcon (*Falco peregrinus anatum*), Common Nighhawk *(Chordeiles minor),* Olive-sided Flycatcher (*Contopus cooperi*) and Canada Warbler (*Wilsonia canadense*) might also have potential occurrence in MLPP as they have relatively widespread habitats. Rare bird species generally require habitat features related to vegetation structure, and are therefore likely to be more generally spread across ecosite types, by contrast with rare plants that may be related to microhabitat. Forest stand age, and the changes in vegetation structure associated with it, is important in determining whether a site is likely to provide habitat for a particular bird species. For example, Common Nighthawk and Olive-sided Flycatcher are most commonly found in mature stands of jack pine in which the canopy has opened up, and do not occur in younger stands. Some of the bird species may require specific or narrow features of these ecosites. For example, the Rusty Blackbird occurs at the edges of wetlands rather than throughout the wetland. The Yellow Rail generally occurs only in sedge fens with very shallow water, or dense stands of sedges on mineral soil which have a shallow stable water cover. Further inventory on animal species at risk in MLPP is necessary to understand their habitats and maintain wildfire biodiversity within the park.

The removal of top carnivores (e.g., wolves, bears) from ecosystems is known to have significant trophic cascade effects in ecosystems (Stolzenburg 2008). This terminology is obscure and what it really means is that taking top predators out of an ecosystem may release prey species (e.g., beaver, moose, elk) from predator-mediated population control (on density and distribution). The Park Division should examine this issue and make recommendations regarding the desirability of continuing to allow the removal of wolves and bears from the park. This is a serious issue for ecosystem health and sustainability and deserves greater attention from park managers.

The issue of big game baiting and outfitting in the park warrants review by park managers. Karst and Wright (2012) surveyed bait sites in the park. They found that outfitting and baiting creates extensive ecosystem fragmentation in the park and results in increased occurrence of invasive exotic plant species (due to the placing of weed-seed contaminated grain baits), and problems with garbage accumulation and other deleterious ecosystem and aesthetic effects. This report contains several recommendations on managing baiting in MLPP.

The practice of baiting has the potential to seriously degrade ecosystem health and to promote the spread of wildlife diseases such as chronic wasting disease (CWD). These issues, as they apply to protected areas in Western Canada, have been thoroughly reviewed by Sorenson and Brooke (2011). Their recommendations on the management of baiting should be given serious consideration by park managers. The issue of baiting is also closely related to the issue of the impacts of ATV use in the park. Karst and Wright (2012) showed that the growth of the outfitting industry and baiting in the park have been accompanied by forest fragmentation by ATV trails.

4. ECOSYSTEM-BASED MANAGEMENT GOALS AND OBJECTIVES

4.1 GOAL 1 - Enhancement of Recreational, Aesthetic, Educational, and Interpretive Opportunities Within a Safe Outdoor Environment.

- **Objective 1.** Manage park vegetation to ensure an attractive, safe and natural environment for park patrons utilizing MLPP trails and non-core area campgrounds
- **Objective 2.** Provide enhanced opportunities for the interpretation of park vegetation, landscapes, ecosystems, and species
- **Objective 3.** Manage core area vegetation to regenerate a vigorous natural forest in campgrounds, and adjacent beach and recreation areas, and to ensure the timely removal of hazardous trees

4.2 GOAL 2 – Maintain and Restore the Natural Landscape, Ecosystem, and Species Diversity of MLPP

- **Objective 1.** Restore a more natural disturbance regime to park ecosystems
- **Objective 2.** Assess the impact of all ongoing management activities as well as proposed developments on park biodiversity and make management recommendations
- **Objective 3.** Monitor the state of MLPP environment and the outcomes of ecosystem-based management actions
- **Objective 4.** Ongoing inventory of MLPP's biological and ecological resources
- **Objective 5.** Prospects for expanding MLPP to create a land management unit with greater ecological integrity and stability
- **Objective 6.** Build conservation partnerships with non-governmental organizations and other government agencies

5. ECOSYSTEM-BASED MANAGEMENT RECOMMENDATIONS AND IMPLEMENTATION

5.1 GOAL 1 -Enhancement of Recreational, Aesthetic, Educational, and Interpretive Opportunities Within a Safe Outdoor Environment

5.1.1 Objective 1. Manage park vegetation to ensure an attractive, safe and natural environment for park patrons utilizing MLPP trails and non-core area campgrounds

Recommendations:

- General vegetation management for non-core areas is addressed under Goal 2.
- Assess and manage high-risk trees in non-core area campgrounds.
- Manage recreational trails and non-core area campgrounds with as little impact as possible (only the amount of tree removal and mowing needed for visitor use and safety).
- Include recreational trails in road/trail inventory and assessment (see Section 5.2.3)
- Include recreational trails and non-core area campgrounds in exotic plant inventory, treatment and management (see Section 5.2.3).

5.1.2 Objective 2. Provide enhanced opportunities for the interpretation of park vegetation, landscapes, ecosystems, and species

Recommendations:

- Develop interpretive material on the concepts of ecosystem-based management planning and other management planning (e.g. forest management plan, wildfire management plan).
- Develop interpretive material on specific topics related to ecosystem-based management, e.g.:
    - The diversity of ecosystems in MLPP, using the new forest ecosite classification to structure the material (i.e., McLaughland, Wright, and Jiricka 2010).
    - The role of ecosystem diversity (including age-class diversity) in providing habitats for a range of animals (e.g. differences in bird communities and environmental services among ecosite types).
    - The natural role of fire in forests of the park; successional stages following fire; and treatments such as prescribed burning to renew degraded ecosystem and landscape.
    - Circumstances under which ecologically-appropriate forest harvest may be used to emulate natural fire disturbances.
    - Climate change and its expected effects on park ecosystems.
    - Grassland remnants: their links to the prairie grasslands of southern Saskatchewan, and their role in the response of the park to climate change. Their conservation and management.
    - The threat of exotic species: where they came from, and how they affect ecosystems in the park.
    - The threat of fragmentation: effects of roads on animal habitat use; role of road and trails in distributing exotic species. The connection between fragmentation and ATV use.
    - The list of species at risk, their locations and their role in natural environment.
- See additional recommendations made by Wilson and Martin (1998) (Appendix 8).

5.1.3 Objective 3. Manage core area vegetation to regenerate a vigorous natural forest in campgrounds, and adjacent beach and recreation areas, and to ensure the timely removal of hazardous trees

Recommendations:

- Risk tree management:
    - Use a standard form for assessing risk trees in core areas (see Section 5.2.3).
    - Implement remedial action for high-risk trees: pruning, cabling, tree removal; moving the target; or excluding visitors from hazardous sites.
- Develop a renewal plan for core-area forests:
    - Map stand composition and age from the SFVI forest inventory.
    - Incorporate field assessments of stand composition and health from the core area inventory (see Section 5.2.3).
    - Prioritize stands for harvesting – oldest and lowest in health first.
    - Develop regeneration plan for different forest types in core area.
    - Protect renewed stands until trees are big enough to withstand recreational traffic.
- Rehabilitate areas of physical damage identified by core area inventory (see Section 5.2.3) (e.g. trampled areas in campgrounds, damaged shorelines).
- Use native plant species as landscaping material, and remove existing exotic trees and other plants and replace with native species.
- See additional, more specific recommendations made by Wilson and Martin (1998) (Appendix 8).

5.2 GOAL 2 – Maintain and Restore the Natural Landscape, Ecosystem, and Species Diversity of MLPP

5.2.1 Objective 1. Restore a more natural disturbance regime to park ecosystems

Recommendations:

- Develop forest management plan and fire management plan to indicate specific management actions of maintaining heath park forest ecosystems.
- Increase the area of young forest in MLPP by renewing patches of mature to old forests, using a combination of managed wildfire and prescribed burning and natural disturbance emulation (NDE) forest harvesting.
    - Do not let fires burn if there are white spruce mixedwood or softwood stands, or old stands in general, in the path of the fire.
    - In addition to managed wildfires, conduct prescribed burns in areas of mature forest. These can be in any area of the park, but should target both aspen-dominated and pine-dominated stands, and should avoid white spruce stands and old stands in general.
    - Where fire is not an option, develop plans for forest regeneration, using NDE forest harvesting, where necessary.
- Develop grassland management plan to manage native grassland components to mitigate the impacts of climate change and minimize the invasion of exotic plant species.
- Conduct prescribed burns in grassland patches which have been identified in the grassland inventory (see Section 5.2.4) as benefiting from burning (e.g. to control woody encroachment or to manage against exotics favoured by litter accumulation).
- General fire management practices:
    - Whenever possible fires should be contained using natural barriers such as water or roads.
    - Fireguards and roads should be kept to the minimum extent consistent with safety.
    - Foam and fire retardant should not be used near water.
    - Fireguards and roads should avoid environmentally sensitive areas, and should be closed and reclaimed as soon as after the fire is out.
    - No salvage logging after fire except for the purpose of restoring more natural forests and landscape and/or removing of high risk trees.
- While there is a preference for renewal by fire in the park in general, timber-harvesting can be used for renewal in the core area (see Section 5.1.3) and other special situations.
- In general, treat insects and diseases as part of the natural disturbance regime:
    - There may be a requirement to control insect attacks in core-area stands, where needed for shade, soil protection, or aesthetics. Control measures to be considered include pruning, tree removal, thinning, grazing, burning, biological controls, or where there are no alternative, chemical controls.
    - No direct action on dwarf mistletoe, but renewal activities in old jack pine stands will reduce susceptibility and risk of insect spread.
    - Work with the Insects and Disease staff of the Saskatchewan Forest Service to devise a strategy for managing Mountain Pine Beetle and Spruce Beetle in MLPP.

5.2.2 Objective 2. Assess the impact of all ongoing management activities and proposed developments on park biodiversity and make management recommendations

Recommendations:

- Revise the park zoning map using current standards, and using the ecosystem-based management plan as a foundation.
- Adopt a general policy of minimizing future development of large-scale recreational or other facilities, in order to protect the natural capital of the park.
- Protect from all development those areas that have been identified as unique ecosystems (e.g. natural grasslands, old-growth forests, unusual wetlands, forests, and springs) or habitats of high importance to wildlife (e.g. bird breeding colonies, ungulate wintering areas, or rare species habitat). Such areas will be identified in ongoing inventory and research (see Section 5.2.4).
- Roads and trails:
  - Reduce the length of roads and trails by closing and reclaiming any that are found to be unnecessary based on the road and trail inventory (see Section 5.2.3).
  - Do not develop any new roads or trails.
  - Include roads and trails in the exotic plant inventory (see Section 5.2.3).
- Reduce ATV use in MLPP because of damage to sensitive sites and because of spread of exotics.
  - Continue the policy of not allowing recreational riding.
  - Eliminate hunting practices including baiting that require ATV use (walk-in hunting only).
  - Seek ways to reduce use by park staff.
  - Where ATV use is allowed (e.g. by park staff or other permitted users), implement policies and training on avoiding site damage, and require washing of machines to reduce seed transport.
- Continue existing policies on gas development:
  - no new surface access
  - reclamation of abandoned well sites and roads to as close to the original state as possible
- Gravel pits:
  - Continue existing policies:
    - Gravel extraction is only permitted for park puposes or for provincial roads within parks.
    - Gravel extraction is only permitted in Resource Extraction and Access zones.
    - Pits should be located so park visitors cannot easily see them.
    - Topsoil must be stockpiled.
    - Exotic plants must be dealt with immediately.
    - Depleted pits must be restored to an appearance that blends in with surrounding landforms.
    - Revegetation must be by native species.
    - Access roads must be restored.
  - In future, access gravel sources outside the park if possible.
  - Ensure that any existing or new gravel borrow pits in the park do not cause further degradation of park native grassland remnants.
  - Include gravel pits in exotic plant inventory.
- Livestock grazing:
  - Remove grazing from the park, using a long-term phase-out period, using a policy of non-renewal of leases once the current lease holder dies or relinquishes the lease.

  - During the phase-out period, ensure that recommended stocking rates and other range management practices are followed.
  - During the phase-out period, ensure that all grazing units are separated from the Waterhen River by fenced buffers.
  - Ensure that the grazers are aware of non-renewal of lease policy by setting up a time frame for the grazing removal.
- Exotic plant species management:
  - Adopt a general park policy of low tolerance for exotic species in all situations.
  - Develop control programs for exotic plant invasions that are most serious and small enough to attack, as identified by exotic plant inventory (see Section 5.2.3), e.g.:
    - smooth brome grass patches in grassland
    - caragana at Raspberry Lake
    - common tansy at Greig Lake
  - Investigate the feasibility of controlling caragana and smooth brome grass throughout the park. Consider the potential for seeding native grass into disturbed roadside environments in the park.

5.2.3 Objective 3. Monitor the state of MLPP environment and the outcomes of ecosystem-based management actions

Recommendations:

- Monitoring of ecosystem representation and disturbance regime:
  - Analyze and update new forest inventory mapping as it becomes available.
  - Generate a new ecosite map and identify any changes in areas of ecosites from the current report.
  - Analyze forest age distribution and identify any changes in proportions of young, mature, and old forest from the current report.
  - Monitor and report on impacts of natural disturbances (e.g. wildfire, windstorm, insect & disease) as well as anthropogenic disturbances (e.g. forest harvesting & prescribed fire).
- Every 10 years conduct a survey of plant and wildlife communities to ensure the success of park ecosystem management and apply any adjustment of management activities if necessary.
- Every 10 years conduct a survey of land-use change in the park and surrounding area, identifying changes such as recreational developments, roads and trails, land clearing and breaking and logging cutovers. GIS files prepared for the current report can be used as the baseline, and subsequent surveys can be compared to this to detect changes.
- Exotic plant inventory:
  - Conduct an inventory of exotic species problems, recording location, type of ecosite, species, and extent.
  - Distinguish extensive problems (e.g. smooth brome grass in grazing units) from localized patches that could be controlled by direct attack.
  - Inventory should include sample areas of:
    - roadsides
    - gas wells and pipelines
    - gravel pits
    - grazing units
    - campgrounds
    - cottage subdivisions
    - any other development areas

  - Repeat the exotic plant inventory every five years, as well as recording incidental observations on an ongoing basis.
- Road and trail inventory:
  - Assess all roads and trails for their importance.
  - Designate roads and trails that are required for access to park facilities, resource management activities, or recreational activities (e.g. hiking trails).
  - Designate all other roads and trails for closure.
- Core area inventory:
  - Conduct a risk assessment of core-area trees
  - Conduct a survey of the health and status of core area forests
  - Record locations and severity of environmental damage from recreational activities
- Baiting station inventory
  - Continue to survey a sample of baiting stations to identify any exotic species that have become established, and assess how invasive they are.
  - Investigate whether baiting by outfitters is causing conflicts with other hunters or otherwise degrading the experience of park users.
  - Investigate whether baiting activity introduces disturbances on wildlife habitats.
  - Implement the recommendations arising from the Landscape Protection Unit with respect to the management of baiting and outfitting in the park.

5.2.4 Objective 4. Ongoing inventory of MLPP's biological and ecological resources

Recommendations:

- Conduct a survey of grassland remnants:
  - location and size
  - species composition
  - exotic invasion issues
  - woody encroachment issues
  - identify remnants that would benefit from prescribed burning or targeted exotic control.
- Document unusual wetlands such as calcareous fens and understand mechanism of high water table in some areas that leads to tree death.
- Assess the occurrence in the park of SARA-listed plant and animal species, and gather information on their habitats and any threats to them.
- Analyze forest age distribution over the larger landscape including the park and the Mistik FMA to the north to ensure the diversity of park ecosystems at landscape level.
- Continue to update forest inventory, species richness and biodiversity for the park.
- Enter past and future vegetation data for MLPP into VegISS and parks database.

5.2.5 Objective 5. Prospects for expanding MLPP to create a land management unit with greater ecological integrity and stability

Recommendations:

- Wilson and Martin (1998) suggested expanding the park to the north to incorporate the Mostoos Escarpment, land that is now Provincial Forest allocated to the Mistik FMA.
  - This expansion would incorporate a larger area of backcountry into the park, in principle creating larger blocks of habitat under park management, and possibly allowing more managed wildfire. However, the area to the north already has a major east-west forestry

road, with smaller roads accessing numerous harvest areas, as well as gaslines and gas wells in the west. If this area was incorporated into the park, the decision would have to be made how much of this road network to keep, and how much new development (e.g. campgrounds) to plan. If the intent was to expand the area of backcountry, this would require closing and reclaiming some roads, and allowing natural succession to erase the current footprint of industrial use.

- Further inventory on land surrounding park boundary is necessary to propose for park expansion in the future, such as some crown land parcels in the south near the farm lands. These land parcels in the boreal transition ecoregion could be valuable as buffer zones to maintain park landscape integrity while provide corridors for wildlife habitat.

5.2.6 Objective 6. Build conservation partnerships with non-governmental organizations and other government agencies

Recommendations:

- There is necessary to enter into partnerships with First Nations and Metis communities to conduct projects related to the management of park's ecosystems and visitor experience. Possible topics include:
    - Integrated use of traditional knowledge on decision making and management of ecological values and services in the park area.
    - Provide funding to develop interpretive programs and educational tools that elevate and improve on First Nation's perspectives on the importance of park ecosystems.
    - Collaborate on the protection, conservation and presentation of burial historic sites in the park.
    - Conduct inventory of interpretive programs and products that reflect First Nation and Metis heritage, culture and perspectives within MLPP.
    - Develop mechanisms that can improve and broaden partnerships and working relationships among First Nations and Metis groups in the park area (e.g. establishment and including those groups in Park Advisory Committee).
- Where possible, enter into partnerships with NGOs, industry or other government agencies to conduct projects related to the park's ecosystems. Possible examples include:
    - Continuing work with Canadian Forest Service and Saskatchewan Forest Service on insects and diseases, fire management, etc.
    - Continuing work with MOE on ungulate and furbearer management.
    - Work with University of Saskatchewan and University of Regina faculty and graduate students on ecological research.
    - Work with Nature Saskatchewan on bird inventories.
    - Work with the Native Plant Society of Saskatchewan on exotic control programs.
    - Work with Prairie Conservation Action Plan on vegetation databases.
    - Work with Prairie Regional Adapation Collaborative on climate change.

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APPENDICES

Appendix 1 Methods for predictive ecosite mapping

Mapping of present-day vegetation was based on the Saskatchewan Forest Vegetation Inventory (SFVI) coverage, which in the area of MLPP is current to 2007. A separate coverage was provided for fires since 2007, including the 2009 “Park Fire” plus nine smaller fires (<100 ha) represented by point locations.

The framework for summarizing vegetation is the new ecosite classification for Saskatchewan’s provincial forests (Mc Laughlan et al. 2010). A coverage in which ecosites were predicted from information in the UTM forest inventory (forest cover, drainage class, texture class) was provided by Saskatchewan Forest Service. The rules used in this prediction were determined, and applied to comparable information in the SFVI forest inventory (forest cover type and soil moisture regime), to predict ecosites for MLPP.

This predictive mapping was checked during the field reconnaissance. In many cases, the predicted ecosite was the same as that determined in the field. Other types differed for a number of reasons. Grassland patches surveyed in the field were often too small to map. The drier jack pine type (BP 02) was only mapped in a few areas because of inadequate information in the SFVI, with most pine stands assigned to the less dry type (BP 03). Similarly, the drier aspen type (BP 05) was mapped in fewer areas than it occurred because of data deficiencies, with most aspen stands assigned to the common mesic type (BP 06). Hardwood types with white birch or balsam poplar were often placed in the common aspen type (BP 06) because these components were not detected on the SFVI map. The distinction between mineral soil types (e.g. BP 09, BP 14), bS-tL swamp (BP 18), and bS bog (BP 19) was sometimes not correctly indicated by the mapped cover or moisture regime information. Such errors are difficult to avoid.

Probably the largest problem related to wetland types. In the predictive rules used on the UTM forest inventory, the “open muskeg” type (FCT code 3300) was translated to “BP 20 Labrador tea shrubby bog”, but much of this type in MLPP falls into “BP 24 Leatherleaf shrubby poor fen”, “BP 25 Willow shrubby rich fen”, or “BP 26 Graminoid fen”. Therefore, the prediction was changed to “BP 20/24/25/26”. The “treed muskeg” type (FCT code 3100) was translated to “BP19 Black spruce treed bog”, but in MLPP often fell into “BP 23 Tamarack treed fen”, so the prediction was changed to “BP 19/23”. Areas mapped as “water” (FCT code 5200) often included wetlands. These areas could be distinguished by the fact that a Soil Moisture Regime (SMR) was assigned to them in the SFVI database. Water areas with SMR of “very wet” were usually *Phragmites* marshes, especially along the Waterhen River as it approaches Waterhen Lake, so the ecosite was changed to “marsh”. Water areas with SMR of “wet” or “moderately wet” (or occasionally even drier) appeared to be similar to the “open muskeg” type, so the prediction was changed to “BP 20/24/25/26”.

Some mapped types were manually edited based on field observations and photo-interpretation. An area along Cold Lake mapped as meadow (and therefore initially translated as BP 01) was determined to be a recent burn (the 2006 Cold Fire). Also, an update file for the 2009 Park Fire was overlaid over the SFVI mapping. Several other areas mapped as meadow along the south boundary of MLPP were determined to be cleared land. Several shoreline areas mapped as rock were determined to be beaches. Therefore, types were added for “burn”, “cleared” and “beach”.

Appendix 2 Vascular plants of Meadow Lake Provincial Park

Sources are Remarchuk and Cota-Sanchez 2005 (R & C 2005), Wilson and Martin 1998 (W & M 1998), and observations by SRC staff in the current project (SRC 2011). Nomenclature has been updated following Harms (2006).

SCIENTIFIC NAME	COMMON NAME	GROWTH-FORM	ORIGIN	SOURCE
ADOXACEAE (Moschatel Family):				
Adoxa moschatellina	moschatel	forb	native	W & M
ALISMATACEAE (Water-plantain Family):				
Alisma triviale	common waterplantain	forb	native	R & C 2005
Sagittaria cuneata	arum-leaved arrowhead	forb	native	R & C 2005
AMARANTHACEAE (Amaranth Family):				
Amaranthus retroflexus	redroot pigweed	forb	exotic	SRC 2011
ANACARDIACEAE (Sumac Family)				
Rhus glabra	smooth sumac	erect shrub	cultivar	SRC 2011
APIACEAE (Parsley Family):				
Cicuta bulbifera	bulbous water-hemlock	forb	native	R & C 2005
Cicuta maculata	water-hemlock	forb	native	R & C 2005
Heracleum maximum	cow-parsnip	forb	native	R & C 2005
Sanicula marilandica	black snakeroot	forb	native	R & C 2005
Sium suave	water-parsnip	forb	native	R & C 2005
Zizia aptera	heart-leaved alexanders	forb	native	R & C 2005
APOCYNACEAE (Dogbane Family):				
Apocynum androsaemifolium	spreading dogbane	forb	native	R & C 2005
ARACEAE (Arum Family):				

Calla palustris	marsh calla	forb	native	R & C 2005
ARALIACEAE (Ginseng Family):				
Aralia nudicaulis	wild sarsaparilla	forb	native	R & C 2005
ASCLEPIADACEAE (Milkweed Family):				
Asclepias ovalifolia	oval-leaf milkweed	forb	native	W & M
ASTERACEAE (Aster Family):				
Achillea alpina	Siberian yarrow	forb	native	R & C 2005
Achillea millefolium	common yarrow	forb	native	R & C 2005
Antennaria neglecta	prairie pussytoes	forb	native	R & C 2005
Antennaria parvifolia	low pussytoes	forb	native	R & C 2005
Arnica chamissonis	chamisso's arnica	forb	native	R & C 2005
Arnica fulgens	shining arnica	forb	native	R & C 2005
Artemisia campestris	plains wormwood	forb	native	R & C 2005
Artemisia frigida	pasture sage	forb	native	SRC 2011
Bidens cernua	nodding beggarticks	forb	native	R & C 2005
Canadanthus modestus	modest aster	forb	native	W & M
Cirsium arvense	Canada thistle	forb	exotic	R & C 2005
Cirsium drummondii	Drummond's thistle	forb	native	R & C 2005
Crepis tectorum	narrow-leaf hawk's-beard	forb	exotic	R & C 2005
Erigeron elatus	tall white fleabane	forb	native	R & C 2005
Erigeron glabellus	smooth fleabane	forb	native	R & C 2005
Erigeron philadelphicus	Philadelphia fleabane	forb	native	R & C 2005
Erigeron strigosus	rough daisy fleabane	forb	native	R & C 2005
Eurybia conspicua	showy aster	forb	native	SRC 2011
Gaillardia aristata	great blanket-flower	forb	native	R & C 2005
Gnaphalium uliginosum	low cudweed	forb	exotic	W & M
Helianthus nuttallii	Nuttall's sunflower	forb	native	R & C 2005
Helianthus tuberosus	Jerusalem-artichoke	forb	native	W & M

Hieracium umbellatum	narrow-leaved hawkweed	forb	native	R & C 2005
Liatris ligulistylis	northern meadow blazing-star	forb	native	R & C 2005
Matricaria discoidea	pineapple-weed	forb	exotic	R & C 2005
Packera paupercula	balsam groundsel	forb	native	R & C 2005
Packera plattensis	prairie groundsel	forb	native	W & M
Petasites palmatus	palmate-leaved colt’s-foot	forb	native	R & C 2005
Petasites sagittatus	arrow-leaved colt's-foot	forb	native	R & C 2005
Senecio eremophilus var. eremophilus	cut-leaved ragwort	forb	native	W & M
Solidago canadensis	Canada goldenrod	forb	native	R & C 2005
Solidago missouriensis	Missouri goldenrod	forb	native	R & C 2005
Solidago simplex var. simplex	mountain goldenrod	forb	native	R & C 2005
Sonchus arvensis	perennial sow-thistle	forb	exotic	R & C 2005
Symphyotrichum ciliolatum	Lindley’s blue aster	forb	native	R & C 2005
Symphyotrichum laeve var. geyeri	smooth blue aster	forb	native	R & C 2005
Symphyotrichum puniceum var. puniceum	purple-stemmed aster	forb	native	R & C 2005
Tanacetum vulgare	common tansy	forb	exotic	R & C 2005
Taraxacum officinale	common dandelion	forb	exotic	R & C 2005
Tephroseris palustris	marsh ragwort	forb	native	R & C 2005
Tragopogon pratensis	meadow goat’s-beard	forb	exotic	R & C 2005
BALSAMINACEAE (Jewelweed Family):				
Impatiens noli-tangere	western touch-me-not	forb	native	W & M
BETULACEAE (Birch Family):				
Alnus incana ssp. tenuifolia	western river alder	erect shrub	native	R & C 2005
Alnus viridis ssp. crispa	green alder	erect shrub	native	R & C 2005
Betula glandulosa	bog birch	erect shrub	native	W & M
Betula papyrifera var. papyrifera	white birch	tree	native	R & C 2005
Betula pumila var. glandulifera	swamp birch	erect shrub	native	R & C 2005
Corylus cornuta var. cornuta	beaked hazelnut	erect shrub	native	R & C 2005

BORAGINACEAE (Borage Family):				
Lappula squarrosa	blue-bur	forb	exotic	W & M
Mertensia paniculata var. paniculata	tall lungwort	forb	native	R & C 2005
BRASSICACEAE (Mustard Family):				
Arabidopsis lyrata	lyre-leaved rock-cress	forb	native	R & C 2005
Boechera divaricarpa	purple rock-cress	forb	native	R & C 2005
Boechera drummondii	Drummond's rock-cress	forb	native	W & M
Boechera holboellii var. retrofracta	reflexed rock-cress	forb	native	W & M
Capsella bursa-pastoris	shepherd's-purse	forb	exotic	R & C 2005
Descurainia sophia	flixweed	forb	exotic	R & C 2005
Erysimum cheiranthoides	wormseed mustard	forb	exotic	R & C 2005
Lepidium densiflorum	common peppergrass	forb	native (+ exotic?)	R & C 2005
Rorippa palustris	marsh yellow-cress	forb	native	R & C 2005
Rorippa sinuata	spreading yellow-cress	forb	native	W & M
Thlaspi arvense	field pennycress	forb	exotic	R & C 2005
Turritis glabra	tower mustard	forb	native	W & M
CAMPANULACEAE (Bellflower Family):				
Campanula rotundifolia	harebell	forb	native	R & C 2005
CAPRIFOLIACEAE (Honeysuckle Family):				
Linnaea borealis ssp. americana	American twinflower	prostrate shrub	native	R & C 2005
Lonicera dioica	twining honeysuckle	erect shrub	native	R & C 2005
Lonicera involucrata var. involucrata	bracted honeysuckle	erect shrub	native	R & C 2005
Symphoricarpos albus var. albus	northern snowberry	erect shrub	native	R & C 2005
Symphoricarpos occidentalis	western snowberry	erect shrub	native	R & C 2005
Viburnum edule	low bush-cranberry	erect shrub	native	R & C 2005
Viburnum opulus var. americanum	high bush-cranberry	erect shrub	native	R & C 2005

CARYOPHYLLACEAE (Pink Family):				
Cerastium brachypodum	short-stalked mouse-ear chickweed	forb	native	W & M
Minuartia dawsonensis	rock sandwort	forb	native	R & C 2005
Moehringia lateriflora	blunt-leaved sandwort	forb	native	R & C 2005
Stellaria borealis	boreal stitchwort	forb	native	W & M
Stellaria crassifolia var. crassifolia	fleshy stitchwort	forb	native	R & C 2005
Stellaria longifolia var. longifolia	long-leaved stitchwort	forb	native	R & C 2005
Stellaria longipes	long-stalked stitchwort	forb	native	W & M
Stellaria media ssp. media	common chickweed	forb	exotic	R & C 2005
CERATOPHYLLACEAE (Hornwort Family):				
Ceratophyllum demersum	coontail	forb	native	R & C 2005
CHENOPODIACEAE (Goosefoot Family):				
Chenopodium album var. album	lamb’s-quarters	forb	exotic	R & C 2005
Chenopodium capitatum	strawberry-blite	forb	native	R & C 2005
Chenopodium glaucum var. salinum	oak-leaf goosefoot	forb	native	W & M
Chenopodium leptophyllum	narrow-leaved goosefoot	forb	native	W & M
CORNACEAE (Dogwood Family):				
Cornus canadensis	Canadian bunchberry	forb	native	R & C 2005
Cornus sericea ssp. stolonifera	red-osier dogwood	erect shrub	native	R & C 2005
CRASSULACEAE (Stonecrop Family):				
Sedum lanceolatum ssp. lanceolatum	lance-leaved stonecrop	forb	native	W & M
CYPERACEAE (Sedge Family):				
Carex alopecoidea	foxtail sedge	graminoid	native	W & M
Carex aquatilis var. aquatilis	water sedge	graminoid	native	R & C 2005
Carex arcta	northern sedge	graminoid	native	W & M
Carex atherodes	awned sedge	graminoid	native	W & M
Carex atratiformis	Raymond's sedge	graminoid	native	W & M

Carex aurea	golden sedge	graminoid	native	R & C 2005
Carex bebbii	Bebb's sedge	graminoid	native	R & C 2005
Carex blanda	woodland sedge	graminoid	native	W & M
Carex brunnescens	brownish sedge	graminoid	native	W & M
Carex disperma	soft-leaved sedge	graminoid	native	SRC 2011
Carex foenea	hay sedge	graminoid	native	R & C 2005
Carex hoodii	Hood's sedge	graminoid	native	W & M
Carex inops ssp. heliophila	sun-loving sedge	graminoid	native	SRC 2011
Carex lasiocarpa ssp. americana	hairy-fruited sedge	graminoid	native	W & M
Carex obtusata	blunt sedge	graminoid	native	W & M
Carex peckii	Peck's sedge	graminoid	native	W & M
Carex pseudocyperus	cypress-like sedge	graminoid	native	R & C 2005
Carex rostrata	beaked sedge	graminoid	native	W & M
Carex tenera var. tenera	quill sedge	graminoid	native	W & M
Carex utriculata	northern beaked sedge	graminoid	native	R & C 2005
Carex viridula var. viridula	green sedge	graminoid	native	R & C 2005
Eleocharis palustris	common spike-rush	graminoid	native	R & C 2005
Eriophorum angustifolium ssp. angustifolium	narrow-leaved cotton-grass	graminoid	native	R & C 2005
Eriophorum gracile	slender cotton-grass	graminoid	native	R & C 2005
Schoenoplectus tabernaemontani	soft-stem bulrush	graminoid	native	R & C 2005
Scirpus microcarpus	small-fruited bulrush	graminoid	native	R & C 2005
Trichophorum alpinum	alpine cottongrass	graminoid	native	R & C 2005
DROSERACEAE (Sundew Family):				
Drosera rotundifolia var. rotundifolia	round-leaved sundew	forb	native	R & C 2005
DRYOPTERIDACEAE (Wood Fern Family):				
Cystopteris fragilis	fragile bladder-fern	forb	native	W & M
Dryopteris carthusiana	spinulose shield-fern	forb	native	SRC 2011
Gymnocarpium dryopteris	northern oak-fern	forb	native	SRC 2011
Matteuccia struthiopteris var. pensylvanica	ostrich fern	forb	native	R & C 2005

ELAEAGNACEAE (Oleaster Family):				
Shepherdia canadensis	Canada buffalo-berry	erect shrub	native	R & C 2005
EQUISETACEAE (Horsetail Family):				
Equisetum arvense	field horsetail	forb	native	R & C 2005
Equisetum hyemale ssp. affine	tall scouring-rush	forb	native	R & C 2005
Equisetum scirpoides	dwarf scouring-rush	forb	native	R & C 2005
Equisetum sylvaticum	woodland horsetail	forb	native	R & C 2005
ERICACEAE (Heath Family):				
Andromeda polifolia	bog-rosemary	erect shrub	native	R & C 2005
Arctostaphylos uva-ursi	common bearberry	prostrate shrub	native	R & C 2005
Chamaedaphne calyculata	leather-leaf	erect shrub	native	R & C 2005
Kalmia polifolia	northern bog-laurel	erect shrub	native	R & C 2005
Ledum groenlandicum	common Labrador-tea	erect shrub	native	R & C 2005
Vaccinium cespitosum var. cespitosum	dwarf bilberry	erect shrub	native	R & C 2005
Vaccinium myrtilloides	velvet-leaf blueberry	erect shrub	native	R & C 2005
Vaccinium oxycoccos	small bog cranberry	prostrate shrub	native	R & C 2005
Vaccinium vitis-idaea ssp. minus	dry-ground cranberry	prostrate shrub	native	R & C 2005
FABACEAE (Legume Family):				
Astragalus agrestis	field milk-vetch	forb	native	R & C 2005
Astragalus americanus	American milk-vetch	forb	native	W & M
Astragalus flexuosus var. flexuosus	pliant milk-vetch	forb	native	W & M
Astragalus laxmannii var. robustior	ascending purple milk-vetch	forb	native	SRC 2011
Caragana arborescens	caragana	erect shrub	exotic	R & C 2005
Hedysarum alpinum ssp. americanum	American sweet-vetch	forb	native	R & C 2005
Lathyrus ochroleucus	cream-colored vetchling	forb	native	R & C 2005

Lathyrus venosus	purple vetchling	forb	native	R & C 2005
Medicago sativa ssp. sativa	alfalfa	forb	exotic	R & C 2005
Melilotus alba	white sweet-clover	forb	exotic	R & C 2005
Melilotus officinalis	yellow sweet-clover	forb	exotic	R & C 2005
Oxytropis deflexa var. sericea	reflexed locoweed	forb	native	R & C 2005
Oxytropis monticola	late yellow locoweed	forb	native	W & M
Thermopsis rhombifolia	golden bean	forb	native	W & M
Trifolium hybridum	alsike clover	forb	exotic	R & C 2005
Trifolium pratense	red clover	forb	exotic	W & M
Trifolium repens var. repens	white clover	forb	exotic	W & M
Vicia americana	American vetch	forb	native	R & C 2005
FUMARIACEAE (Fumitory Family):				
Corydalis aurea ssp. aurea	golden corydalis	forb	native	R & C 2005
Corydalis sempervirens	pink corydalis	forb	native	R & C 2005
GENTIANACEAE (Gentian Family):				
Gentianella amarella ssp. acuta	northern gentian	forb	native	R & C 2005
Halenia deflexa ssp. deflexa	American spurred gentian	forb	native	R & C 2005
GERANIACEAE (Geranium Family):				
Geranium bicknellii	Bicknell's wild geranium	forb	native	R & C 2005
GROSSULARIACEAE (Currant Family):				
Ribes americanum	wild black currant	erect shrub	native	R & C 2005
Ribes glandulosum	skunk currant	erect shrub	native	W & M
Ribes hudsonianum var. hudsonianum	northern black currant	erect shrub	native	R & C 2005
Ribes lacustre	bristly black currant	erect shrub	native	W & M
Ribes oxyacanthoides	northern gooseberry	erect shrub	native	R & C 2005
Ribes triste	swamp red currant	erect shrub	native	R & C 2005
HALORAGACEAE (Water-milfoil Family):				

Myriophyllum sibiricum	Siberian water-milfoil	forb	native	R & C 2005
Myriophyllum spicatum	Eurasian spiked water-milfoil	forb	exotic	W & M
Myriophyllum verticillatum	whorled water-milfoil	forb	native	W & M
HIPPURIDACEAE (Mare's-tail Family):				
Hippuris vulgaris	common mare's-tail	forb	native	R & C 2005
HYDROCHARITACEAE (Frog's-bit Family):				
Elodea canadensis	Canada waterweed	forb	native	W & M
HYDROPHYLLACEAE (Water-leaf Family):				
Phacelia franklinii	Franklin's scorpionweed	forb	native	R & C 2005
IRIDACEAE (Iris Family):				
Sisyrinchium montanum	mountain blue-eyed-grass	forb	native	R & C 2005
JUNCACEAE (Rush Family):				
Juncus alpinoarticulatus	alpine rush	graminoid	native	R & C 2005
Juncus arcticus var. balticus	Baltic rush	graminoid	native	R & C 2005
Juncus bufonius	toad rush	graminoid	native	W & M
Juncus dudleyi	Dudley's rush	graminoid	native	W & M
Juncus nodosus	knotted rush	graminoid	native	R & C 2005
Juncus vaseyi	Vasey's rush	graminoid	native	W & M
JUNCAGINACEAE (Arrow-grass Family):				
Triglochin maritimum	seaside arrow-grass	forb	native	R & C 2005
Triglochin palustre	marsh arrow-grass	forb	native	R & C 2005
LAMIACEAE (Mint Family):				
Agastache foeniculum	blue giant-hyssop	forb	native	R & C 2005
Dracocephalum parviflorum	American dragonhead	forb	native	R & C 2005
Galeopsis tetrahit var. tetrahit	common hemp-nettle	forb	exotic	R & C 2005

Lycopus asper	rough water-horehound	forb	native	R & C 2005
Lycopus uniflorus var. uniflorus	one-flowered water-horehound	forb	native	R & C 2005
Mentha arvensis	wild mint	forb	native	R & C 2005
Scutellaria galericulata ssp. epilobiifolia	marsh skullcap	forb	native	R & C 2005
Stachys pilosa var. pilosa	hairy hedge-nettle	forb	native	R & C 2005
LEMNACEAE (Duckweed Family):				
Lemna minor	lesser duckweed	forb	native	R & C 2005
Spirodela polyrrhiza	common duck's-meat	forb	native	R & C 2005
Wolffia columbiana	Columbian wolffia	forb	native	W & M
LENTIBULARIACEAE (Bladderwort Family):				
Utricularia intermedia	flat-leaf bladderwort	forb	native	R & C 2005
Utricularia macrorhiza	greater bladderwort	forb	native	R & C 2005
LILIACEAE (Lily Family):				
Lilium philadelphicum var. philadelphicum	eastern red lily	forb	native	R & C 2005
Maianthemum canadense	wild lily-of-the-valley	forb	native	R & C 2005
Maianthemum racemosum ssp. amplexicaule	feathery solomon's-seal	forb	native	W & M
Maianthemum stellatum	star-flowered solomon's-seal	forb	native	R & C 2005
Maianthemum trifolium	three-leaved solomon's-seal	forb	native	R & C 2005
Prosartes trachycarpum	fairy bells	forb	native	R & C 2005
Streptopus amplexifolius	clasping-leaf twisted-stalk	forb	native	W & M
Zygadenus elegans ssp. elegans	white camas	forb	native	R & C 2005
LYCOPODIACEAE (Club-Moss Family):				
Diphasiastrum complanatum	ground-cedar	forb	native	R & C 2005
Diphasiastrum sitchense	Sitka ground-cedar	forb	native	W & M
Lycopodium annotinum	stiff club-moss	forb	native	R & C 2005
Lycopodium clavatum	running club-moss	forb	native	R & C 2005
Lycopodium dendroideum	ground-pine	forb	native	R & C 2005

MENYANTHACEAE (Buck-bean Family):				
Menyanthes trifoliata	buck-bean	forb	native	R & C 2005
MONOTROPACEAE (Indian-pipe Family):				
Monotropa uniflora	Indian-pipe	forb	native	R & C 2005
NYMPHAEACEAE (Water-lily Family):				
Nuphar variegatum	yellow pond-lily	forb	native	R & C 2005
ONAGRACEAE (Evening-Primrose Family):				
Chamerion angustifolium ssp. angustifolium	common fireweed	forb	native	SRC 2011
Circaea alpina ssp. alpina	small enchanter's-nightshade	forb	native	R & C 2005
Epilobium ciliatum	northern willow-herb	forb	native	R & C 2005
Oenothera biennis	common evening-primrose	forb	native	R & C 2005
OPHIOGLOSSACEAE (Grape-Fern Family):				
Botrychium multifidum	leathery grape-fern	forb	native	R & C 2005
Botrychium virginianum var. virginianum	Virginia grape-fern	forb	native	W & M
ORCHIDACEAE (Orchid Family):				
Coeloglossum viride var. virescens	longbracted bog-orchid	forb	native	R & C 2005
Corallorrhiza maculata	spotted coralroot	forb	native	R & C 2005
Corallorrhiza trifida	early coralroot	forb	native	W & M
Cypripedium passerinum	sparrow's-egg lady's-slipper	forb	native	R & C 2005
Goodyera repens	dwarf lesser rattlesnake-plantain	forb	native	R & C 2005
Listera cordata	heart-leaved twayblade	forb	native	W & M
Platanthera aquilonis	northern green bog-orchid	forb	native	R & C 2005
Platanthera obtusata	blunt-leaved bog-orchid	forb	native	R & C 2005
Spiranthes lacera	northern slender ladies'-tresses	forb	native	R & C 2005
Spiranthes romanzoffiana	hooded ladies'-tresses	forb	native	R & C 2005
PINACEAE (Pine Family):				

Abies balsamea	balsam fir	tree	native	R & C 2005
Larix laricina	tamarack	tree	native	R & C 2005
Picea glauca	white spruce	tree	native	R & C 2005
Picea mariana	black spruce	tree	native	R & C 2005
Pinus banksiana	jack pine	tree	native	R & C 2005
PLANTAGINACEAE (Plantain Family):				
Plantago major	common plantain	forb	exotic	R & C 2005
POACEAE (Grass Family):				
Agropyron cristatum	crested wheat-grass	graminoid	exotic	W & M
Agrostis scabra	rough hairgrass	graminoid	native	R & C 2005
Alopecurus aequalis var. aequalis	short-awned foxtail	graminoid	native	R & C 2005
Anthoxanthum hirtum ssp. arcticum	sweet grass	graminoid	native	W & M
Avena sativa	cultivated oats	graminoid	exotic	R & C 2005
Avenula hookeri	Hooker’s oat-grass	graminoid	native	SRC 2011
Beckmannia syzigachne	American slough grass	graminoid	native	R & C 2005
Bromus inermis	smooth brome	graminoid	exotic	R & C 2005
Bromus latiglumis	broad-glumed brome	graminoid	native	W & M
Bromus pumpellianus	northern awnless brome	graminoid	native	W & M
Calamagrostis canadensis	marsh reed-grass	graminoid	native	R & C 2005
Calamagrostis stricta ssp. inexpansa	northern reed-grass	graminoid	native	SRC 2011
Calamagrostis stricta ssp. stricta	narrow reed-grass	graminoid	native	W & M
Calamovilfa longifolia	sand-grass	graminoid	native	R & C 2005
Cinna latifolia	drooping wood-grass	graminoid	native	W & M
Danthonia intermedia	timber wild oat-grass	graminoid	native	SRC 2011
Elymus trachycaulus ssp. subsecundus	awned wheat-grass	graminoid	native	SRC 2011
Elymus trachycaulus ssp. trachycaulus	slender wheat-grass	graminoid	native	W & M
Festuca altaica ssp. hallii	plains rough fescue	graminoid	native	SRC 2011
Festuca saximontana var. saximontana	Rocky Mountain fescue	graminoid	native	R & C 2005
Glyceria borealis	northern manna-grass	graminoid	native	W & M

Glyceria grandis var. grandis	tall manna-grass	graminoid	native	W & M
Hesperostipa curtiseta	western porcupine-grass	graminoid	native	SRC 2011
Hordeum jubatum	fox-tail barley	graminoid	native	R & C 2005
Koeleria macrantha	June grass	graminoid	native	SRC 2011
Leymus innovatus	hairy wild-rye	graminoid	native	R & C 2005
Oryzopsis asperifolia	rough-leaved rice-grass	graminoid	native	SRC 2011
Phalaris arundinacea	reed canary-grass	graminoid	native	R & C 2005
Phragmites australis	giant reed-grass	graminoid	native	R & C 2005
Piptatherum pungens	northern rice-grass	graminoid	native	R & C 2005
Poa palustris	fowl blue-grass	graminoid	native (+ exotic)	W & M
Poa pratensis	Kentucky blue-grass	graminoid	exotic (+ native?)	R & C 2005
Puccinellia nuttalliana	Nuttall's alkali-grass	graminoid	native	W & M
Schizachne purpurascens	false melic grass	graminoid	native	SRC 2011
Sphenopholis intermedia	slender wedge-grass	graminoid	native	W & M
POLEMONIACEAE (Phlox Family):				
Collomia linearis	narrow-leaved collomia	forb	native	R & C 2005
POLYGALACEAE (Milkwort Family):				
Polygala paucifolia	fringed milkwort	forb	native	W & M
Polygala senega var. senega	seneca-snakeroot	forb	native	R & C 2005
POLYGONACEAE (Buckwheat Family):				
Persicaria amphibia	water smartweed	forb	native	R & C 2005
Persicaria lapathifolia	dock-leaved smartweed	forb	native	R & C 2005
Polygonum achoreum	leathery knotweed	forb	native	W & M
Polygonum aviculare	prostrate knotweed	forb	exotic	R & C 2005
Rumex fueginus	golden dock	forb	native	R & C 2005
Rumex occidentalis	western dock	forb	native	R & C 2005
Rumex triangulivalvis	narrow-leaved dock	forb	native	W & M

POTAMOGETONACEAE (Pondweed Family):				
Potamogeton natans	floating pondweed	forb	native	R & C 2005
Potamogeton richardsonii	Richardson's pondweed	forb	native	R & C 2005
Stuckenia pectinata	sago pondweed	forb	native	R & C 2005
PRIMULACEAE (Primrose Family):				
Androsace septentrionalis ssp. puberulenta	northern pygmyflower	forb	native	W & M
Lysimachia ciliata	fringed loosestrife	forb	native	W & M
Lysimachia thyrsiflora	tufted loosestrife	forb	native	R & C 2005
Primula incana	mealy primrose	forb	native	W & M
Trientalis borealis ssp. borealis	northern star-flower	forb	native	R & C 2005
PYROLACEAE (Wintergreen Family):				
Monesis uniflora ssp. uniflora	one-flowered wintergreen	forb	native	R & C 2005
Orthilia secunda	one-sided wintergreen	forb	native	R & C 2005
Pyrola asarifolia ssp. asarifolia	pink wintergreen	forb	native	R & C 2005
Pyrola chlorantha	greenish-flowered wintergreen	forb	native	R & C 2005
Pyrola elliptica	shinleaf	forb	native	R & C 2005
RANUNCULACEAE (Buttercup Family):				
Actaea rubra	baneberry	forb	native	R & C 2005
Anemone canadensis	Canada anemone	forb	native	R & C 2005
Anemone multifida	cut-leaf anemone	forb	native	R & C 2005
Anemone virginiana	riverbank anemone	forb	native	R & C 2005
Aquilegia brevistyla	small-flowered columbine	forb	native	R & C 2005
Caltha palustris var. palustris	yellow marsh-marigold	forb	native	R & C 2005
Delphinium glaucum	tall larkspur	forb	native	R & C 2005
Pulsatilla patens ssp. multifida	prairie crocus	forb	native	R & C 2005
Ranunculus abortivus	small-flowered buttercup	forb	native	W & M
Ranunculus aquatilis var. diffusa	white water buttercup	forb	native	R & C 2005
Ranunculus cymbalaria	shore buttercup	forb	native	W & M

Ranunculus macounii	Macoun's buttercup	forb	native	R & C 2005
Ranunculus pensylvanicus	Pennsylvania buttercup	forb	native	W & M
Ranunculus sceleratus	celery-leaved buttercup	forb	native	R & C 2005
Thalictrum sparsiflorum var. richardsonii	few-flowered meadow-rue	forb	native	W & M
Thalictrum venulosum	veiny meadow-rue	forb	native	R & C 2005
ROSACEAE (Rose Family):				
Amelanchier alnifolia var. alnifolia	saskatoon	erect shrub	native	R & C 2005
Argentina anserina	silverweed	forb	native	R & C 2005
Comarum palustre	marsh cinquefoil	forb	native	R & C 2005
Dasiphora fruticosa	shrubby cinquefoil	erect shrub	native	R & C 2005
Fragaria vesca ssp. americana	American woodland strawberry	forb	native	R & C 2005
Fragaria virginiana ssp. glauca	smooth wild strawberry	forb	native	R & C 2005
Geum aleppicum	yellow avens	forb	native	W & M
Geum macrophyllum var. perincisum	cut-leaf avens	forb	native	R & C 2005
Geum rivale	purple avens	forb	native	R & C 2005
Geum triflorum var. triflorum	three-flowered avens	forb	native	R & C 2005
Potentilla arguta ssp. arguta	white cinquefoil	forb	native	R & C 2005
Potentilla norvegica ssp. monspeliensis	rough cinquefoil	forb	native (+ exotic?)	R & C 2005
Potentilla pensylvanica var. pensylvanica	Pennsylvania cinquefoil	forb	native	W & M
Prunus pensylvanica	pin cherry	erect shrub	native	R & C 2005
Prunus virginiana var. virginiana	choke cherry	erect shrub	native	R & C 2005
Rosa acicularis	prickly rose	erect shrub	native	R & C 2005
Rosa woodsii var. woodsii	Wood's rose	erect shrub	native	R & C 2005
Rubus arcticus ssp. acaulis	stemless raspberry	forb	native	R & C 2005
Rubus chamaemorus	cloudberry	forb	native	SRC 2011
Rubus idaeus ssp. strigosus	wild red raspberry	erect shrub	native	R & C 2005
Rubus pubescens var. pubescens	dewberry	forb	native	R & C 2005
Sibbaldiopsis tridentata	three-toothed cinquefoil	forb	native	R & C 2005
Spiraea alba var. alba	narrow-leaved meadowsweet	erect shrub	native	R & C 2005

RUBIACEAE (Madder Family):				
Galium boreale	northern bedstraw	forb	native	R & C 2005
Galium labradoricum	northern bog bedstraw	forb	native	R & C 2005
Galium trifidum var. trifidum	small bedstraw	forb	native	R & C 2005
Galium triflorum	sweet-scented bedstraw	forb	native	R & C 2005
Houstonia longifolia	long-leaved bluets	forb	native	W & M
SALICACEAE (Willow Family):				
Populus balsamifera	balsam poplar	tree	native	R & C 2005
Populus tremuloides	trembling aspen	tree	native	R & C 2005
Salix bebbiana	beaked willow	erect shrub	native	R & C 2005
Salix candida	hoary willow	erect shrub	native	R & C 2005
Salix discolor	pussy willow	erect shrub	native	R & C 2005
Salix interior	sandbar willow	erect shrub	native	R & C 2005
Salix lasiandra var. lasiandra	western shining willow	erect shrub	native	R & C 2005
Salix pedicellaris	bog willow	erect shrub	native	R & C 2005
Salix petiolaris	basket willow	erect shrub	native	R & C 2005
Salix planifolia	plane-leaf willow	erect shrub	native	W & M
Salix scouleriana	Scouler's willow	erect shrub	native	W & M
SANTALACEAE (Sandalwood Family):				
Comandra umbellata	bastard toadflax	forb	native	R & C 2005
Geocaulon lividum	northern comandra	forb	native	R & C 2005
SAXIFRAGACEAE (Saxifrage Family):				
Chrysosplenium tetrandrum	northern golden-saxifrage	forb	native	W & M
Heuchera richardsonii	Richardson's alumroot	forb	native	R & C 2005
Mitella nuda	bishop's-cap	forb	native	R & C 2005
Parnassia palustris var. tenuis	marsh grass-of-parnassus	forb	native	R & C 2005
SCROPHULARIACEAE (Figwort Family):				

Castilleja miniata ssp. miniata	red Indian-paintbrush	forb	native	R & C 2005
Melampyrum lineare var. lineare	American cow-wheat	forb	native	R & C 2005
Pedicularis groenlandica ssp. groenlandica	elephant's-head	forb	native	W & M
Penstemon procerus var. procerus	slender blue beardtongue	forb	native	R & C 2005
Veronica americana	American speedwell	forb	native	R & C 2005
SELAGINELLACEAE (Spike-Moss Family):				
Selaginella densa var. densa	prairie clubmoss	forb	native	SRC 2011
Selaginella selaginoides	prickly spike-moss	forb	native	W & M
SOLANACEAE (Nightshade Family):				
Leucophysalis grandiflora	large white ground-cherry	forb	native	W & M
TYPHACEAE (Cat-tail Family):				
Typha latifolia	common cat-tail	graminoid	native	R & C 2005
URTICACEAE (Nettle Family):				
Urtica dioica ssp. gracilis	stinging nettle	forb	native	R & C 2005
VIOLACEAE (Violet Family):				
Viola adunca var. adunca	early blue violet	forb	native	R & C 2005
Viola canadensis var. rugulosa	western Canada violet	forb	native	R & C 2005
Viola nephrophylla	northern bog violet	forb	native	R & C 2005
Viola pedatifida	crowfoot violet	forb	native	SRC 2011
Viola renifolia	kidney-leaved white violet	forb	native	W & M

Appendix 3 Locations (UTM coordinates, NAD83, extended zone 13) and species present in selected grassland patches.

Easting	241996	225046	247266	226819	247266	190361	191106	231852	246277
Northing	6033975	6043647	6037447	6041815	6037447	6049390	6047411	6036561	6039706
area of patch (ha)	19.86	1.73	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Prairie species:									
plains rough fescue	x	x	x	x	x				
June grass	x	x	x	x					
western porcupine grass	x	x							
Hooker's oatgrass		x	x						
sun-loving sedge		x							
Species of either prairie or forest:									
awned wheatgrass	x	x	x	x	x	x	x	x	x
timber oatgrass	x	x		x					
Rocky Mountain fescue						x			x
hay sedge						x	x		
northern ricegrass							x		
Forest species:									
hairy wild-rye					x				
Exotic species:									
smooth brome	x	x							
Kentucky bluegrass	x	x						x	

Appendix 4 Amphibians and reptiles of Meadow Lake Provincial Park

(after Wilson and Martin 1998)

COMMON NAME	SCIENTIFIC NAME
Amphibians:	
<u>Bufonidae - Toads</u>	
Canadian Toad	*Bufo hemiophrys*
<u>Hylidae – Treefrogs</u>	

Striped Chorus Frog	*Pseudacris triseriata*
<u>Ranidae – True Frogs</u>	
Wood Frog	*Rana sylvatica*
Northern Leopard Frog	*Rana pipiens*
Reptiles:	
<u>Colubridae – Typical Snakes</u>	
Red-sided Garter Snake	*Thamnophis sirtalis*

Appendix 5 Mammals of Meadow Lake Provincial Park

(after Wilson and Martin 1998)

COMMON NAME	SCIENTIFIC NAME
<u>Soricidae – Shrew</u>	
Masked Shrew	*Sorex cinereus*
Arctic Shrew	*Sorex arcticus*
Dusky Shrew*	*Sorex obscurus*
Water Shrew*	*Sorex palustris*
Pygmy Shrew*	*Microsorex hoyii*
<u>Vespertilionidae – Plainnose Bats</u>	
Little Brown Bat	*Myotis lucifugus*
Silver-Haired Bat*	*Lasionycteris noctivagans*
Big Brown Bat*	*Eptesicus fuscus*
Hoary Bat*	*Lasiurus cinereus*
<u>Leporidae – Rabbits and Hares</u>	
Snowshoe Hare	*Lepus americanus*
<u>Sciuridae – Squirrels</u>	
Woodchuck	*Marmota monax*
Thirteen-lined Ground Squirrel	*Citellus tridecemlineatus*
Franklin’s Ground Squirrel*	*Citellus franklinii*
Least Chipmunk	*Eutamias minimus*
Red Squirrel	*Tamiasciurus hudsonius*
Northern Flying Squirrel*	*Glaucomys sabrinus*
<u>Castoridae – Beavers</u>	
American Beaver	*Castor canadensis*
<u>Crecetinae – Mice, Lemmings and Voles</u>	

Deer Mouse	*Peromyscus maniculatus*
Gapper's Red-backed Vole	*Clethrionomys gapperi*
Heather Vole*	*Phenacomys intermedius*
Meadow Vole	*Microtus pennsylvanicus*
Muskrat	*Ondatra zibethicus*
Northern Bog Lemming	*Synaptomys borealis*
Muridae – Old World Rats and Mice	
House Mouse*	*Mus musculus*
Zapodidae – Jumping Mice	
Meadow Jumping Mouse*	*Zapus hudsonius*
Erethizontidae – Porcupine	
Porcupine	*Erethizon dorsatum*
Canidae – Wolves, Dogs and Foxes	
Coyote	*Canis latrans*
Gray Wolf	*Canis lupus*
Red Fox	*Vulpes velox*
Ursidae – Bears	
Black Bear	*Ursus americanus*
Procyonidae – Raccoons	
Raccoon	*Procyon lotor*
Mustelidae – Weasels, Skunks	
Marten*	*Martes americana*
Fisher	*Martes pennanti*
Ermine	*Mustela erminea*
Least Weasel	*Mustela rixosa*
Longtail Weasel	*Mustela frenata*
Mink	*Mustela vison*
Wolverine*	*Gulo gulo*
Badger*	*Taxidea taxus*
Striped Skunk	*Mephitis mephitis*
River Otter	*Lutra canadensis*
Felidae – Cats	
Lynx	*Lynx lynx*
Mountain Lion*	*Felis concolor*
Cervidae – Deer	
Elk	*Cervus elaphus*
Mule Deer	*Odocoileus hemionus*
White-tailed Deer	*Odocoileus virginiana*

Moose	*Alces alces*
Woodland Caribou*	*Rangifer tarandus*

Note: Species marked * should occur in the park or have been known to occur in the area even though they have not been recorded recently.

Appendix 6 Birds of Meadow Lake Provincial Park

(after Wilson and Martin 1998)

COMMON NAME	SCIENTIFIC NAME
Gaviidae – Loons	
Common Loon	*Gavia immer*
Podicipedidae – Grebes	
Red-necked Grebe	*Podiceps grisegena*
Horned Grebe	*Podiceps auritus*
Western Grebe	*Aechmophorus occidentalis*
Pied-billed Grebe	*Podilymbus podiceps*
Pelecanidae – Pelicans	
American White Pelican	*Pelecanus erythrorhynchos*
Phalacrocoracidae – Cormorants	
Double-crested Cormorant	*Phalacrocorax auritus*
Ardeidae – Herons and Bitterns	
Great Blue Heron	*Ardea herodias*
Black-crowned Night Heron	*Nycticorax nycticorax*
American Bittern	*Botaurus lentiginosus*
Anatidae – Swans, Geese and Ducks	
Tundra Swan	*Olor columbianus*
Canada Goose	*Branta Canadensis*
White-fronted Goose	*Anser albifrons*
Snow Goose	*Chen caerulescens*
Mallard	*Anas platyrhynchos*
Gadwall	*Anas strepera*
Northern Pintail	*Anas acuta*
Green-winged Teal	*Anas crecca*
Blue-winged Teal	*Anas discors*
Northern Shoveler	*Anas clypeata*
American Widgeon	*Anas americana*
Redhead	*Aythya americana*
Ring-necked Duck	*Aythya collaris*

Canvasback	*Aythya valisineria*
Lesser Scaup	*Aythya affinis*
Common Goldeneye	*Bucephala clangula*
Bufflehead	*Bucephala albeola*
White-winged Scoter	*Melanitta deglandi*
Ruddy Duck	*Oxyura jamaicensis*
Common Merganser	*Mergus merganser*
Red-breasted Merganser	*Mergus serrator*
<u>Cathertidae – American Vultures</u>	
Turkey Vulture	*Cathertes aura*
<u>Accipitridae – Hawks, Eagles, Harriers</u>	
Northern Goshawk	*Accipiter gentilis*
Cooper’s Hawk	*Accipiter cooperii*
Sharp-shinned Hawk	*Accipiter striatus*
Red-tailed Hawk	*Buteo jamaicensis*
Broad-winged Hawk	*Buteo platypterus*
Swainson’s Hawk	*Buteo swainsoni*
Rough-legged Hawk	*Buteo lagopus*
Golden Eagle	*Aquilo chrysaetos*
Bald Eagle	*Haliaeetos leucocephalus*
Northern Harrier	*Circus cyaneus*
<u>Pandionidae – Ospreys</u>	
Osprey	*Pandion haliactus*
<u>Falconidae – Falcons</u>	
Merlin	*Falco columbarius*
American Kestrel	*Falco sparverius*
Peregrine Falcon	*Falco peregrinus*
<u>Tetraonidae – Grouse and Ptarmigan</u>	
Spruce Grouse	*Dendragapus canadensis*
Ruffed Grouse	*Bonasa umbellus*
Sharp-tailed Grouse	*Tympanchus phasianellus*
Willow Ptarmigan	*Lagopus lagopus*
<u>Gruidae – Cranes</u>	
Sandhill Crane	*Grus canadensis*
<u>Rallidae – Rails, Coots</u>	
Sora	*Porzana carolina*
Yellow Rail*	*Coturnicops noveboracensis*
Virginia Rail*	*Rallus limicola*
American Coot	*Fulica americana*
<u>Charadriidae – Plovers</u>	

Semipalmated Plover	*Charadrius semipalmatus*
Killdeer	*Charadrius vociferous*
<u>Scolopacidae – Snipe, Sandpipes</u>	
Common Snipe	*Capella gallinago*
Spotted Sandpiper	*Actitus macularia*
Solitary Sandpiper	*Tringa solitaria*
Greater Yellowlegs	*Tringa melanoleucus*
Lesser Yellowlegs	*Tringa flavipes*
Willet	*Catoptrophorus semipalmatus*
Least Sandpiper	*Calidris minutilla*
Baird’s Sandpiper	*Calidris bairdii*
<u>Laridae – Gulls and Terns</u>	
Herring Gull	*Larus argentatus*
California Gull	*Larus californicus*
Ring-billed Gull	*Larus delawarensis*
Franklin’s Gull	*Larus pipixcan*
Bonaparte’s Gull	*Larus philadelphia*
Forester’s Tern	*Sterna forsteri*
Common Tern	*Sterna hirundo*
Black Tern	*Chlidonias nigra*
Caspian Tern	*Hydroprogne caspia*
<u>Columbidae – Doves</u>	
Mourning Dove	*Zenaida macroura*
<u>Strigidae – Owls</u>	
Great Horned Owl	*Bubo virginianus*
Snow Owl	*Nyctea scandiaca*
Great Grey Owl	*Strix nebulosa*
Boreal Owl*	*Aegolius funereus*
Long-eared Owl*	*Osio otus*
Short-eared Owl*	*Asio flammeus*
Barred Owl*	*Strix varia*
Northern Hawk Owl*	*Surnia ulula*
<u>Caprimulgidae – Goatsuckers</u>	
Common Nighthawk	*Chordeiles minor*
<u>Trochilidae – Hummingbirds</u>	
Ruby-throated Hummingbird	*Archilochus colubris*
<u>Alcedinidae – Kingfishers</u>	
Belted Kingfisher	*Megaceryl alcyon*
<u>Picidae – Woodpeckers</u>	
Northern Flicker	*Colaptes auritus*

Pileated Woodpecker	*Dryocopus pileatus*
Yellow-bellied Sapsucker	*Spyrapicus varius*
Downy Woodpecker	*Dendrocopos pubescens*
Hairy Woodpecker*	*Dendrocopos villosus*
Black-backed Woodpecker	*Picoides arcticus*
Three-toed Woodpecker	*Picoides tridactylus*

Tyrannidae – Tyrant Flycatcher

Eastern Kingbird	*Tyrannus tyrannus*
Eastern Phoebe	*Sayornis phoebe*
Least Flycatcher	*Empidonax mimimus*
Alder Flycatcher	*Empidonax alnorum*
Yellow-bellied Flycatcher	*Empidonax flaviventris*
Western Wood-Peewee	*Contopus sordidulus*
Olive-sided Flycatcher	*Nuttallornis borealis*

Alaudidae – Larks

Horned Lark	*Eremophilia alpestris*

Hirundidae – Swallows

Tree Swallow	*Iridoprocne bicolor*
Barn Swallow	*Hirundo rustica*
Cliff Swallow	*Petrachelidon pyrrhonota*
Bank Swallow	*Riparia riparia*
Purple Martin	*Progne subis*

Corvidae – Jays, Magpies and Crows

Gray Jay	*Perisoreus canadensis*
Blue Jay	*Cyanocitta cristata*
Black-billed Magpie	*Pica pica*
Common Raven	*Corvus corax*
American Crow	*Corvus brachyrhynchos*

Paridae – Titmice

Black-capped Chickadee	*Parus atricapillus*
Boreal Chickadee	*Parus hudsonicus*

Sittidae – Nuthatches

Red-breasted Nuthatch	*Sitta canadensis*

Certhiidae – Creepers

Brown Creeper	*Certhia familiaris*

Troglodytidae – Wrens

House Wren	*Troglodytes aedon*
Winter Wren*	*Troglodytes troglodytes*
Marsh Wren*	*Telmatodytes palustris*

<u>Turdidae – Thrushes and Bluebirds</u>	
American Robin	*Turdus migratorius*
Hermit Thrush	*Catharus guttata*
Swainson's Thrush	*Catharus ustulata*
Grey-cheeked Thrush*	*Hylocichla minima*
Mountain Bluebird	*Sialia currucoides*
<u>Sylvidae – Kinglets</u>	
Golden-crowned Kinglet	*Regulus satrapa*
Ruby-crowned Kinglet	*Regulus calendula*
<u>Motacillidae – Pipits</u>	
American Pipit	*Anthus rubescens*
<u>Bombycillidae – Waxwings</u>	
Cedar Waxwing	*Bombycilla cedrorum*
Bohemian Waxwing	*Bombycilla garrulous*
<u>Sturnidae – Starlings</u>	
European Starling	*Sturnus vulgaris*
<u>Vireonidae – Vireos</u>	
Solitary Vireo	*Vireo solitarius*
Philadelphia Vireo	*Vireo philadelphia*
Red-eyed Vireo	*Vireo olivaceus*
Warbling Vireo	*Vireo gilvus*
<u>Parulidae – Wood Warblers</u>	
Black-and-White Warbler	*Mniotilta varia*
Tennessee Warbler	*Vermivora peregrine*
Orange-crowned Warbler	*Vermivora celata*
Nashville Warbler	*Vermivora ruficappila*
Yellow Warbler	*Dendroica petechia*
Magnolia Warbler	*Dendroica magnolia*
Cape May Warbler	*Dendroica tigrina*
Yellow-rumped Warbler	*Dendroica coronatea*
Black-throated Green Warbler	*Dendroica virens*
Chestnut-sided Warbler	*Dendroica pensylvanica*
Bay-breasted Warbler	*Dendroica castanea*
Blackpoll Warbler	*Dendroica striata*
Palm Warbler	*Dendroica palmarum*
Overbird	*Seiurus aurocapillus*
Northern Waterthrush	*Seirus novaboracensis*
Connecticut Warbler	*Oporornis agilis*
Mourning Warbler	*Oporonis philadelphia*
Common Yellowthroat	*Geothlypis trichas*
Wilson's Warbler	*Wilsonia pusilla*

American Redstart	*Setophaga ruticilla*
Canada Warbler*	*Wilsonia canadense*
Ploceidae – Weaver Finches	
House Sparrow	*Passer domesticus*
Icteridae – Meadowlarks, Blackbirds and Oriels	
Western Meadowlark	*Sturnella neglecta*
Yellow-headed Blackbird	*Xanthocephalus xanthocephalus*
Red-winged Blackbird	*Agelaius phoeniceus*
Northern Oriole	*Icterus galbule*
Rusty Blackbird	*Euphagus carolinus*
Brewer's Blackbird	*Euphagus cyanocephalus*
Common Grackle	*Quiscalus quiscula*
Brown-headed Cowbird	*Molothrus ater*
Thraupidae – Tanagers	
Western Tanager	*Piranga ludoviciana*
Fringillidae – Grosbeaks, Finches, Sparrows and Buntings	
Rose-breasted Grosbeak	*Pheucticus Iudoviciana*
Purple Finch	*Carpodacus purpureus*
Evening Grosbeak	*Hesperiphona vespertina*
Pine Grosbeak	*Pinicola enucleator*
Hoary Redpoll*	*Carduelis hornemanni*
Common Redpoll*	*Carduelis flammea*
Pine Siskin	*Spinus pinus*
American Goldfinch	*Spinus tristis*
White-winged Crossbill	*Loxia leucoptera*
Red Crossbill*	*Loxia curvirostra*
Savannah Sparrow	*Passerculus sandwichensis*
Le Conte's Sparrow	*Ammospiza leconteii*
Vesper Sparrow	*Pooecetes gramineus*
Dark-eyed Junco	*Junco hyemalis*
Tree Sparrow	*Spizella arborea*
Chipping Sparrow	*Spizella passerinea*
Clay-colored Sparrow	*Spizella pallida*
White-throated Sparrow	*Zonotrichia albicollis*
White-crowned Sparrow	*Zonotrichia leucophrys*
Harris' Sparrow*	*Zonotrichia querula*
Fox Sparrow*	*Passerella iliaca*
Swamp Sparrow	*Melospiza geogiana*
Lincoln's Sparrow	*Melospiza lincolni*
Song Sparrow	*Melospiza melodia*
Lapland Longspur	*Calcarius lapponicus*
Smith's Longspur*	*Calcarius pictus*
Snow Bunting	*Plectrophenax nivalis*

Note: Species marked * should occur in the park, even though they have not been recorded.

Appendix 7 Distribution of other bird species (not mentioned in the main text) in relation to ecosites.

X indicates major use, x indicates minor use. M indicates species that migrate through MLPP but do not breed.

	BP1	BP2	BP3	BP4	BP12	BP5	BP 6	BP 7	BP16	BP 9	BP10	BP15	BP14	BP18	BP19	BP23	BP20	BP24	BP25	BP26	Marsh	beach	burns	cleared	developed	water
Northern Goshawk			X	X	X	X	X	X	X	X	X	X	X	X												
Cooper's Hawk				X		X	X	X	X																	
Sharp-shinned Hawk				X		X	X	X	X	X	X	X	X													
Red-tailed Hawk				X		X	X	X	X		X	X														
Broad-winged Hawk				X		X	X	X	X		X	X														
Bald Eagle																										X
Northern Harrier																		X		X						
Osprey																										X
Merlin		X	X	X												X	X	X		X	X	X	X	X	X	X
American Kestrel																	X	X		X	X	X	X	X	X	X
Spruce Grouse		X	X	X	X					X	X	X	X	X	X											
Sharp-tailed Grouse	X																X	X		X			X	X		
Northern Flicker																							X	X	X	
American Three-toed Woodpecker		X	X	X	X					X	X	X	X	X	X											
Eastern Phoebe																									X	X
Western Wood Pewee			X	X	X	X																				
Horned Lark																						M	M	M	M	
Barn Swallow																								X	X	

Cliff Swallow																										X
Bank Swallow																										X
Purple Martin																									X	X
Black-billed Magpie																								X	X	
Common Raven																										
American Crow																										
House Wren						X																				
Gray-cheeked Thrush																										
Mountain Bluebird																							X	X		
Golden-crowned Kinglet										X	X															
American Pipit																						M				
Cedar Waxwing	X					X										X			X							
Bohemian Waxwing																										
European Starling																								X	X	
Philadelphia Vireo							X												X							
Black-and-white Warbler																			X							
Nashville Warbler							X							X	X	X										
Yellow Warbler											X								X							
Cape May Warbler										X	X															
Blackpoll Warbler					X								X	X	X											
Palm Warbler														X	X	X										
Northern Waterthrush																										
Connecticut Warbler				X			X							X					X							
Mourning Warbler							X		X														X			X

Common Yellowthroat																			X							X
Wilson's Warbler																		X	X							
Canada Warbler										X	X	X														X
House Sparrow																									X	
Purple Finch											X	X														
Evening Grosbeak											X															
Pine Grosbeak																										
Hoary Redpoll																										
Common Redpoll																										
American Goldfinch																								X	X	
Red Crossbill										X	X															
Dark-eyed Junco		X	X	x	X					X	x	x	x													
Tree Sparrow																										
Clay-colored Sparrow	X																	x								
White-crowned Sparrow																										
Harris's Sparrow																										
Fox Sparrow																										X
Lapland Longspur																						M		M	M	
Smith's Longspur																						M		M	M	
Snow Bunting																						M		M	M	

Appendix 8 Additional recommendations made by Wilson and Martin (1998), organized by the objectives used in the current report.

GOAL 1 - Enhancement of Recreational, Aesthetic, Educational, and Interpretive Opportunities Within a Safe Outdoor Environment

Objective 2. Provide enhanced opportunities for the interpretation of park vegetation, landscapes, ecosystems, and species

- Develop interpretive programs and facilities using themes based on the park's physical and natural features.
- Provide at least one self-guided interpretive trail that reflects local landscape or ecosystem themes near each major park campground.
- Ensure that the design and layout of interpretive developments such as trails and visitor centres respect and are compatible with the park's natural and physical environment.
- Education programs should be conducted on the environmental problems caused by the indiscriminate use of ATVs in the park.
- Provide several well-designed and informative self-guided interpretive walking trails to allow visitors to experience and learn about the park’s natural environment.
- Develop a park trail plan identifying opportunities for access to significant natural and physical features.

Objective 3. Manage core area vegetation to regenerate a vigorous natural forest in campgrounds, and adjacent beach and recreation areas, and to ensure the timely removal of hazardous trees

- Park facility and infrastructure development should be located and designed to blend into the natural landscape.
- Ensure that new developments are planned and designed so as to minimize their environmental impact, including reducing cuts and fills during construction, using native landscaping materials and minimizing turfed areas.
- Ensure that the themes of recreational activities and programs and the design and layout of recreational facilities and developments are based on and respect the park's natural and physical environment.
- Do not locate recreational facilities in environmentally sensitive areas such as wetlands, areas with erodible soils, important wildlife habitat or sites containing rare plants.
- Plant new trees and shrubs in public use areas to renew and revitalize the existing vegetation. Where new plantings are established in areas with heavy pedestrian traffic, they should be protected with snow fence or similar barriers.
- In public use areas, plant trees in clumps rather than singly. Use mulch or native shrubs to fill in between the trees. Mowing around clumps is more efficient and less damaging to the vegetation than mowing around individual trees.
- Reduce the area of grass that is being mowed in developed areas to only those locations that are essential for public use. In non-essential areas, replace turfgrass with low maintenance natural vegetation.

- Do not use pesticides or herbicides except in heavily-used locations such as campgrounds or day use areas where insect or disease outbreaks threaten the survival of the forest cover. Wherever possible, remove and destroy affected trees rather than using chemical controls.
- Educate and encourage cottagers to keep their lots as natural as possible by minimizing lawn areas, maintaining a natural tree cover and using native plants for landscaping.
- Do not allow mowing or alteration of shoreline vegetation.
- Provide a boat trailer and extra vehicle parking area within each campground and disallow boat trailer parking at individual campsites. This will help prevent damage to campsite vegetation.
- Prepare a brochure or other information handout acquainting campers with the requirement to avoid damaging campground vegetation. Warn or fine people for damaging vegetation, especially through improper vehicle parking.
- Where possible and without removing excessive vegetation and thus narrowing or eliminating vegetated buffer strips between campsites, enlarge and level campsite living areas to provide more useable space and thus reduce damage to vegetation.
- Enforce restrictions on the number of vehicles that can be parked at each campsite.
- Prepare and implement campground and day use areas redevelopment plans identifying existing and potential environmental problem areas and solutions to those problems. Examples of problem areas include:
    - At Flotten Lake campground, removal of some lakeshore campsites and a tree planting program is required to prevent further shoreline erosion in some areas. As well, a walking trail and viewpoint should be constructed to replace the numerous paths that have developed on the easily eroded sandy hill at the rear of the campground.
    - At Grieg Lake campground, dying and dead aspen trees should be removed, particularly those close to roads and campsites. White spruce should be underplanted to supplement those that are already beginning to regenerate. Some selective removal of healthy aspen trees should be undertaken to vary the age composition of the existing even-aged stand. Tree stumps should be cut flush with the ground to prevent tripping injuries to campers.
    - At Kimball Lake campground, dead and dying birch trees that are hazardous to campers and their equipment should be removed. In many cases, it may only be necessary to remove the dead tops of these trees using a cherrypicker. In the day use area, clumps of jack pine and native shrubs should be planted, protected by snow fence or similar barriers to allow them to establish themselves. Barriers should also be used to protect fragile beach dune and backshore ground cover. Park staff should use Cushmans or similar vehicles to do maintenance and should follow the existing concrete walk instead of driving pick-up trucks on backshore areas and thus damaging ground cover vegetation. Finally, many of the unneeded roads left over from fighting the 1980 forest fire should be closed or converted to bicycle trails.
    - At Matheson Lake campground, fencing and tree and shrub planting are required in the area of the beach front picnic shelter to prevent bank erosion. Two sets of stairs, one on each side of the picnic shelter, should be constructed to allow beach access.
- Ensure that sewage holding tanks are in place and are in good condition in recreational or commercial developments.

- Ensure that sewage lagoons are watertight; alternatively, consider a biological treatment system such as an engineered marsh for waste water.

GOAL 2 - Maintain the Existing Landscape, Ecosystem, and Species Diversity of MLPP

Objective 1. Restore a more natural disturbance regime to park ecosystems

- Allow firewood cutting in road-accessible mistletoe-infested areas.
- Maintain a variety of forest age classes to reduce the possibility of large scale insect/disease outbreaks.

Objective 2. Assess the impact of all ongoing management activities and proposed developments on park biodiversity and make management recommendations

- Ensure that the existing park zoning meets the goal of protecting natural processes.
- Consider only those projects or developments that are compatible with park natural system preservation goals for the zoning plan.
- Identify and protect from human disturbance park areas containing unusual or unique vegetative associations such as `old growth' forest stands, fens or grasslands. These areas should be identified and documented in the annual ecological resource surveys.
- Identify and protect from human disturbance park areas of high importance to wildlife such as bird breeding colonies, ungulate wintering areas or rare species habitat. These areas should be identified and documented in the annual ecological resource surveys.
- Prepare management plans to protect rare plant and animal species in the park.
- Prepare and implement recovery plans for threatened or rare species.
- Consider re-introducing species, particularly mammals, that have been extirpated in the park but which formerly may have occurred in the area.
- Inventory existing roads and trails in the park. Close those which are no longer needed after documenting factors such as their history, purpose and amount of use.
- Close unnecessary roads and trails to limit hunter access into backcountry areas of the park.
- Avoid unnecessary new roads, trails or clearings to limit plant and animal habitat fragmentation and cowbird parasitism of nesting songbirds.
- Allow only those roads necessary for access to developed areas in the park and for any authorized resource extraction activities. Decommission roads used for resource extraction activities as soon as they are no longer needed.
- Select speed limits which reduce the chance of vehicle/animal collisions.
- Environmental Protection Plans should be prepared for new road developments.
- Limit or prohibit resource use activities that conflict with the recreational users of the park. Examples of conflicts include visible forest harvesting operations or sand and gravel pits along trails, canoe routes or roads.
- Allow forest harvesting only for vegetation management purposes.
- Concentrate forest harvesting operations on priority areas such as stands with heavy mistletoe infestations and areas with a high fire hazard which are in public view or which pose a threat to developed facilities.
- Have contingency plans in place for chemical or other toxic substance spills.
- Monitor hunting, fishing and trapping harvest levels to ensure that they are sustainable. In the longer term, consider closing the park for hunting, trapping and commercial fishing.

- Create `wilderness' precincts in the park where hunting and trapping are not allowed.
- Develop guidelines to ensure that bear baiting does not interfere with recreational use of the park and does not lure bears to the vicinity of campgrounds and other developed areas.
- Discontinue the stocking of non-native gamefish.
- In timber harvest areas, provide 20 metre wide vegetated buffer zones along waterbodies to prevent sedimentation and provide shade.
- Ensure that any construction activity along or across waterbodies is carried out in such a way as to minimize environmental damage such as sediment generation, shoreline disturbance and damage to vegetation and fish habitats.
- Where resource management activities are in public view, they should be conducted so as to blend in visually with the surrounding natural environment. Cut blocks should not have straight edges or square corners, and trees should not be planted in rows or lines.
- New or relocated powerlines, pipelines or other utilities should be located along existing utility or road corridors.
- Utility or road corridor widths should be kept to a minimum and alignments should avoid straight lines. Utility corridor widths should be allowed to revegetate as much as possible.

Objective 3. Monitor the state of MLPP environment and the outcomes of ecosystem-based management actions

- Every 10 years conduct a survey of landscape change in the park and surrounding area, identifying changes such as recreational developments, roads and trails, land clearing and breaking and logging cutovers. A baseline document should be prepared first, and all subsequent surveys should be compared to this to ascertain incremental changes. Changes in the management of the park should be made in response to changing land use patterns outside the park. For example, if mature and overmature forest stands outside the park are being heavily harvested, it would be desirable to maintain a higher proportion of these inside the park to provide a more balanced regional mix of ecosystems.

Objective 4. Ongoing inventory of MLPP's biological and ecological resources

- Maintain and regularly update a detailed inventory of park ecological resources.
- To this end, baseline surveys should be conducted for breeding birds, carnivores, small mammals, insects, lichens, fungi, rare plants and vegetation associations.
- Surveys should be designed to be scientifically valid and comparable from one year to the next.