RANGELAND MONITORING IN WILLMORE WILDERNESS PARK

Progress Report for
Foothills Model Forest

Alberta
ENVIRONMENTAL PROTECTION

Prepared by

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INTRODUCTION

Willmore Wilderness Park is a 4597 square kilometer area in west-central Alberta located adjacent to the north side of Jasper National Park and east of the British Columbia border. Established in 1959, it spans a broad transition zone from boreal forest to Rocky Mountains. Being a wilderness park, and managed under such legislation, the main use of the park is for recreation. Motorized vehicle use is prohibited within the park, instead cross country skiers, hikers and back country horse users provide significant levels of traffic on the network of trails scattered throughout the park's valleys and mountain passes. The majority of use in the park each year is during the summer and fall months. The use on the rangelands comes in the form of recreational horse use, commercial guides and outfitters, offering backcountry trail riding, camping in the summer, and hunting in the fall.

The increasing levels of horse use in Willmore has created concern for the condition of native ranges found throughout the park. With most of the park being heavily forested, grazing opportunities are limited to the valley bottoms and moist, semi-open drainages. Trails throughout the park generally follow the more accessible valley bottoms. Traditional camping sites located along many trails are receiving heavier intensities of grazing pressure than they can presently sustain. As a result, change to the species composition and the productivities of the native ranges are occurring in some areas. The invasion of non-native species on heavily used areas and the retention of adequate supplies of winter forage for wildlife are also areas of concern.

Recently, there has also been concern with the rate the native grasslands have been encroached by shrubs. This is a serious problem because most of the productive grasslands become inaccessible and less productive for both horses and wildlife. It is believed that the lack of fire within the Park has allowed shrubs to expand onto the remaining grassland community types.

A detailed classification of the rangeland resource in Willmore was completed by Bork (1994). It included lists of plant community types, major plant species, forage production and response to grazing pressure. At this time it was also recognized that long-term monitoring of a number of these types was required to determine, range condition and trend, the effect of horse and wildlife grazing on biomass production, soils and watersheds and to determine the successional changes on these rangelands in the presence and absence of grazing and fire disturbance. In 1998 a number of sites were established to examine the effects of shrub encroachment onto grasslands, the effect of prescribed burning on shrub and tree cover and the effect of horse and wildlife grazing on grassland vegetation. The specific objectives of the study were to:

1. Monitor shrub encroachment onto a Arctic Rough fescue-Tufted hairgrass dominated community type near Eagles Nest Cabin.
2. Monitor shrub encroachment onto a Tufted hairgrass-Sedge dominated community type at Sunset creek.
3. Monitor the effect of a 1990 prescribed burn on a Bog birch-Willow/Bog sedge-Sedge dominated community type at Monaghan flats.
4. Monitor the effect of a prescribed burn on a Aspen dominated community at Kvass flats in the

presence and absence of horse grazing.
5. Monitor the successional changes of a moderately to heavily grazed Slender wheatgrass-Sedge dominated community in the presence and absence of horse grazing at the Sulphur River cabin.
6. Monitor the effect of big horn sheep and wildlife grazing on a White Mountain avens-Sedge dominated community at Hayden ridge.
7. Assess overall range condition and determine appropriate carrying capacities (Horse Use Days) for specific range community types throughout the park.

PHYSICAL CONDITIONS OF WILLMORE WILDERNESS PARK

Willmore covers both foothill and mountain landforms and receives both boreal and cordilleran climate influences with significant variations in temperature, elevation, slope and precipitation (Strong 1992). The result is a wide array of plant communities in transition across the span of the park. The higher elevations of the park are represented by the Alpine and Subalpine subregions, with only limited corridors along the lower elevational river valleys indicative of the Upper Foothills subregion (Strong and Thompson 1995).

Alpine subregion

The alpine environment generally occurs above timberline. Ogilvie (1969), found timberline to be controlled by low temperature, wind dessication, avalanching and snow depth. The alpine plants and communities show adaptations to these extreme environmental conditions. The alpine plant communities tend to be low growing where they are protected from the wind and benefit from the warmer temperatures close to the ground (Ogilvie 1969). On south facing, wind swept ridges the bog sedge and white dryad communities are found. At slightly lower elevations where snow accumulates the low growing willow communities predominate (arctic willow, snow willow, rock willow). On the north facing slopes where snow accumulates the blackening sedge and heather community types are found. In the valley bottoms below timberline the willow, bog birch, and grassy meadow community types are typical. The sequence of plant communities in the Alpine and upper Subalpine is outlined in Willoughby and Smith (1998).

Subalpine subregion

The subalpine subregion is a Rocky Mountain altitudinal vegetation zone with its upper boundary formed by the Alpine subregion, whereas the lower boundary abuts the Montane, Foothills parkland and the Upper Foothills subregions. In Alberta, the subalpine extends from 1525 m to 2175 m at its southernmost occurrence and from 1360 m to 2000 m in the vicinity of Grande Cache (Strong 1992). The subalpine has a cordilleran climate characterized by snowy, cold winters and showery cool summers. Annual precipitation ranges from 329 mm to 916 mm, with maximum precipitation falling during July. The subalpine recieves more precipiatiton during the winter months than any subregion (Strong 1992). The mean summer temperatures averages 9.4 ^{o}C and winter temperatures typically average -8.9 ^{o}C with December and January

being the coldest months. The cold winter temperatures help to maintain the snowpack which makes this an important watershed area.

The majority of the vegetation is dominated by seral lodgepole pine forests at lower elevations with Engelmann spruce and subalpine fir forests being more common at higher elevations. At timberline dwarf spruce, subalpine and whitebark pine are typical of the transition to the Alpine subregion. Imperfectly drained bottomlands are dominated by willow, bog birch, sedge, tufted hairgrass and california oatgrass species and the steep south facing slopes are often dominated by fescue, hairy wildrye, wheatgrass and junegrass species (Willoughby and Smith 1998).

Upper Foothills subregion

This subregion is found elevationally below the subalpine and above the Lower Foothills subregions. It ranges in elevation from 1200-1500m at lower latitudes and from 1000-1250 m at higher latitudes. It is dominated by closed canopy lodgepole pine forests with the potential climax species on reference sites being white spruce and black spruce. This subregion can be distinguished from the Subalpine subregion by the lack of engelmann spruce and from the Lower Foothills by the lack of aspen.

This subregion has a boreal climate which is modified by the Rocky Mountains. The average annual precipitation is 538 mm with over half the precipitation recieved in the summer months (340 mm). The temperature averages 11.5 ^{0}C in the summer and -6.0 ^{0}C in the winter. These temperatures are milder and not nearly as extreme as the other subregions within the Boreal forest and Foothills natural regions.

The native grass and shrubland community types are found in the valley bottoms adjacent to streams and rivers throughout the Upper Foothills subregion. Deep snow accumulations and/or cold air drainage prevent trees from growing in these valley bottoms (Daubenmire 1978). These grass and shrublands, historically burned frequently further preventing tree encroachment. The sequence of grass and shrubland community types in the Upper Foothills is outlined in Willoughby and Smith (1997).

METHODS

The transects established in Willmore will become part of the Alberta Environmental Protection's permanent rangeland reference area program. The Rangeland Reference Area program administered by the Land and Forest Service was established by the Eastern Rockies Forest Conservation Board to assess range condition and monitor trend on rangelands within the boundaries of the Rocky Mountain Forest Reserve (RMFR). To date fifty-nine reference areas have been established throughout the foothills of Alberta extending from south of Blairmore to Willmore Park. These areas include permanently marked grazed and ungrazed transects. Species composition data has been recorded on these transects since 1953 when many of the sites were established. Recently, the data of many of these sites has been analyzed in order to determine the successional pathways in the presence and absence of grazing. This long-term data used in conjunction with a detailed ecological classification of the range community types will help to determine the health of the forested rangelands in the province.

Reference sites were established on areas that represented primary range. Originally sites

thought to be in poor range condition were selected. These sites were usually represented by open grasslands on south-facing slopes, benchlands and terraces. The reference sites were not located near salt or within 100-ft. (30-m) of a fence. The preferred distance from a water source was greater than 1000-ft. (300-m) but less than 1-mi. (1.6-km).

The majority of the reference sites consist of a fenced exclosure and a 100-ft (33-m) transect inside and outside the exclosure. The outside transect was situated 25-ft (8-m) or greater from the edge of the exclosure. A number of reference areas consist only of permanently marked transects. At 3-in. (7-cm) intervals, the basal frequency of the plant species were recorded using Parker's loop (Parker 1954). In 1982, the canopy cover of the plant species was also recorded (at 6-ft. (1.8-m) intervals) using a 20x50 cm Daubenmire frame. Presently, the transects are being recorded every three years. All the basal frequency data prior to 1980 was converted to canopy cover using regression analysis. In Willmore all transects are 30 m long and each transect will be read every 2 m. Forbs, grass, moss and lichen canopy cover will be recorded in a 20x50 cm quadrat and canopy cover of shrubs will be recorded in a 1 m^2 quadrat. At each transect one to five 50x100 cm quadrats were clipped , separated into trees, shrubs, forbs and graminoids, oven dried and weighed. The recommended stocking rate is based on 50% of the total production and the fact one horse unit requires 682 kg of dry weight material for one month of grazing.

A combination of of both ordination (DECORANA) (Gauch 1982) and cluster analysis (SAS) will be used to group the inside and outside transects of different years. These techniques combine the sites based on the similarity of species composition. The groupings from cluster analysis are overlain on the site ordination.

RESULTS

Willoughby (1997,1998) has found that it takes 20-30 years of continuous monitoring before species composition changes can be detected from reduced grazing pressure or as a result of shrub encroachment. It is likely that it will take longer to detect species composition changes in the grass and shrublands of Willmore because of the harsh growing conditions found in the mountainous terrain. The results outlined here will discuss the general ecology, objectives and expected results for each site established in Willmore in 1998.

Eagles Nest Cabin transect

This transect was established in a Arctic Rough fescue-Tufted Hairgrass dominated community just south of Eagles Nest cabin (Appendix A) to examine the effect of shrub encroachment onto the native grasslands. This community type is transitional between the Subalpine and Upper Foothills subregions. It represents the transition zone from the dry Junegrass/Sage dominated slopes to the moist tufted hairgrass, sedge dominated community types (Willoughby and Smith 1997). These grasslands are fairly moist and have well developed soils which makes them very productive. Morgantini and Russell (1983), found that rough fescue dominated community types were the primary foraging areas for elk in the Ya Ha Tinda area. The presence of rough fescue likely makes this community type important for wildlife in Willmore.

Succession in the absence of disturbance is to a Bog birch/Rough fescue dominated community(Willoughby and Smith 1997). The Bog birch community type generally has a half to

a third less forage than the rough fescue dominated community types.

Sunset Creek transect

This transect was established in a Tufted hairgrass-Sedge dominated community type at the confluence of the Sunset creek and the North Berland river (Appendix A) in order to examine the effect of shrub encroachment onto the native grasslands. This community type is typical of moist meadows in both the Subalpine and Upper Foothills subregions (Willoughby and Smith 1997). This community type is drier than the pure sedge meadows, but moister than the rough fescue dominated community types.

Willoughby (1998) found that when this community is protected from grazing or fire for 25-30 years, willow and bog birch expand and tufted hairgrass and sedge decline in the Upper Foothills subregion. The decline in graminoid cover also results in a decline in available forage production (2200 to 1800 kg/ha).

Monaghan burn transect

This transect was established at Monaghan flats (Appendix A) in order to examine the effect of the 1990 prescribed burn on the Bog birch-Willow/Bog sedge dominated community. The purpose of the original burn was to reduce willow and bog birch cover in an effort to increase forage supply (MacCallum and Yakimchuk 1992). Initial results indicate that there has been a decline in willow cover and an increase in bog birch cover to near pre-burn levels in 1998 (Table 1).

Table 1: Percent cover and composition for willow and bog birch on Monaghan flats for preburn 1990, post burn 1990,1991 and 1998.

	%cover				%composition			
Year	90	90	91	98	90	90	91	98
Willow	34	20	27	10	75	93	90	45
Bog birch	11	1	3	12	26	7	10	55

MacCallum and Yakimchuk (1992) found burning of the Monoghan flats meadow initially reduced the height and canopy cover of birch and willow and shifted the composition to favour willow, but they felt that both bog birch and willow would increase to pre-burn levels within 7-10 years. Eight years after the burn bog birch had recovered to pre-burn levels and willow had declined. The decline in willow is likely the result of not having the transect located in exactly the same place as the previous transects. The increase in bog birch cover after fire is similar to the results Bork et al. (1996) found at Seven Mile flats in the Upper Foothills subregion. They found that bog birch continued to increase in cover despite being burned 3 times in 10 years. They felt that periodic burning (3-5 year interval) would be needed to control bog birch regrowth.

The presence of bog sedge in this community indicates that this community type is located within the Subalpine subregion. Willoughby and Smith (1998) found that bog sedge cover increased when one moved from the Upper Foothills to the Subalpine subregion. It is important that this site continued to monitored because there is no other prescribed burn sites within the Subalpine subregion that are currently being monitored.

Kvass burn exclosure

This exclosure was established in a burned aspen stand adjacent to Kvass flats (Appendix A) in order to examine the effects of fire and horse grazing on aspen regeneration and forage production. Currently, the dominant vegetation of the burned site is rose and hairy wildrye and there is little evidence of aspen regeneration. It also appears there has been a dramatic increase in forage supply from an unburned aspen forest 500 kg/ha (Bork 1994) to over 1600 kg/ha in the burned area (Table 3). However, further work will have to be done in the adjacent unburned aspen forest in order to make direct comparisons between pre and post burning at this site.

Sulphur exclosure

This exclosure was established in a Slender wheatgrass-Sedge dominated community type, near the Sulphur River cabin (Appendix A). The site has been extensively utilized by horses. Bork (1994) felt that this community type represented heavily grazed tufted hairgrass or rough fescue dominated community types. It was felt that heavy grazing pressure caused fescue or hairgrass to decline in the stand and allowed sedge and slender wheatgrass to increase. By establishing an exclosure at this site the successional pathways of this community type in the presence and absence of grazing can be determined. An understanding of the successional pathways will allow range condition of this site and similar community types within Willmore to be determined.

Hayden ridge exclosure

This wildlife exclosure was established by a Msc student in a White mountain avens dominated community in the mid 1970's (Appendix A) These white mountain aven communities are extensively utilized by bighorn sheep during the winter months because they remain snow free. Transect readings from both inside and outside the exclosure indicate only slight differences between the grazed and ungrazed transects (Table 2). The outside transect has a larger number of species which one would expect in a grazed situation (Willoughby 1995). The inside transect has a lower number of species and evidence of low growing woody species (willow, bilberry) which are not found on the outside transect. The increase in woody species inside the exclosure maybe the result of increased moisture and not the result of being ungrazed by wildlife. Exclosures in Southern Alberta tend to be moister in the absence of grazing because the increased litter inside the exclosure tends to catch more snow. Efforts are currently being made to locate the original data from this study.

Table 2. Species canopy cover inside and outside the Hayden ridge exclosure in Willmore Wilderness Park in 1998.

Species	In	Out
Grasses		
Bog sedge	6	1
Hairy wildrye	6	9
Arctic rough fescue	T	T
Forbs		
White mountain avens	39	42
Alpine hedysarum	2	T
Alpine bistort	4	3
White camas	1	1
Shrubs		
Dwarf bilberry	T	-
Rock willow	T	-
Lichens		
Reindeer lichen	40	10
Dog lichen	-	2
Species richness	**19**	**25**

DISCUSSION AND MANAGEMENT IMPLICATIONS

Monitoring these reference sites in Willmore will establish a benchmark to determine the ecological climax and successional changes of these range communities. It will provide an assessment of range condition of similar range types altered by domestic or wildlife grazing, flooding, or lack of natural wild fire. Understanding succession and the ecological diversity of these range types will assist in developing management schemes throughout the park.

In addition to monitoring species diversity, biomass production was also collected to determine the amount of forage available for domestic and wildlife grazing. Based on current biomass production (kg/ha) carrying capacities of each site were assessed based on 50% allocation of total production and 1.5 Animal Units for a horse. This establishes a stocking rate (Horse Days per hectare) to enable land managers to allocate appropriate amount of horse use levels that sustain the natural range types within a given area (Table 3).

However, it must be understood that to ensure the continued productivity and survival of some native range types, particularly those that have been overgrazed, much lower stocking rates are needed for range recovery to occur. Domestic grazing can also be used, in conjunction with prescribed fire, to restrict shrub and tree encroachment thereby protecting these natural range types.

Monitoring species composition and biomass production establishes an ecological evaluation of how these range types are changing overtime based on current management

practices. It provides information on the condition of the park and provides guidelines on how to manage these range types to maximize species richness, diversity, productivity, wildlife habitat, and aesthetics.

Table 3. Biomass production and stocking rates for sites monitored in Willmore Wilderness Park, 1998.

Site Description	Range Community Types	Biomass Production (kg/ha)	Stocking Rate (H.D./ha)
Kvass Flats	Aspen-Rose/Hairy Wild Rye	1645	37
Sulphur-Kvass	Slender Wheatgrass – Sedge	693	15
Monoghan Flats	Bog birch-Willow/Bog Sedge	2022	45
Hayden Ridge	White Mountain Avens	289	Non-use
Sunset Creek	Tufted Hairgrass-Sedge	2264	50
Eaglesnest	Arctic Rough Fescue-Tufted Hairgrass	1374	30

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APPENDIX A:

SITE DESCRIPTIONS AND PHOTOS

Eagle's nest cabin transect

Region – Northeast Slopes; District – Foothills; Date established – 1998; Location – Twp. 52, Rge. 4 Sec. 22 NW W6 (N 53.30.477, W118.29.946); Elevation –1614 m; Nutrients – permesotrophic; Drainage – well; Moisture – subhygric; Soil Classification – Orthic Humic Regosol; Description of Area – rough fescue, hairy wildrye, tufted hairgrass meadow surrounded by willow and bog birch shrublands; Major species present, rough fescue (Festuca scabrella), tufted hairgrass (Deschampsia cespitosa), slender wheatgrass (Agropyron trachycaulum), hairy wildrye (Elymus innovatus) sedge spp (Carex spp.) Veiny meadow rue (Thalictrum venulosum), yellow beardtongue (Penstemon confertus); Seral stage – young edaphic climax; Transect locations – 30 m long, read every 2 m starting at 2 m, read on right hand side of the tape, read from west to east; This transect was one of a number of transects established to monitor shrub encroachment onto the remaining grassland meadows within Willmore Wilderness Park.

Sunset transect

Region – Northeast Slopes; District – Foothills; Date established – 1998; Location – Twp. 54, Rge. 5 Sec. 30 SE W6 (N 53.41.982, W 118.43.600); Elevation –1630 m; Nutrients – permesotrophic; Drainage – well; Moisture – subhygric-hygric; Soil Classification – Orthic Humic Regosol?; Description of Area – tufted hairgrass meadow surrounded by willow and bog birch shrublands; Major species present tall lungwort (Mertensia paniculata), monkshood (Aconitum delphinifolium), tufted hairgrass (Deschampsia cespitosa), slender wheatgrass (Agropyron trachycaulum), sedge spp (Carex spp.) Veiny meadow rue (Thalictrum venulosum); Seral stage – young edaphic climax; Transect locations – 30 m long, read every 2 m starting at 2 m, read on right hand side of tape from north to south; This transect was one of a number of transects established to monitor shrub encroachment onto the remaining grassland meadows within Willmore Wilderness Park.

Monoghan burn transect

Region – Northeast Slopes; District – Foothills; Date established – 1998; Location – Twp. 53, Rge. 7 Sec. 23 SE W6 (N 53.35.227, W118.55.172); Elevation –1530 m; Nutrients – permesotrophic; Drainage – well; Moisture – subhygric; Soil Classification – Humic Regosol; Parent material-alluvial deposits on top of outwash gravels; Description of Area – Bog birch , willow shrubland which was burned in the spring of 1990; Major species present, Bog birch (Betula glandulosa), willow (Salix spp.), bog sedge (Kobresia myosuroides), slender wheatgrass (Agropyron trachycaulum), sedge spp (Carex spp.) california oatgrass (Danthonia californica), strawberry (Fragaria virginiana); Seral stage – young edaphic climax; Transect locations – 30 m long, read every 2 m starting at 2 m, read on right hand side of tape from east to west; This transect was established to monitor the effects of the 1990 burn on bog birch and willow cover at Monoghan flats within Willmore Wilderness Park.

Kvass burn exclosure

Region – Northeast Slopes; District – Foothills; Date established – 1998; Location – Twp. 56, Rge. 9 Sec. 3 NE W6 (N 53.49.02, W119.14.850); Elevation –1060 m; Aspect – 180°; Slope – 20%; Nutrients – mesotrophic; Drainage – well; Moisture – mesic; Soil Classification – Orthic Regosol; Parent material – coarse textured colluvial deposits, on slopes above the Smoky River; Description of Area – aspen stands which were burned in 1996; Major species present, slender wheatgrass (Agropyron trachycaulum), sedge spp (Carex spp.) hairy wildrye (Elymus innovatus) snowberry (Symphoricarpos occidentalis), rose (Rosa acicularis), strawberry (Fragaria virginiana), Lindley's aster (Aster ciliolatus), showy aster (Aster conspicuus); Seral stage – early seral; Exclosure construction – 20 x 30 m with wood and steel posts and two strands of barbed wire; Transect locations – 30 m long, read every 2 m starting at 2 m, read on right hand side of tape from north to south, the outside transect is located 3 m to the east of the exclosure and is read from north to south; This exclosure was established to monitor the effects of the prescribed burn at Kvass flats in Willmore Wilderness Park

Sulphur exclosure

Region – Northeast Slopes; District – Foothills; Date established – 1998; Location – Twp. 54, Rge. 8 Sec. 13 NE W6 (N 53.40.080, W119.02.196); Elevation –1634 m; Nutrients – mesotrophic; Drainage – well; Moisture – mesic - subhygric; Soil Classification – Orthic Regosol; Parent material – coarse textured fluvial deposits, adjacent to the Sulphur River; Description of Area – grazed sedge, slender wheatgrass meadow surrounded by willow and bog birch shrublands; Major species present, slender wheatgrass (Agropyron trachycaulum), sedge spp (Carex spp.) , sheep fescue (Festuca saximontana), alpine milkvetch (Astragalus alpinus), mouse eared chickweed (Cerastium arvense), strawberry (Fragaria virginiana); Seral stage – young edaphic climax; Exclosure construction – 20 x 30 m with wood and steel posts and two strands of barbed wire; Transect locations – 30 m long, read every 2 m starting at 2 m, read on right hand side of tape from north to south, outside transect located 3 m on north side of the exclosure and read from south to north; This exclosure was established to monitor shrub encroachment and recovery of heavily grazed grassland meadows within Willmore Wilderness Park.

Hayden ridge exclosure

Region – Northeast Slopes; District – Foothills; Date established – 1976?; Location – Twp. 55, Rge. 7 Sec. 21 NE W6 (N53.46.170 W118.58.608); Elevation – 1878 m; Aspect – 180°; Slope – 30%; Nutrients – submesotrophic; Drainage – rapidly; Moisture – subxeric; Soil Classification – Orthic Regosol; Parent material – coarse textured sandstone shale deposits, on ridge tops overlooking the Sulphur River; Description of Area – dry windswept snow free ridges; Major species present, white mountain avens (Dryas integrifolia, D. octopetala), bog sedge (Kobresia myosuroides), hairy wildrye (Elymus innovatus) alpine bistort (Polygonum viviparum), reindeer lichen (Cladina spp); Seral stage – mature edaphic climax; Exclosure construction – 20 x 30 m with wood and steel posts and 8 ft page wire; Transect locations – 30 m long, read every 2 m starting at 2 m, read on right hand side of tape from northeast to southwest, the outside transect is located 3 m to the east of the exclosure and is read from south to north; This exclosure was established in the mid 1970's to monitor the effects of the bighorn sheep grazing in Willmore Wilderness Park

Monitoring sites within Willmore Wilderness Park