

Protected Area Policies and Climate Change: The Case of the Prairie Ecozone, Saskatchewan



SUMMARY DOCUMENT

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Grasslands National Park

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INTRODUCTION

This study focuses on the prairie ecozone, a highly fragmented landscape where protected areas are particularly vulnerable to the effects of climate change. We modeled the impacts of climate change through the application of climate scenarios and vegetation models on nineteen protected areas of the prairie ecozone in Saskatchewan. This was intended to assess the capacity of current protected areas policies to represent and sustain ecological health under future climate conditions. A review and assessment of protected area policy was conducted of Saskatchewan's Representative Areas Network (RAN) and of each type of protected area. Policy recommendations for Saskatchewan's protected areas to respond to climate change are proposed, including a template to review protected area policy in other jurisdictions. The policy recommendations are intended to support park and protected area planners and managers to respond to climate change now and in the near future.

Climate change has been identified as one of the key threats to prairie biodiversity (James et al. 2001). Two recent studies in Saskatchewan have examined the possible effects of climate change on prairie biodiversity (James et al. 2001) and island forests of the northern Great Plains (Henderson et al. 2002). At the national level, Scott et al. (2002) predicted through modeling that 50% of Canada's National Parks will undergo significant vegetation changes with climate change and identified major policy challenges for Parks Canada. These studies suggest the need for major changes in protected area selection and management policies to respond to current and anticipated climatic changes. More intrusive forms of management, for instance, may be required to preserve some form of tree cover on prairie island forests (Henderson et al. 2002). The introduction of exotic tree species is one potential adaptation strategy to maintain a desired landscape and ecosystem function that we may need to consider.

PROTECTED AREAS AND CLIMATE CHANGE

Climate change seriously threatens biodiversity. Since we are locked in to significant future climate change even if greenhouse gas emissions are severely reduced today, we need adaptation strategies. Most protected areas have been designed to represent and protect specific natural features, species and communities, but have not taken into account the potential changes to ecosystems that could be induced by climate change (Scott and Lemieux 2005). For example, establishing a network of protected areas to represent natural regions that includes vegetation type may be problematic. A key objective of protected area management is biodiversity conservation, yet some species may be eliminated from a given protected area as the climate becomes warmer or drier. Other species better adapted to warmer or drier climates may be prevented from immigrating to the protected area because of the absence of migration corridors.

SASKATCHEWAN'S REPRESENTATIVE AREAS NETWORK (RAN)

Saskatchewan, through its Representative Areas Network (RAN) program, has established an extensive system of parks and protected areas across the province and is now nearing the RAN designation of 9% of its land base (Figure 1). The framework of the RAN is based on "enduring features," that is the kind of features that change only gradually over time. Within its biodiversity action plan, Saskatchewan committed to expand the RAN to include 12% of the land and water within the province by 2009.

The RAN is a unique assemblage of protected areas, as it encompasses over 15 types of land designations managed by the private sector, non-government organizations, federal agencies (including national parks) and provincial agencies (including provincial parks) (Table 1). The areas include highly protected areas (e.g. ecological reserves) as well as working landscapes such as community pastures that encompass some of the best remaining native prairie in the province. While biodiversity conservation is a primary objective of all protected areas within the RAN, the diversity of management regimes and lack of program regulations or standards means ecosystem management is a constant challenge, particularly under climate change.

As of 2005, a total of 10% of the Prairie Ecozone is encompassed within the RAN, with the vast majority (over 85%) occurring on lands available for agricultural production – primarily grazing. The remaining 15% is comprised of ecological reserves, national and provincial parks, and lands dedicated to wildlife protection.

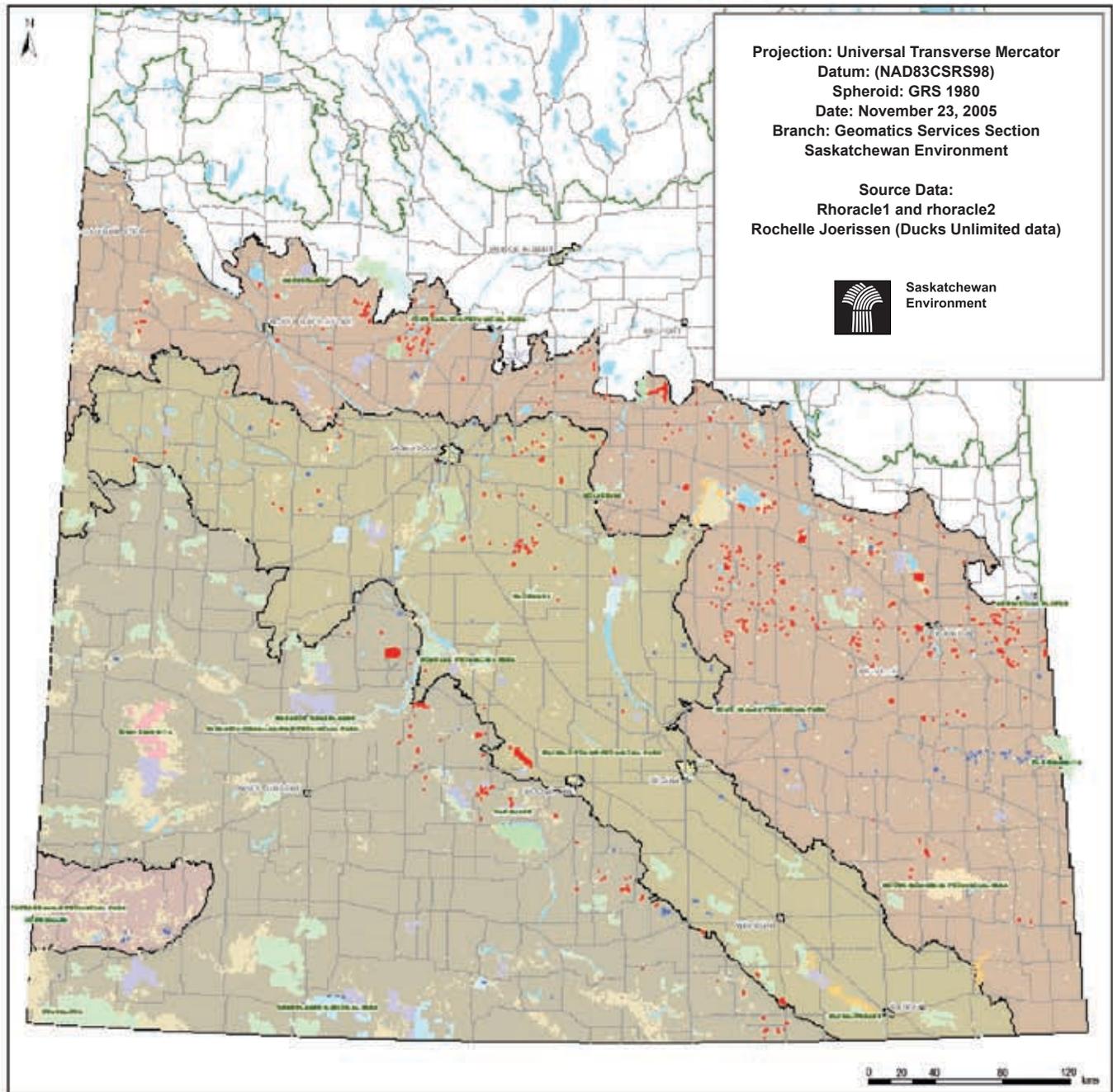
MODELING CHANGES IN VEGETATION ZONES

One of the critical questions for protected area policy is the impact of climate change on the natural ecosystems that are being protected. In order to address this question, we analyzed the potential future changes in vegetation zonation in the Prairie Ecozone of Saskatchewan.

The modeling method that best represents the current vegetation zones of the prairie region is Hogg's (1994) Climatic Moisture Index (CMI). CMI, defined as annual precipitation minus annual potential evapotranspiration, indicates the level of moisture available to an ecosystem: the lower the CMI value, the drier the conditions. Hogg (1994) showed that moisture levels correlate well with the southern boundaries of the boreal forest and the aspen parkland, thereby defining the vegetation zones of the Prairies (Table 2).

We can extend this work by looking at the major grassland types occurring in the Great Plains of the United States (Table 3 and Figure 2). Similar climates to those predicted by the climate change scenarios for the Canadian Prairies can presently be found in the central and northern Great Plains. Therefore the vegetation types that occur in those climates

Saskatchewan Representative Areas Network Within Prairie Ecozone



Projection: Universal Transverse Mercator
Datum: (NAD83CSRS98)
Spheroid: GRS 1980
Date: November 23, 2005
Branch: Geomatics Services Section
Saskatchewan Environment

Source Data:
Rhoracle1 and rhoracle2
Rochelle Joerissen (Ducks Unlimited data)



Saskatchewan
Environment

- | | | | |
|--------------------------|------------------------------|--------------------------|------------------------|
| Highway | Ducks Unlimited lands | National Wildlife Area | Ecological Reserve |
| Waterbody | Conservation Easement | Park Land | FWD Fund Lands |
| City | Provincial Community Pasture | Migratory Bird Sanctuary | PFRA Community Pasture |
| Prairie Ecozone | PCS Rocanville | Wildlife Refuge | Game Preserve |
| Prairie Ecoregion | CFB Dundurn | National Park | WHPA |
| Aspen Parkland | SWA Lands | RA Ecological Reserve | |
| Cypress Upland | | | |
| Mixed Grassland | | | |
| Moist Mixed Grassland | | | |
| Remaining Ecoregions | | | |

Figure 1: Saskatchewan Representative Areas Network within the Prairie Ecozone

Protected Area Type & Legislation	Purpose	Total %
Saskatchewan Environment Administered Land		
Park Lands under the <i>Parks Act</i> <ul style="list-style-type: none"> • Provincial Parks • Protected Areas • Park Land Reserves • Recreation Sites • Historic Sites (not included in total %) 	Protect natural and cultural resources, landscapes or features for future generations for their recreation and education. <ul style="list-style-type: none"> • Protected areas are more for habitat protection, not recreation and education. • Park Land Reserves are designations which set aside land for five years while discussions are undertaken to determine a permanent designation. 	3%
Ecological Reserves under the <i>Ecological Reserves Act</i>	Protect land for biodiversity and natural resource conservation.	< 1%
Fish and Wildlife Development Fund Lands under the <i>Natural Resources Act</i>	Protect wildlife and aquatic habitat through land acquisition funded by hunters and fisherpersons.	2%
Wildlife Refuges under <i>The Wildlife Act</i>	Protect, propagate, perpetuate, manage, control, regulate or enhance wildlife or its habitat in designated areas.	< 1%
Game Preserves under <i>The Wildlife Act</i>	Protect, propagate, perpetuate, manage, control, regulate or enhance wildlife or its habitat in designated areas.	1%
Special Zones under <i>The Lands Act</i>	Protect Crown Resource Lands without a legal designation.	< 1%
Other Provincially Administered Land		
Provincial Community Pastures under <i>The Pastures Act</i> , managed by Saskatchewan Agriculture and Food (SAF)	Primarily to protect grazing land, but also native prairie ecosystems.	10%
Wildlife Habitat Protection Land under <i>The Wildlife Habitat Protection Act</i> , managed by SAF	Primarily to protect habitat for ungulates and licensed hunting and angling opportunities.	45%
Saskatchewan Watershed Authority lands under <i>The Saskatchewan Watershed Authority Act</i>	Protect waterfowl habitat.	1%
Government of Canada/Federally Administered Land		
Parks Canada under <i>The Canada National Parks Act</i> <ul style="list-style-type: none"> • National Parks • National Historic Sites 	Protect and present nationally significant examples of Canada's natural and cultural heritage and foster public understanding, appreciation and enjoyment in ways that ensure their ecological and commemorative integrity for present and future generations.	1%
Migratory Bird Sanctuaries under the <i>Migratory Birds Convention Act</i>	Protect staging waterfowl areas/colonial nesting birds.	2%
National Wildlife Areas under the <i>Canada Wildlife Act</i>	Protect wildlife habitat.	2%
CFB Dundurn	Protect native habitat.	1%
PFRA Community Pastures under the <i>Prairie Farm Rehabilitation Act</i>	Primarily to protect grazing land, but also native prairie ecosystems.	29%
Non-Government Agencies		
Ducks Unlimited	Protect habitat for ducks and other waterfowl.	< 1%
Nature Conservancy of Canada	Protect native habitat.	< 1%
Corporate		
Potash Corporation of Saskatchewan	Protect native habitat.	< 1%
Others		
Conservation Easements on private land under <i>The Conservation Easements Act</i>	Protect native habitat.	< 1%

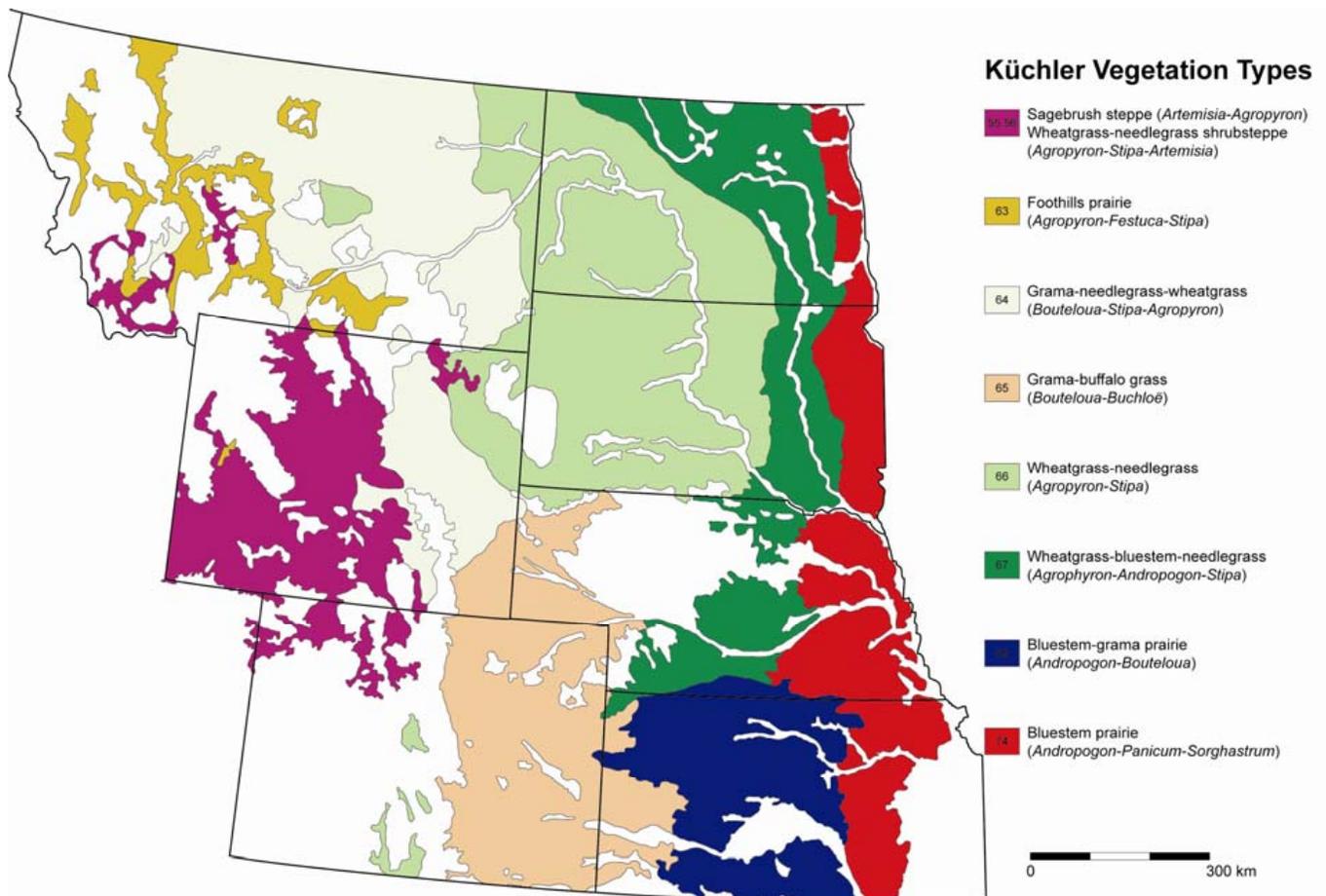
Table 1: Protected Area Type, Purpose and Percentage of Representative Area Network (RAN) within Prairie Ecozone, Saskatchewan

CMI	Vegetation zone
>0	Forest
0 to -150 mm	Aspen Parkland
-150 to -300 mm	Mixed Prairie
<-300 mm	Dry Mixed Prairie

Table 2. Thresholds of the climatic moisture index (CMI) used to define Canadian vegetation zones

DESCRIPTIVE NAME	KÜCHLER TYPES
Foothills Prairie	63 Foothills Prairie
Northern Mixed Prairie (dry)	64 Grama – Needlegrass – Wheatgrass
Northern Mixed Prairie (intermediate)	66 Wheatgrass – Needlegrass
Northern Mixed Prairie (moist)	67 Wheatgrass – Bluestem – Needlegrass
Tallgrass Prairie	74 Bluestem
Shortgrass Prairie	64 Grama – Buffalograss
Sagebrush Steppe	55,56 Sagebrush Steppe

Table 3: Major zonal grassland types in the central and northern Great Plains of the United States, after Küchler (1964)



Source: Küchler, A. W. *Potential Natural Vegetation of the Conterminous United States*, American Geographical Society

Figure 2: Major zonal grassland types in and adjacent to the central and northern Great Plains, after Küchler (1964)

can be used as analogues for the future vegetation of our region. Analogues cannot be taken as exact predictions, because of lags in migration of species and other factors, but they can show the direction of future changes.

To predict changes in vegetation zonation, outputs from three Global Climate Models (GCMs) for the 2040-2069 period (referred to as the 2050s) were applied to the Canadian Prairies: CGCM2 A21, CSIROmk2b B11 and Hadley CM3 B21. These scenarios were selected because they represent the full GCM range of possible temperature and precipitation futures. All three scenarios indicate increases in temperature and growing degree-days (an indication of the amount of heat available for plant growth). Precipitation shows little change under one scenario, and small increases under the other two scenarios. Overall, less moisture is expected to be available for plant growth largely due to an increase in evaporation. Changes in growing degree-days and precipitation are shown spatially using the CSIROmk2b B11 scenario (Figures 4 and 6).

Changes in vegetation zones were based on changes to the climatic variables. For U.S. vegetation zones, a logistic regression model was developed based on annual precipitation, annual potential evapotranspiration, and seasonal distribution of precipitation. If future climates fell outside the range of current Canadian climates (warmer), then U.S. vegetation types based on the logistic regression model were predicted. If future climates fell within the range of current Canadian climates, then Canadian vegetation types based on the Climate Moisture Index were predicted.

PREDICTED CHANGES IN VEGETATION ZONATION

Vegetation zones are expected to shift northward considerably by the 2050s under all three climate change scenarios. The change is represented spatially using the CSIROmk2b B11 scenario (Figure 8). Much of the southern boreal forest will have a climate more suitable for aspen parkland, while the current aspen parkland will shift toward open grassland. The southern grassland region will shift toward the kind of mixed prairie currently found in Montana, Wyoming, and North and South Dakota. The driest part of the grassland region will shift toward shortgrass prairie, currently found in Colorado and further south.

ECOLOGICAL IMPACTS

The ecological impacts of climate change depend upon the location and physiography of the protected area. A gradual reduction of tree and shrub cover is predicted, impacting heavily wooded regions such as Cypress Hills and Moose Mountain Provincial Parks, Wolverine PFRA Pasture, and Assiniboine Slopes Ecological Reserve. A consequent decrease in animal species that are dependent on woody cover is expected, along with an increase in grassland species. Certain animal and plant species currently found only in the U.S. will also gradually appear over time. All

areas will see a decrease of midgrasses and an increase in shortgrasses, as well as a decrease in cool-season grasses and an increase in warm-season grasses. While forest production will most certainly be reduced in the drier climate, grassland production loss may be moderated by the increase in warm-season grasses, which utilize water more efficiently. In certain areas, such as the Great Sand Hills Ecological Reserve and Douglas Provincial Park, there will be an increased potential for dune activation. In southern areas such as Moose Mountain Provincial Park, water bodies are expected to shrink as ponds are replaced by wetlands, and wetlands are invaded by forest.

MANAGEMENT IMPLICATIONS

Management implications for protected areas vary depending on the protected area's designation and the predicted ecological impacts. In forested areas, for instance, there will be a reduced need to control woody invasion of grasslands. There will be declining opportunities for forest- and water-based recreation in many protected areas. Changes to nature interpretation themes may be required in provincial and national parks as the landscape evolves. In community pastures, grazing capacity of grasslands may decrease in some areas due to the drier climate and increase in other areas due to loss of tree cover. Shifts in potential grassland species composition may mean that range management will have to be changed, and shrinking water bodies may require additional water development in some areas.

Numerous adaptation responses exist, and some will inevitably challenge current protected area objectives. As certain species begin to disappear, for example, we will have to decide whether to try to protect them or accept the loss of these species. As tree cover is reduced in wooded areas, we might consider taking a proactive approach to preserve forest through the introduction of exotic species that are better adapted to a drier climate. More intensive management of remaining forests (i.e. through salvage logging) may also be required to reduce fire hazards. In each case, decisions will have to be supported by relevant and science-based information. There is, therefore, a need in all protected areas for greater monitoring to detect long-term ecological changes.

REVIEW OF PROTECTED AREAS POLICY IN SASKATCHEWAN

We also identified the capacity of protected areas policy to represent and sustain ecological health under climate change. Public policy instruments available for the larger system (the Representative Areas Network) were reviewed along with those available for all protected land types found within the Prairie Ecozone. The range of policy instruments that were reviewed included: legislation, regulations, major public policy documents/commitments, management plans, signed agreements (Memorandums of Understanding – MOUs), and other public information. A survey of management

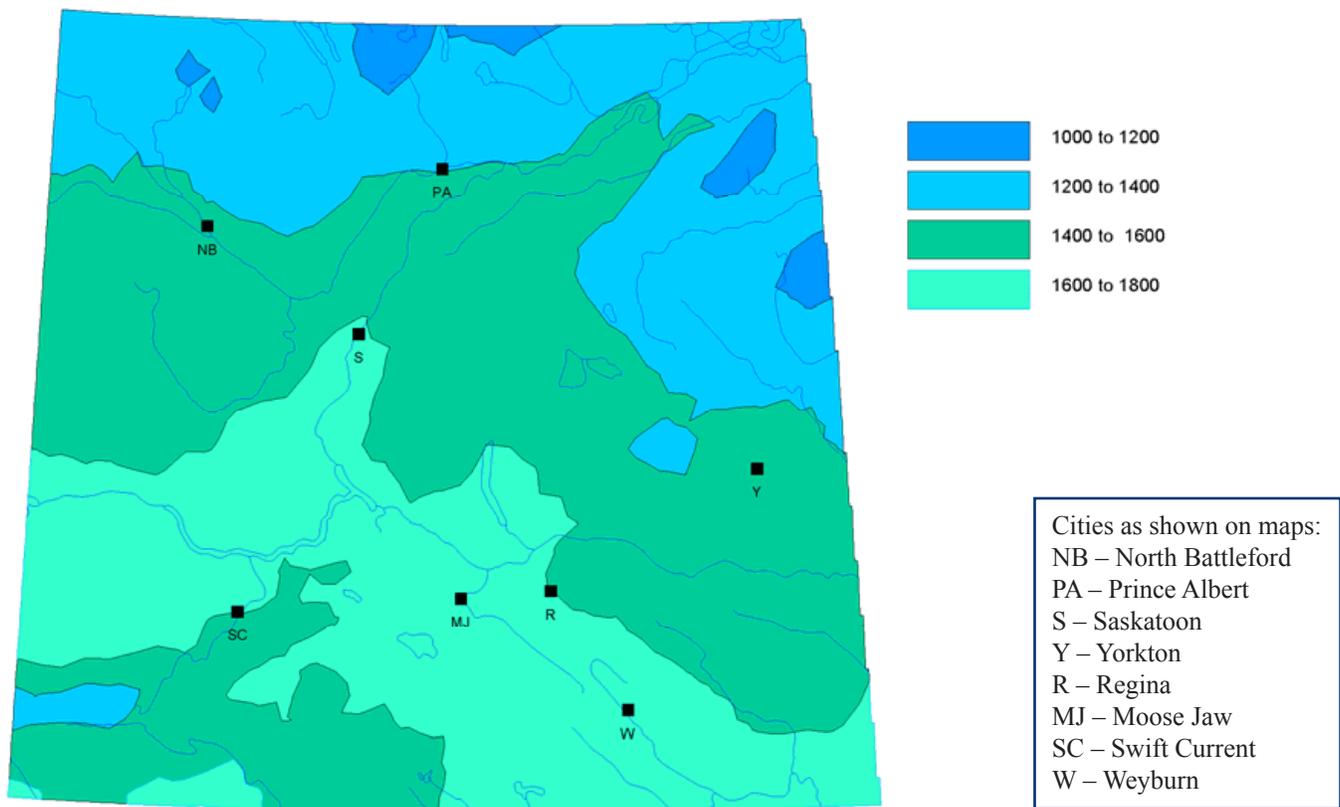


Figure 3: Growing degree-days in southern Saskatchewan based on 1961-90 normals

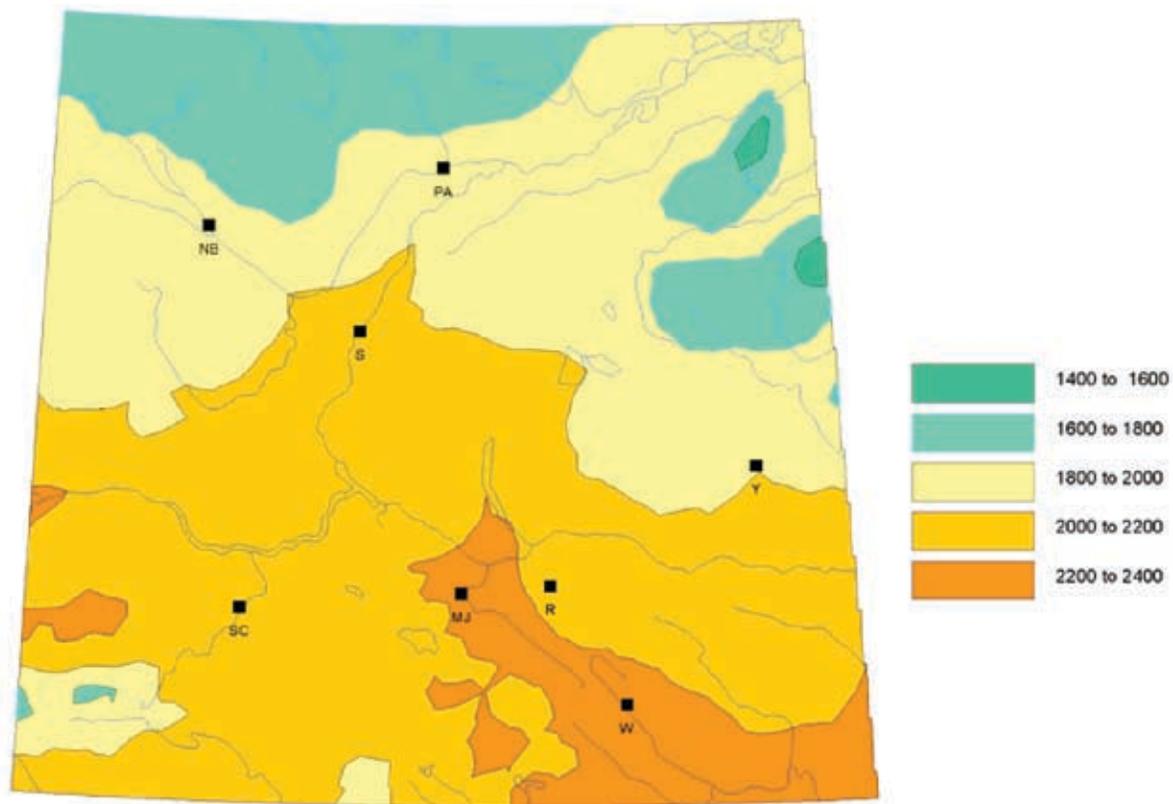


Figure 4: Growing degree-days in southern Saskatchewan in the 2050s based on the CSIROmk2b B11 scenario

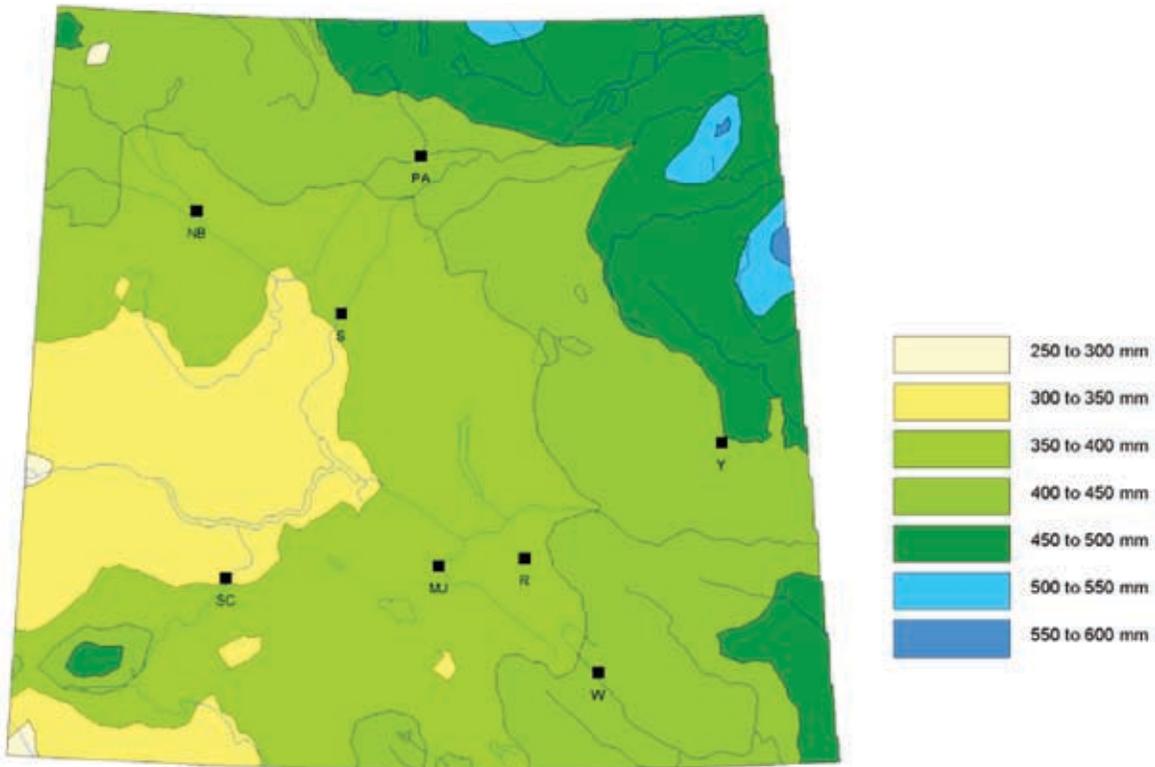


Figure 5: Annual precipitation in southern Saskatchewan based on 1961-90 normals

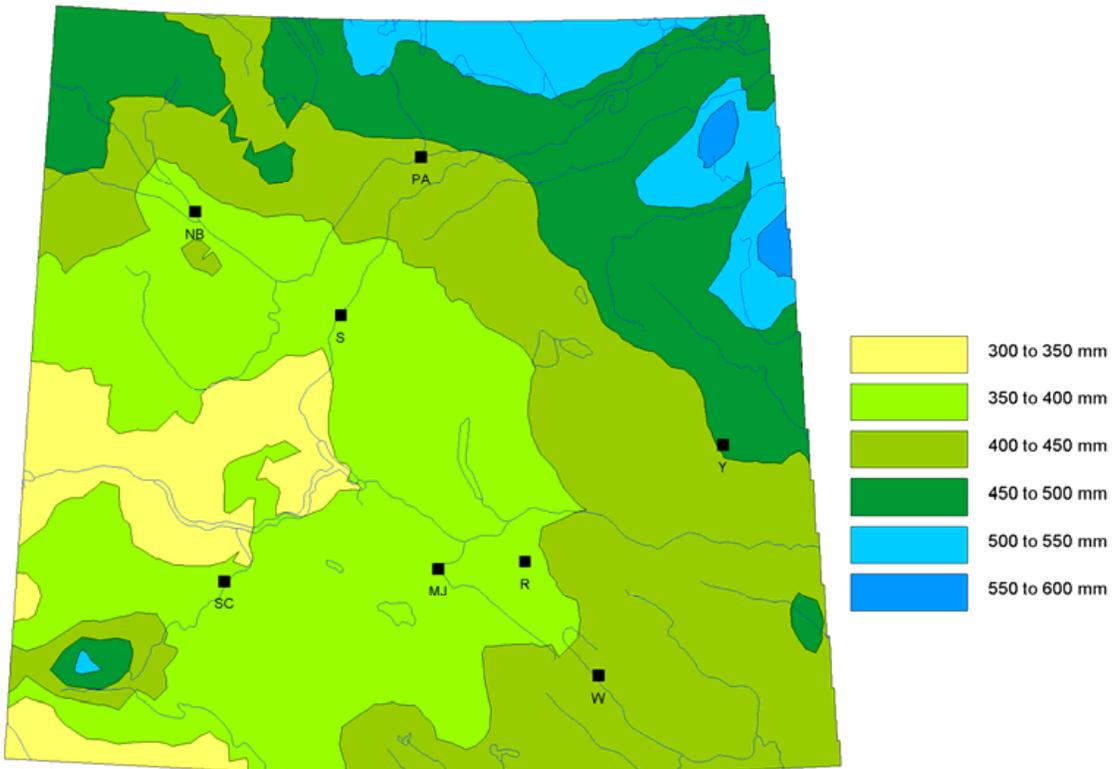


Figure 6: Annual precipitation in southern Saskatchewan in the 2050s based on the CSIROmk2b B11 scenario

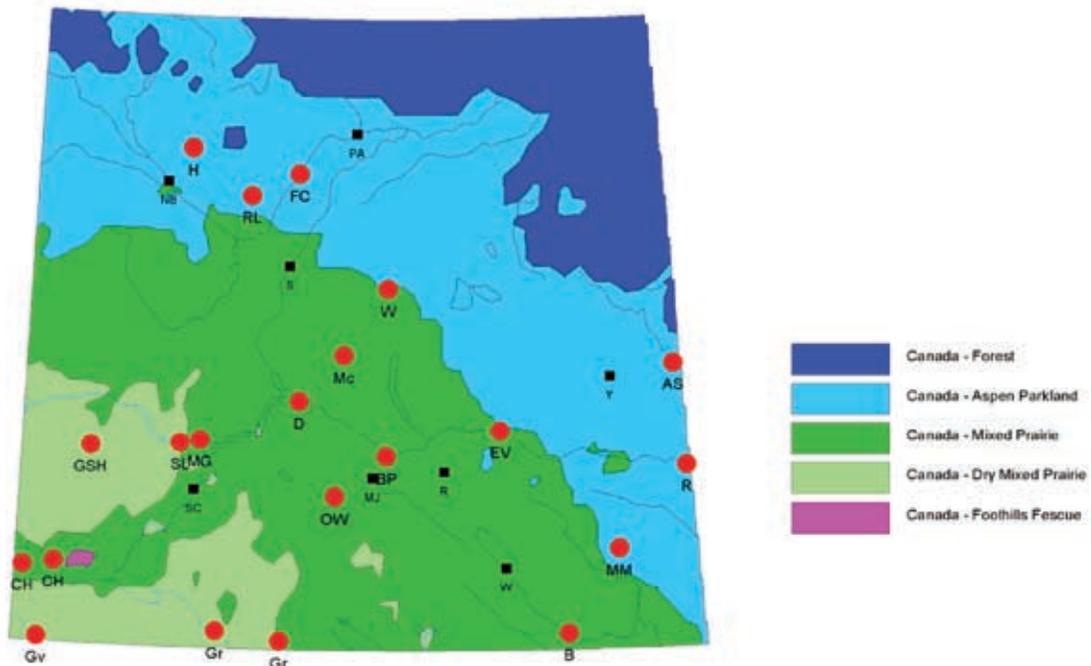


Figure 7: Predicted vegetation zones in southern Saskatchewan under the current climate (1961-90 normals)

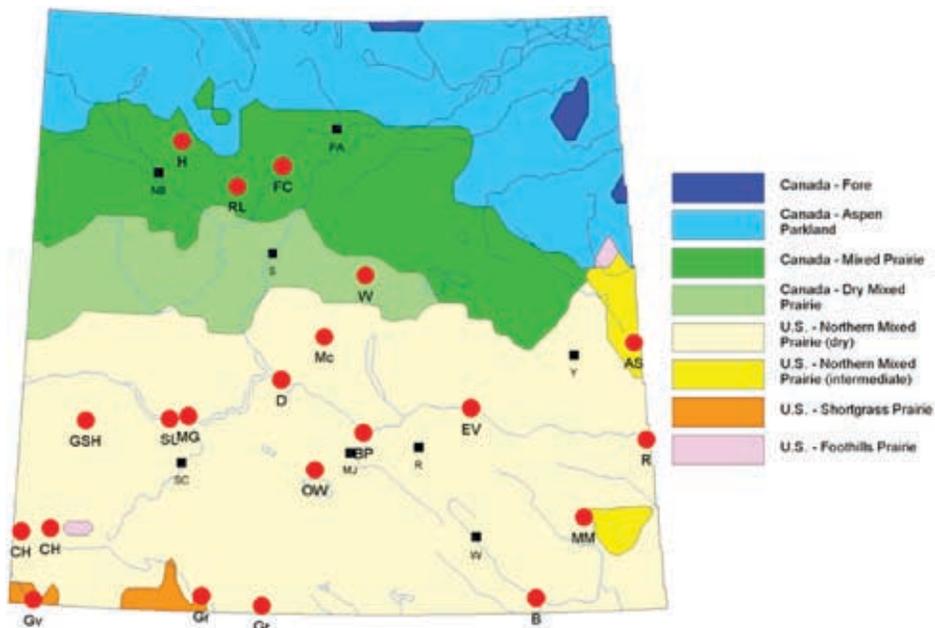


Figure 8: Predicted vegetation zones in southern Saskatchewan in the 2050s under CSIROmk2b B11 scenario

AS	Assiniboine Slopes Ecological Reserve	Gv	Govenlock Community Pasture
B	Buffalograss Ecological Reserve	H	Hatherleigh Community Pasture
BP	Buffalo Pound Provincial Park	Mc	McCraney Community Pasture
CH	Cypress Hills Provincial Park (West Block and Centre Block)	MG	Matador Grasslands Provincial Protected Area
D	Douglas Provincial Park	MM	Moose Mountain Provincial Park
EV	Echo Valley Provincial Park	OW	Old Wives Community Pasture
FC	Fort Carlton Provincial Park	R	PCS Rocanville (private stewardship area)
FW	Fort Walsh National Historic Site	SL	Saskatchewan Landing Provincial Park
Gr	Grasslands National Park (West Block and East Block)	W	Wolverine Community Pasture
GSH	Great Sand Hills Ecological Reserve (proposed)		

Table 4: Case study areas, with abbreviations used on vegetation zonation maps

activities and climate change awareness was conducted of site managers for all protected areas within Saskatchewan's Prairie Ecozone and a climate change workshop for the same managers was also conducted as part of the research.

We found that the Representative Areas Network (RAN) program has a strong foundation for active management to meet ecologic integrity objectives, particularly where agreements through Memoranda of Understanding (MOUs) have been established with various partners. The RAN program has yet to adopt a leadership role to guide ecosystem monitoring or resource management planning and implementation across the system. The provincial government has made a commitment to establish RAN management policies and standards, and the network has the potential to serve as an excellent framework for demonstrating leadership and communications on management issues, including climate change.

Individual operating agencies within the RAN exhibit a range of capacity to address ecological integrity, including climate change. Parks Canada has one of the most robust management regimes. Most other agencies at the program level do not mandate management plans or ecological monitoring, nor do they clearly articulate goals or objectives referencing ecosystem management, biodiversity conservation, or climate change. However, where site management plans exist, ecosystem management, biodiversity conservation and climate change may be referenced, particularly among the more recent plans. Although the value of ecological monitoring is recognized and it occurs among some agencies, there is little policy directing that it occur. Again Parks Canada stands out as being the most active agency in addressing climate change, exhibiting a desirable range and alignment of policies (legislation, plans, management policies) for climate change adaptation.

The policy review revealed a number of barriers to climate change adaptation when it comes to policy instruments as they apply to protected areas. These include:

- No specific resource management goals/objectives – although ecosystem management and biodiversity conservation are generally acknowledged among the various management agencies responsible for protected area.
- No prescriptive policy requiring resource management planning, addressing climate change, or monitoring.



Figure 9: Great Sand Hills Ecological Reserve

- No full alignment of natural resources management policies from legislation to site management level.

POLICY REVIEW TEMPLATE

The policy review template uses key evaluation questions to identify policy barriers or opportunities for climate change adaptation in protected areas. Critical to the review is an assessment of the management regime to ensure biodiversity conservation. The template poses the following questions:

- What policy instruments are available for each type of protected area within a jurisdiction or protected area system?
- Is there strong alignment among the policy instruments, and are they prescriptive or enabling?
- Is there a system plan to guide new designations of protected areas? Is the foundation of the system plan challenged by climate change (e.g. vegetation based)? Are the system or individual site management objectives or standards barriers or opportunities to climate change?
- What IUCN classification is assigned to the protected area and what are the management implications for climate change adaptation?
- Is there a protection/conservation, recreation, or research/education mandate for each type of protected area within the system, and is the protection mandate species- or ecosystem-specific?
- Do site management plans exist, and do they reference natural resource management, ecosystem management or climate change adaptation?



Figure 10: Waterfowl in a Saskatchewan wetland

- Are there revenue sources to offset natural resource management costs such as climate change adaptation?
- Are dispositions (i.e. permits and leases) allowed, and do these dispositions pose a risk to climate change adaptation?
- What is the current management regime, and what opportunities or barriers to climate change adaptation does it pose?

POLICY RECOMMENDATIONS

The following recommendations are based on the climate change impact assessment, the policy review, and feedback received from the managers survey and workshop.

Policy Recommendations for Adaptation to Climate Change within Saskatchewan’s Representative Areas Network (RAN)

- Continue expansion of the RAN to ensure representation of all 11 ecoregions in Saskatchewan, focusing on high diversity sites, and build in connectivity.
- Establish a legislative and regulatory framework and funding to support ecosystem management and research on biodiversity conservation and climate change within the RAN.
- Establish performance management guidelines for all protected areas within the RAN in light of climate change. Incorporate these within a standard memorandum of understanding (MOU) and establish agreements with all RAN management agencies.

- Establish a common framework of alternative adaptation strategies – from unmanaged change to proactive management that could be applied to individual protected areas depending on their management objectives.
- Develop common messages around climate change impacts and adaptations among protected area agencies with an education mandate.
- Undertake a risk assessment of climate change on protected areas to identify priority management areas.
- Identify sites to be used as ecological benchmarks and establish a monitoring program sensitive to climate change.
- Identify sites where there is a good baseline of biophysical data that could be used to demonstrate climate change impacts and encourage related research.

Recommendations for Protected Area Agencies for Adaptation to Climate Change

- Actively manage sites to minimize threats to biodiversity (overuse, pesticides and pollution, habitat loss and fragmentation) and incorporate climate change consideration in management planning.
- Establish management zones for larger protected areas to accommodate a diversity of management approaches to maintain maximum ecosystem diversity and increase resiliency to climate change. Implementation and response monitoring and assessment will also lead to improved management.

- Undertake a review of active management activities (endangered species protection, controlled burns, exotic species management, fire protection) in light of climate change and determine if changes are necessary.
- Develop grazing guidelines for applicable protected areas in light of climate change impacts.

General Recommendations for Adaptations to Climate Change

- Restoration of plant species: identify plant species for propagation and develop seed quality standards, choosing restoration species or varieties based on adaptation to future climate, rather than recreating historic plant communities.
- Exotic species introductions: allow exotic species introduction experiments within isolated areas where the spread can be controlled.
- Management legislation: for ecological reserves and provincial park lands, establish a well-aligned management planning policy framework within the full range of policy instruments beginning with enabling or prescribing management planning.

CONCLUSIONS

The Prairie Ecozone will change significantly under a warmer, drier climate. Protected areas will be particularly vulnerable to changes in water resources, plant and animal species. Management of these areas will have to be modified as the landscape evolves. If certain features are to be preserved, more intrusive forms of adaptation may have to be utilized, such as the introduction of exotic species. This will challenge current protected area objectives, namely to conserve existing habitat and biodiversity.

While the Representative Areas Network (RAN) provides a strong foundation for active management to address climate change, the adaptive capacity of individual operation agencies within the RAN is generally weak. The absence of resource management objectives, prescriptive policy requiring resource management planning, and an alignment of natural resources management policies remains a barrier to adaptation. Adaptation will require the incorporation of climate change into policy instruments, greater ecological monitoring, and more active management of protected areas at the site-level. Such measures hold relevance not only to the Saskatchewan Prairie Ecozone, but to protected areas throughout Canada.



Figure 11: Moose Mountain Provincial Park

PHOTO CREDITS

Figure 10, Ducks Unlimited (Langhorst); Figure 11, Saskatchewan Ministry of Environment; Figure 12, Saskatchewan Ministry of Agriculture; all others, including front, back and inside cover, Dave Sauchyn

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Figure 12: Cattle round up at a Saskatchewan community pasture



Figure 13: *Cypress Hills Provincial Park*

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