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Saskatchewan Rangeland Ecosystems Publication 1

Ecoregions and Ecosites

A project of the Saskatchewan Prairie Conservation Action Plan



**Jeff Thorpe
Saskatchewan Research Council
2007**

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Table 12 Production data for communities on the Loam Ecosite. Values are averages of at least five plots within a given community type.

community	alteration from reference community	annual production (kg/ha)				
		estimated graminoids	clipped graminoids	clipped forbs	clipped browse	clipped total
Mixed Grassland						
MG-LM-A	reference	1209				
MG-LM-B	minor	897	1275	182	11	1440
MG-LM-D	minor	725	914	184	29	1107
MG-LM-E	moderate	488				
MG-LM-F	moderate	582				
Aspen Parkland						
AP-LM-A	reference		1419	199	0	1619
AP-LM-B	moderate	931				

Table 13 Example of determination of recommended stocking rates, for a location where the regional trend shows a rate of 1.00.

	ratio to reference	Ecosite			
		Loam	Sand	Solonetzic	other ecosites
		ratio to Loam			
		1.00	0.94	0.66	...
reference community	1.00	1.00	0.94	0.66	...
minor alteration	1.00	1.00	0.94	0.66	...
moderate alteration	0.80	0.80	0.75	0.53	...
significant alteration	0.60	0.60	0.56	0.40	...

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CENTERFOLD – Range Ecosites of Southern Saskatchewan

Table 11 Average ratio of the recommended stocking rate on a given ecosite to that on the Loam Ecosite.

Ecosite	Ratio
Badlands	0.29
Saline Upland	0.52
Gravelly	0.60
Solonetzic	0.66
Dunes	0.73
Thin	0.73
Sand	0.94
Clay	0.96
Sandy Loam	0.97
Loam	1.00
Saline Dry Meadow	1.11
Saline Overflow	1.37
Overflow	1.54
Dry Meadow	2.34
Wet Meadow	2.59
Shallow Marsh	2.69

The stocking rates used in the regional analysis are based on AAFC-PFRA pasture fields in good to excellent range condition. Therefore, they should be applicable to the reference plant communities as well as to those showing minor alteration from the reference community. To examine trends in more altered communities, the available production data for communities on the Loam Ecosite were analyzed. These included production data based on clipping of quadrats to measure peak standing crop, as well as data in which graminoid production was estimated from basal area of individual graminoid species using the method of Lodge and Campbell (1965). Because most plots in the database did not have production data, there was little information for some communities. Only averages based on at least five plots within a community type were used (Table 12).

While the data in Table 12 are incomplete, they do show a trend of declining productivity from the reference community to those with increasing alteration from the reference. Based on this trend, communities showing moderate alteration were set at 80% of the regional stocking rates, and communities showing significant alteration at 60% of the regional stocking rates. This is similar to the approach followed by Wroe et al. (1988) and Abouguendia et al. (1990) in assigning rates to lower range condition classes. For communities dominated by exotic invaders, no information was available for estimating stocking rates.

To summarize, the recommended stocking rates for reference communities on the Loam Ecosite were based on the regional value determined from analysis of PFRA stocking records (Tables 9 and 10). Recommended stocking rates for reference communities on ecosites other than Loam were determined by multiplying the regional value by the ecosite ratio shown in Table 11. Recommended stocking rates for altered communities were determined by multiplying the rate for the reference community by 0.8 (moderate alteration) or 0.6 (significant alteration). The overall calculation is shown in Table 13.

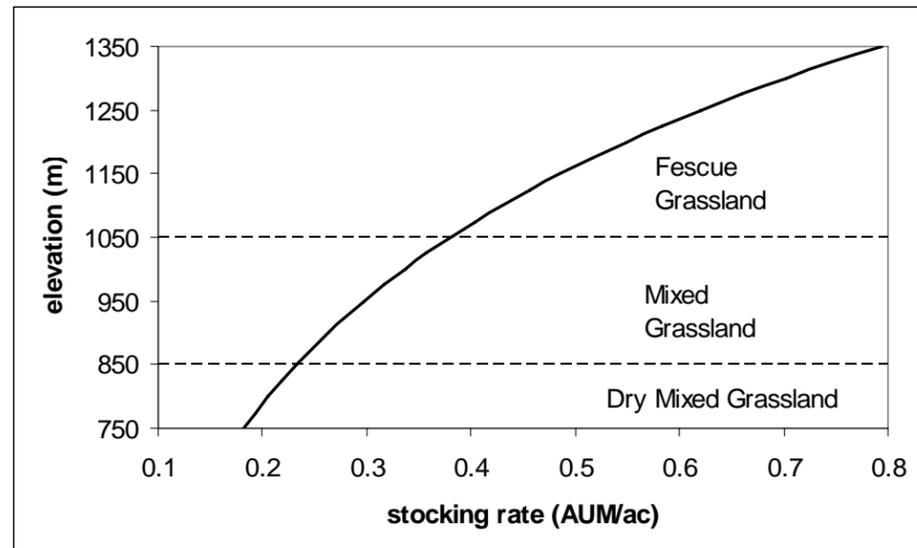


Figure 6 Recommended stocking rates for the Loam Ecosite in the Cypress Upland Ecoregion, as a continuous response to elevation.

The values shown in Figure 6 and Table 10 are intended for the Loam Ecosite in the Cypress Upland. However, they could also be applied to other areas within the Mixed Grassland where there are strong elevational gradients, such as the Wood Mountain Upland. These areas do not reach elevations high enough to support extensive fescue grassland as found in the Cypress Hills, but the Mixed Grassland becomes moister and more productive with increasing elevation.

The analysis of recommended stocking rates shown above was for the Loam Ecosite. In Saskatchewan, this ecosite accounts for more rangeland than any other, and can be considered to be the modal site, neither excessively wet nor excessively dry. Therefore, the analysis should be a good representation of the regional trends in productivity. Ideally, a similar analysis would be done for each ecosite, but unfortunately the data were insufficient for ecosites other than Loam. Therefore, the approach that was taken was to modify the regional trend determined for the Loam Ecosite, based on published data showing the relative productivities of different ecosites. Recommended stocking rates and/or production values were taken from existing publications (Wroe et al. 1988, Abouguendia 1990, Adams et al. 2003, 2004, 2005, NRCS ecological site descriptions for MLRAs 58a and 60b in Montana and 64 and 65 in Nebraska [<http://esis.sc.egov.usda.gov/>]). For each publication, the ratio of the production or stocking rate on a given ecosite to that on loam was calculated. These ratios were fairly consistent among publications, so they were averaged (Table 11).

1. INTRODUCTION

Ecosystem classification is one of the building-blocks of sustainable range management. Rangeland ecosystems vary with climatic patterns, with landform and soil features, and with the history of grazing and other events. The ecosystems that result from these factors have different plant species, different levels of production, and different management requirements. Therefore, it makes good ecological sense to classify and map the different types of rangeland ecosystems as a basis for planning. This information can be used for setting stocking rates, planning grazing systems, identifying habitat for various wildlife species, designing species-at-risk surveys, and planning vegetation management treatments.

In Saskatchewan, this process was first placed on a systematic basis in 1990, when Zoheir Abouguendia published *Range Plan Development: a Practical Guide to Planning for Management and Improvement of Saskatchewan Rangeland*. The classification of regions and range sites used by Abouguendia has been modified somewhat in *Saskatchewan Rangeland Ecosystems*, but is based on the same concepts.

Within range sites, the vegetation composition depends on the level of grazing impact as well as other factors. In *Range Plan Development*, this type of variation was represented by the **range condition scale**, which gives a high score to the potential community for the site, and lower scores to communities that have been altered by grazing impact. In recent years, range scientists have found that vegetation changes may be too complicated to represent by a single scale. They have also found that some changes may be difficult to reverse, so that communities may not move back up the scale when conditions change. Because of these findings, the current approach is to represent vegetation change by **state-and-transition diagrams**, showing a number of different community types that could occur on a given site, and the types of transitions from one community to another. In this approach, there could be transitions between communities caused by grazing impact, but there could also be transitions in other directions related to fire or exotic invasion.

Alberta has led the way in Canada in moving to this approach, with a series of publications describing community types in relation to range sites (Adams et al. 2003, 2004, 2005). Funding from Agriculture and Agri-Food Canada's Greencover Canada Program has now made it possible to start this work in Saskatchewan. The Prairie Conservation Action Plan (PCAP), a partnership of 27 groups representing the livestock industry, federal and provincial agencies, conservation groups, and universities, formed a steering committee to work on several projects related to range health. *Saskatchewan Rangeland Ecosystems* is one of the products of this PCAP initiative.

Saskatchewan Rangeland Ecosystems is a series of publications in a three-ring binder format. Publication 1 presents the new classification of ecoregions and ecosites, and gives detailed guidelines for identifying ecosites. The first map of range ecosites for the province of Saskatchewan appears as a centrefold in the publication. The publication also explains how communities within ecosites were classified and described. Publications 2 and 3 are large tables developed as information tools to help users in identifying range ecosites from soils information. Publication 4 gives descriptions of the community types that occur on the Loam Ecosite.

Publication 5 does the same for the Sandy Loam and Sand Ecosites, Publication 6 for the Clay Ecosite, and so on. As further community descriptions are developed, they can be added to the binder.

2. ECOREGIONS

The first step in ecosystem classification is to divide the province into ecological regions or **ecoregions**. Ecoregions are broad zones that are determined mainly by climate. The composition and productivity of rangeland will be different in a moist climate compared to a dry climate, even if the soil material is the same. This means that the classification of range ecosites must be nested within the broader ecoregions.

The original range site classification by Abouguendia (1990) used the Brown, Dark Brown, and Black Soil Zones as regions. In the driest of these, the Brown Soil Zone, a “Dry Brown” subzone was separated by the level of annual precipitation. After Abouguendia’s guide was published, Padbury and Acton (1994) developed a standard ecoregion classification for the province, integrated with Canada’s national ecological land classification (ESWG 1996). Within the grassland part of Saskatchewan (the Prairie Ecozone), there are four ecoregions, which are close related to the soil zones:

- Aspen Parkland - similar to the Black Soil Zone
- Moist Mixed Grassland - similar to the Dark Brown Soil Zone
- Mixed Grassland - similar to the Brown Soil Zone
- Cypress Upland - local area with strong elevation changes, rising from Brown to Dark Brown to Black soils

Both soil zones and ecoregions reflect the patterns of climate across the province, from warmer and drier in the Mixed Grassland (Brown Soil Zone) to cooler and moister in the Aspen Parkland (Black Soil Zone). In the Cypress Upland, precipitation increases and temperature decreases with rising elevation. The moisture available for plant growth depends partly on inputs from precipitation, but is also affected by the losses to evaporation. Therefore Hogg’s (1994) **climatic moisture index**, which is defined as annual precipitation minus annual potential evapotranspiration¹, was used. Positive numbers indicate an excess of precipitation over evaporation, as occurs in moist forest climates. Negative numbers indicate drier grassland climates, in which there is less moisture from precipitation than could potentially be evaporated. Moisture index values range from 0 to -175 mm in the Aspen Parkland, -175 to -250 mm in the Moist Mixed Grassland, and below -250 mm in the Mixed Grassland (Figure 1). The Cypress Upland shows a rise in moisture index with elevation.

The standard ecoregions shown in Figure 1 form the basis for the new range classification. However, it was necessary to make some modifications.

¹ Potential evapotranspiration is the amount of evaporation that would occur if there were no shortage of soil moisture. In the method used by Hogg (1994), potential evapotranspiration is estimated from monthly temperature and solar radiation.

Table 9 Average recommended stocking rate for the Loam Ecosite in each ecoregion, predicted from the climatic moisture gradient. The Aspen Parkland has been arbitrarily divided at a CMI value of -125 mm.

Ecoregion	climatic moisture index (mm)	stocking rate	
		AUM/ha	AUM/ac
Dry Mixed Grassland	below -325 mm	0.49	0.20
Mixed Grassland	-325 to -225 mm	0.72	0.29
Aspen Parkland, drier portion	-225 to -125 mm	1.10	0.44
Aspen Parkland, moister portion	above -125 mm	1.67	0.68

For example, in estimating stocking rates for a community pasture or ranch, one could determine which region it falls into, and use the average value for that region (Table 9). This is similar to the method used by Abouguendia et al. (1990) based on soil zones. On the other hand, a more exact estimate might be obtained by finding the location on the map (Figure 5) and reading the recommended stocking rate at that location.

The Cypress Upland Ecoregion required special treatment. As discussed in Section 2, the regional mapping of the climatic moisture index was not precise enough to capture the small-scale elevational pattern in the Cypress Hills. Therefore, elevations were used to map the boundaries between regions. Henderson et al. (2002) estimated that CMI increases 58 mm for each 100 m rise in elevation in the Cypress Hills. By adding this increase to the assumed value of -325 mm at the boundary between Dry Mixed Grassland and Mixed Grassland, one can predict the CMI values at higher elevations, and use these values to estimate stocking rates. The results can again be shown either as average stocking rates for elevational zones (Table 10), or as a continuous increase in recommended stocking rate with elevation (Figure 6).

Table 10 Average recommended stocking rates for the Loam Ecosite in the Cypress Upland Ecoregion, predicted from the relationship between elevation and climatic moisture index.

Ecological Region	elevation	climatic moisture index	stocking rate	
			AUM/ha	AUM/ac
Mixed Grassland at lower elevations	below 1050 m	below -209 mm	0.74	0.30
Fescue Grassland at higher elevations	above 1050 m	above -209 mm	1.39	0.56

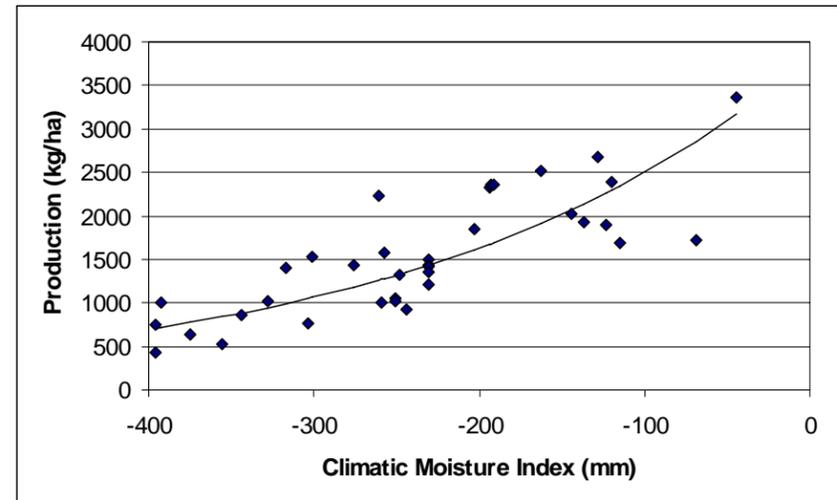


Figure 4 Annual grassland production from reference areas on Loamy Sites in the Canadian Prairies, in relation to the climatic moisture index.

The trend shown in Figure 3 is considered to be the best evidence available for determining recommended stocking rates for the Loam Ecosite. This trend can be used to estimate recommended stocking rates in two ways:

- as a continuous response to the climatic moisture gradient (Figure 5)
- as average values for the ecoregions (Table 9)

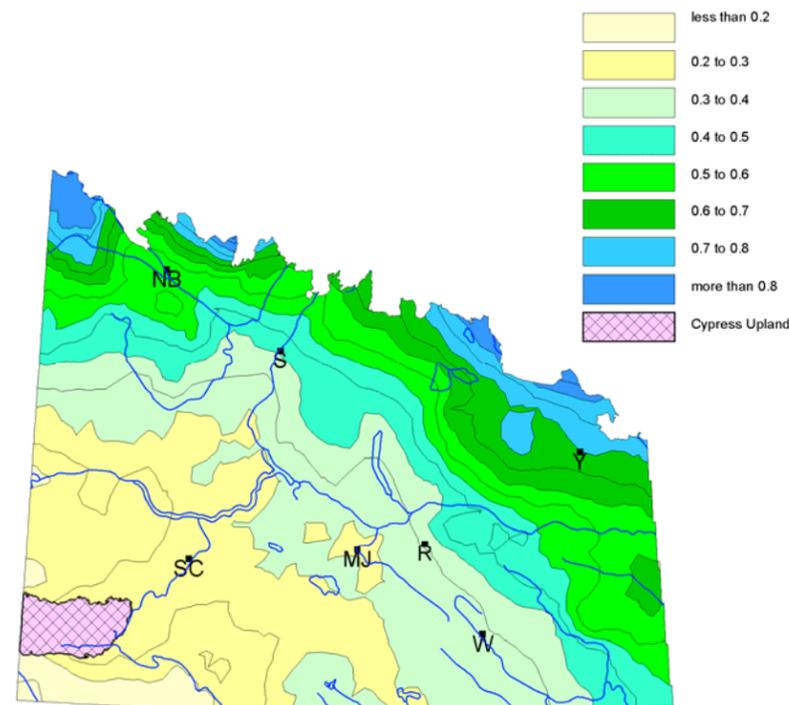


Figure 5 Recommended stocking rates (AUM/ac) for the Loam Ecosite, as a continuous surface predicted from the climatic moisture index.

First, the Mixed Grassland Ecoregion includes a fairly wide range of moisture index values. Study of the patterns of vegetation suggests that a drier subregion should be recognized, with a moisture index of -325 mm as the approximate boundary. This boundary was modified by elevation patterns north and south of the Cypress Hills, as discussed below. The main area will be referred to as **Mixed Grassland**, and the drier area as **Dry Mixed Grassland**.

In the Moist Mixed Grassland Ecoregion, there were not enough data to clearly distinguish plant communities from those in the ecoregions to the north and south. Until there is more information, it is recommended that the drier parts that are transitional to the Mixed Grassland (moisture index below -225 mm) be assessed using the information from the Mixed Grassland. The moister parts of the Moist Mixed Grassland (moisture index above -225 mm) that are transitional to the **Aspen Parkland** have been combined with it for community classification purposes.

In the **Cypress Upland**, ecological conditions change rapidly with elevation. The moisture index map (Figure 1) reflects this in a general way, but is not precise enough to accurately represent the region. Therefore, elevation data were used directly in drawing boundaries². Fescue grassland occurs mainly above elevations of 1,000 m (3,300 feet) on the north slope, and 1,050 m (3,450 feet) on the south slope. Mixed Grassland occurs below these elevations. At lower elevations, both north and south of the Cypress Hills, Mixed Grassland gives way to Dry Mixed Grassland. On the north slope, this transition occurs at about 775 m (2,550 feet). On the south slope of the Cypress Hills, and extending eastward to the south slope of the Wood Mountain Upland, the transition to Dry Mixed Prairie varies from 950 m (3100 feet) in the west to 850 m (2800 feet) in the east.

The modified ecoregion map is shown in Figure 2. The general ecological differences among the regions are summarized in Table 1.

² This analysis used elevation boundaries that were developed for soil zones in the Cypress Hills by Saskatchewan Assessment Management Agency, and a field survey of the distribution of fescue grassland by Saskatchewan Environment.

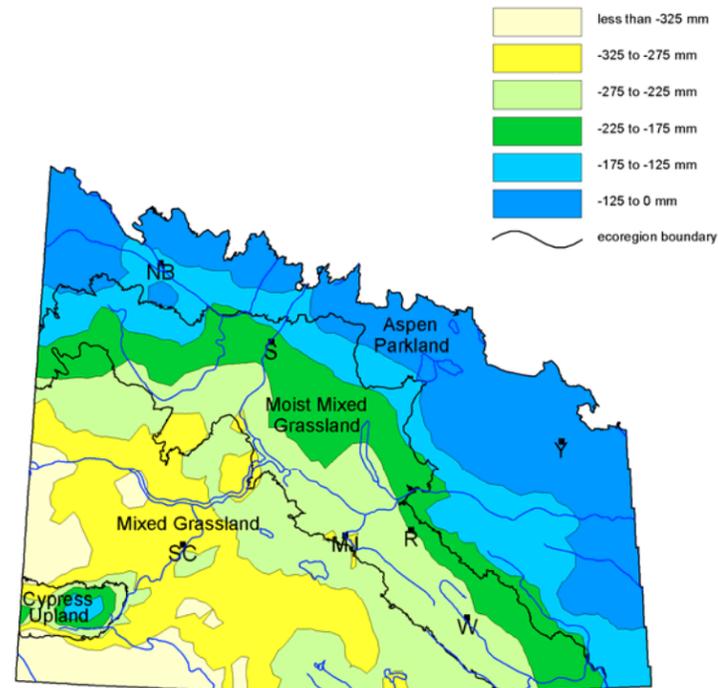


Figure 1 Climatic moisture index for the 1961-1990 period in the Prairie Ecozone of southern Saskatchewan. Ecoregion boundaries are shown for comparison.

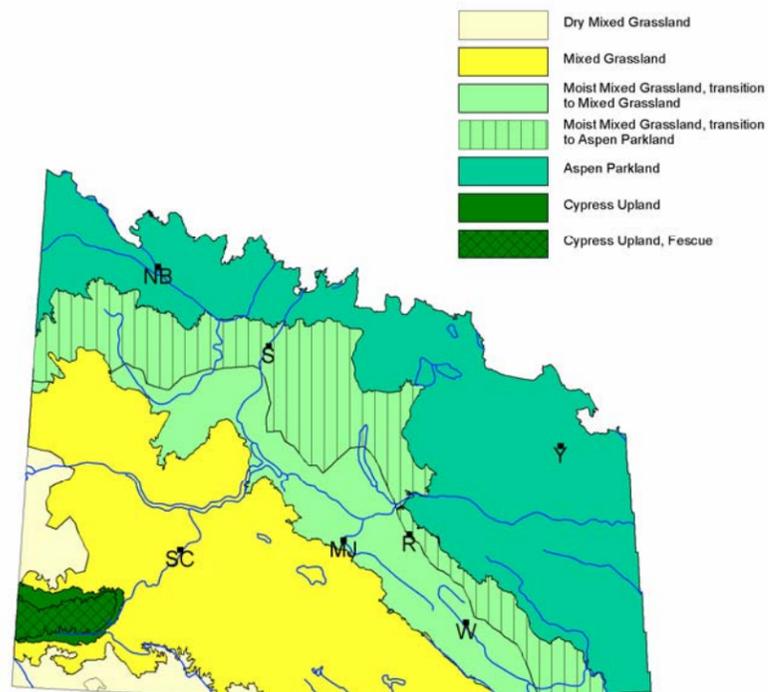


Figure 2 Range ecoregions (modified from Ecoregions of Saskatchewan – see Figure 1).

5. PRODUCTION AND STOCKING RATES

The community descriptions show average production values, for communities with sufficient data. However, for many communities the data were insufficient to calculate meaningful averages. The descriptions also show recommended stocking rates. These are intended to be initial estimates of sustainable stocking rates for each community. In actual use, they should be fine-tuned on the basis of pasture characteristics and monitoring of range trend.

Recommended stocking rates were based on a new analysis of historic stocking rate data from AAFC-PFRA community pastures. Actual stocking of individual fields was recorded for years from 1988-2002, in pastures in Saskatchewan and Manitoba. Data were restricted to fields that have been maintained in good to excellent range condition, so they should represent sustainable stocking rates. In order to reduce the effect of site variation, only fields with predominantly Loamy Sites were used in the analysis. The effect of climatic variation was captured by determining the climatic moisture index (CMI) (see Figure 1 in Section 2) for each field. The pattern of stocking rates in relation to CMI is shown in Figure 3. Stocking rates increase from the driest regions (CMI = -400) to the moistest (CMI close to zero), and the graph shows a slight upward curve.

In a separate analysis, measured grassland production values from benchmark sites and research plots (mostly ungrazed) were plotted against CMI. The results (Figure 4) show almost exactly the same pattern as the stocking rate analysis, providing independent confirmation of the climatic trend in productivity.

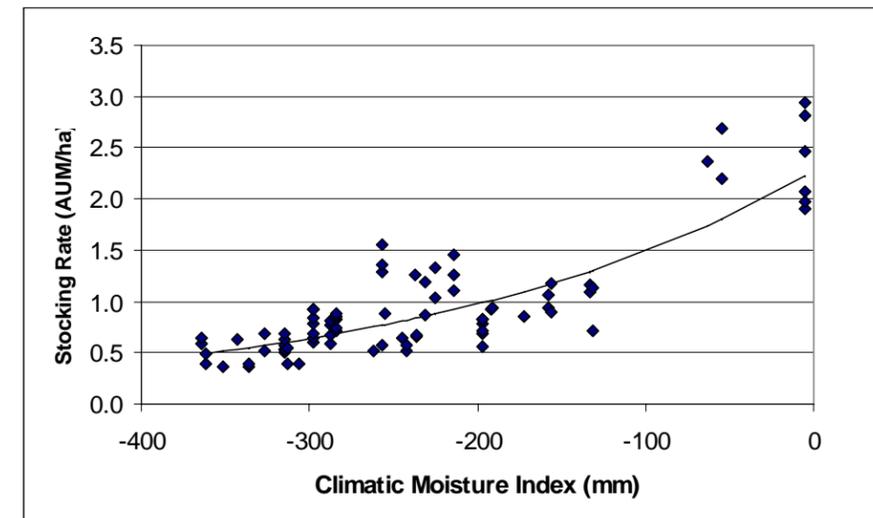


Figure 3 Stocking rates of fields in good to excellent range condition on Loamy Sites in AAFC-PFRA pastures in Manitoba and Saskatchewan, in relation to the climatic moisture index.

Table 8 Example of calculating percent similarity to the reference community using percent cover data, for a sample plot on Loam Ecosite in the Aspen Parkland.

	PERCENT COVER		
	reference community	sample plot	lesser of the two values
Major graminoids			
plains rough fescue	23	2	2
northern wheat grass	5	0	0
western porcupine grass	2	5	2
sedge	2	0.2	0.2
bearded wheat grass	1	2	1
Kentucky blue grass	1	0	0
June grass	0	0.1	0
Hooker's oat grass	0	0.1	0
Major forbs and half-shrubs			
three-flowered avens	0	0.1	0
everlasting	5	0.1	0.1
timber oat grass		0.1	
rough hair grass		0.01	
sheep fescue		0.01	
Total of minor graminoids	0	0.12	0
crocus anemone		0.1	
cut-leaved anemone		0.1	
early blue violet		0.1	
field chickweed		0.1	
gaillardia		0.1	
golden bean		0.1	
hedysarum		0.1	
long-fruited anemone		0.1	
low goldenrod		0.1	
many-flowered aster		0.1	
northern bedstraw		0.1	
prairie sage		0.1	
woolly yarrow		0.1	
pasture sage		0.1	
Total of minor forbs and half-shrubs	2	1.4	1.4
rose		0.1	
Total of minor shrubs	0	0.1	0
TOTAL	41	11.22	6.7
PERCENT SIMILARITY	=(200*6.7)/(41+11.22)		25.7

Table 1 General differences among range ecoregions.

	Ecoregion			
	Dry Mixed Grassland	Mixed Grassland*	Aspen Parkland**	Cypress Upland, Fescue
climate moisture index (mm)	below -325	-325 to -225	-225 to 0	-225 to 0
zonal soils	Brown Chernozems	Brown and some Dark Brown Chernozems	Dark Brown and Black Chernozems	Dark Brown and Black Chernozems
reference community on Loam Ecosite	Northern Wheat Grass – Needle-and-thread	Western Porcupine Grass – Northern Wheat Grass	Plains Rough Fescue – Northern Wheat Grass	Plains Rough Fescue
potential production on Loam Ecosite (kg/ha)	600 to 1,000	1,000 to 1,500	1,500 to 3,400	1,600 to 3,300

* Also applies to drier parts of Moist Mixed Grassland Ecoregion, and lower elevations in Cypress Upland Ecoregion.

** Also applies to moister parts of Moist Mixed Grassland Ecoregion.

3. ECOSITES

3.1 Ecosite Classification

The ecoregions described in the previous section are defined by broad patterns of climate. Within these regions, rangeland is divided into ecological sites or **ecosites**, which are defined by more local factors. SRM (1989) defined an ecological site as: “A kind of land with a specific potential natural community and specific physical site characteristics, differing from other kinds of land in its ability to produce vegetation and to respond to management”.

Within a local area such as a ranch or a community pasture, it can be assumed that the climate is more or less uniform. Therefore, the variation in growing conditions is mainly related to ecosite. Differences in physical site factors, such as topography, soil texture, and soil moisture regime, create different environments for plant growth. For example, a pasture in the Mixed Grassland may be partly made up of rolling hills with well-drained, loam-textured soils. The potential plant community³ on this land is dominated by western porcupine grass and northern wheat grass. However, depressions between the hills may have moist soils that support sedge meadows. Another part of the pasture may be a sand plain with lower water-holding capacity, on which the potential plant community is dominated by needle-and-thread and sand reed grass. The loamy

³ The potential plant community was defined by SRM (1989) as: “The biotic community that would become established on an ecological site if all successional sequences were completed without interferences by man under the present environmental conditions.” This is usually interpreted to be the community that develops under ungrazed to lightly grazed conditions.

upland, the wet meadows, and the sand plain are different ecosites: they have different physical site factors, and they support different potential plant communities.

Abouguendia (1990) presented the classification of range sites that has been used in Saskatchewan in recent years. The ecosites used in the present report (Table 2) are based on Abouguendia’s classification, with some modifications:

- “Dunesand” has been split into “Low Dunes” and “High Dunes” based on experience with ecological mapping in dunesand areas.
- “Burnout” has been renamed “Solonetzic” to conform to soil survey terminology.
- “Sandy” has been renamed “Sandy Loam” to avoid confusion with the Sand Ecosite.
- Ecosites on moist to wet ecosites, including “Subirrigated”, “Wetland”, and “Closed Depression” have been replaced with the zonation terminology used by wetland ecologists: “Dry Meadow”, “Wet Meadow”, “Shallow Marsh”, “Deep Marsh”, and their saline counterparts (Walker and Coupland 1970, Stewart and Kantrud 1972, Millar 1976).
- Definitions of ecosites have been written, with specific criteria to aid in use of soil survey information for mapping.

Table 2 Classification of range ecosites for grasslands of southern Saskatchewan.

GROUP	ECOSITE	DEFINITION	
DRY	Badlands (BD)	Sparsely vegetated landscapes with >10% exposure of bedrock. Areas mapped as Badlands may include vegetated islands that are too small to map separately.	
	Thin (TH)	<ul style="list-style-type: none"> • Landscapes with predominantly steep slopes (>20%) (excluding Badlands or Dunes); and/or • Landscapes with truncated soil profiles resulting from high natural levels of erosion (excluding Badlands or Dunes). 	
	Gravelly (GR)	Landscapes with gravelly soils at the surface, or with a thin surface layer of finer material over a gravel substrate.	
	Dunes (DN)	Low Dunes (LDN)	Landscapes with sand dunes creating local relief of 1 to 3 metres, and/or slope steepness of 5% to 15%. Potential vegetation includes a mosaic of cover types (grassland, shrubland, woodland) associated with aspect and slope position. Usually with complete plant cover on all slope positions.
		High Dunes (HDN)	Landscapes with sand dunes creating local relief of more than 3 metres, and/or slope steepness >15%. Potential vegetation includes a mosaic of cover types (grassland, shrubland, woodland) associated with aspect and slope position. South-facing slopes and ridges often have sparse vegetation or bare sand.
	Solonetzic (SO)	Landscapes with soils in the Solonetzic Order, characterized by a hard, impermeable B-horizon which is high in sodium. Often with scattered depressions (“burnouts” or “blowouts”) where the soil has been eroded down to the B-horizon.	
ZONAL	Sand (SD)	Stable well-drained upland ecosites with coarse-textured soils (sand, loamy sand), but without dune topography.	
	Sandy Loam (SL)	Stable well-drained upland ecosites with moderately coarse-textured soils (sandy loam).	
	Loam (LM)	Stable well-drained upland ecosites with medium to moderately fine-textured soils (loam, silt loam, clay loam).	
	Clay (CY)	Stable well-drained upland ecosites with fine to very fine-textured soils (clay, heavy clay).	

Table 7 Example of calculating percent similarity to the reference community using percent biomass data, for a sample plot on Loam Ecosite in the Mixed Grassland.

	PERCENT BIOMASS		
	reference community	sample plot	lesser of the two values
Major graminoids			
western porcupine grass	31	15	15
northern wheat grass	24	15	15
June grass	5	0	0
western wheat grass	4	5	4
blue grama	4	20	4
needle-and-thread	4	14	4
sedges	3	20	3
plains rough fescue	3	0	0
green needle grass	2	1	1
plains reed grass	1	0	0
Hooker's oat grass	1	0	0
Major forbs and half-shrubs			
pasture sage	7	1	1
crested wheat grass		3	
Total of minor graminoids	3	3	3
prairie sage		1	
scarlet mallow		2	
cinquefoil		1	
goat's-beard		5	
Total of minor forbs and half-shrubs	6	8	6
PERCENT SIMILARITY			55

The publication also includes a state-and-transition diagram representing the successional relationships among the various community types.

In using the community descriptions, it is important to understand that they do not represent every possible variation in species composition. Rather, they represent the major trends. A sample plot examined in the field may not exactly match any of the described community types. The user should examine the composition trends shown by described types, then attempt to interpret the composition of the sample plot in relation to these trends.

As an aid to this interpretation, the user can calculate the percent similarity (Mueller-Dombois and Ellenberg 1974) between the sample plot and the reference community for that ecosite. Table 7 shows an example on Loam Ecosite in the Mixed Grassland Ecoregion. The description for the reference community (MG-LM-A in Publication 4) gives average values of percent biomass for each major species, as well as totals for minor species. Values determined for the sample plot are entered beside those for the reference community. In this example, the sample plot had data for one graminoid (crested wheat grass) and four forbs (prairie sage, scarlet mallow, cinquefoil, and goat’s-beard) that were not listed as major species in the reference community. Such species must be grouped as “minor” species, even though they may be of major importance in the sample plot. Percent similarity is then calculated by taking the lesser of the two values for each species, and summing these lesser values.

This example used percent biomass data, which should add up to 100 in each plot, allowing the use of the simplified calculation of percent similarity shown in Table 7. Some community descriptions show percent cover data, which do not usually add up to 100. In this case, the full formula for percent similarity must be used (Mueller-Dombois and Ellenberg 1974). The sum of the lesser values is multiplied by 200, then divided by the sum of the reference values plus the sum of the sample values. An example of the calculation for percent cover is given in Table 8.

Percent similarity values can be used directly to judge the extent to which the sample plot has been altered from the reference community. However, the Saskatchewan Range Health Assessment method refers to classes of alteration in assigning points for ecological status. The following ranges of similarity can be used as a rough guide for assigning these classes:

- more than 85% - reference community
- 65 – 85% - minor alteration
- 45 – 65% - moderate alteration
- 25 - 45% - significant alteration
- less than 25% - severe alteration

GROUP	ECOSITE		DEFINITION
MOIST	Overflow (OV)	Overflow (OV)	Well-drained sites (no mottles or gleying), but on alluvial landforms (floodplains, alluvial fans) that receive additional moisture from stream overflow or run-in.
		Solonetzic Overflow (OVSO)	Overflow sites with Solonetzic soils
		Saline Overflow (OVSA)	Overflow sites with saline soils
	Meadow (MD)	Dry Meadow (DMD)	Moist low-lying sites that are rarely flooded. Imperfectly drained soils show signs of occasional saturation, such as faint to distinct mottles (e.g. Gleyed Chernozems).
		Wet Meadow (WMD)	Wet low-lying sites that are normally flooded for 3-4 weeks in spring. Poorly drained soils show signs of prolonged saturation, such as dull colours or prominent mottles (Gleysolic soils). Potential vegetation includes diverse communities of fine-textured grasses, sedges, and forbs, sometimes with tall willows.
	Marsh (MH)	Shallow Marsh (SMH)	Wetlands that are normally flooded until July or early August. Gleysolic or Organic Soils. Potential vegetation includes simpler communities of intermediate-sized grasses and sedges.
		Deep Marsh (DMH)	Wetlands that are normally flooded throughout the growing season (non-use areas). Potential vegetation consists of a few species of tall, coarse graminoids (e.g. cattails, bulrushes).
	SALINE	Saline Upland (UPSA)	
Saline Meadow (MDSA)		Saline Dry Meadow (DMDSA)	Moist low-lying sites that are rarely flooded, with saline soils. Potential vegetation is dominated by salt-tolerant plants.
		Saline Wet Meadow (WMDSA)	Wet low-lying sites that are normally flooded for 3-4 weeks in spring, with saline soils. Potential vegetation is dominated by salt-tolerant plants.
Saline Marsh (MHSA)		Saline Shallow Marsh (SMHSA)	Wetlands that are normally flooded until July or early August, with saline soils. Potential vegetation is dominated by salt-tolerant plants.
		Saline Deep Marsh (DMHSA)	Wetlands that are normally flooded throughout the growing season (non-use areas), with saline soils. Potential vegetation consists of a few species of salt-tolerant plants.

The ecosite definitions in Table 2 may overlap in some cases. The following key for identifying ecosites based on soil and landscape features (Table 3) shows the logical priority of the various characteristics. For example, a site may have very steep slopes and sandy loam textures. The slope characteristic comes earlier in the key than the texture characteristic, so the site would be placed in the Thin Ecosite rather than the Sandy Loam Ecosite.

Table 3 Key for identifying range ecosites based on soil and landscape features.

a. Exposed bedrock	Badlands
a. Not exposed bedrock	
b. Saline	
c. Gleysols	
d. Marsh soils.....	Saline Shallow Marsh, Saline Deep Marsh
d. Other Gleysols.....	Saline Wet Meadow
c. Gleyed series in other orders (e.g. Gleyed Chernozems).....	Saline Dry Meadow
c. Not Gleysol or Gleyed	
d. Alluvial landforms including floodplains, fans, aprons.....	Saline Overflow
d. Not alluvial landforms.....	Saline Upland
b. Not saline	
e. Gleysols	
f. Marsh soils.....	Shallow Marsh, Deep Marsh
f. Other Gleysols.....	Wet Meadow
e. Gleyed series in other orders (e.g. Gleyed Chernozems).....	Dry Meadow
e. Not Gleysol or Gleyed	
g. Dunesand (coarse-textured, eolian mode of deposition)	
h. Steep slopes (slope classes 6 and 7).....	High Dunes
h. Moderate slopes (slope classes 4 and 5).....	Low Dunes
h. Gentle slopes (slope classes 1, 2, and 3).....	Sand
g. Not Dunesand	
i. Alluvial landforms including floodplains, fans, aprons	
j. Solonetzic.....	Solonetzic Overflow
j. Not Solonetzic.....	Overflow
i. Not alluvial landforms	
k. Very steep slopes (slope class 7).....	Thin
k. Not very steep slopes (slope classes 1, 2, 3, 4, 5, 6)	
l. Eroded soil profile.....	Thin
l. Not eroded soil profile	
m. Solonetzic.....	Solonetzic
m. Not Solonetzic	
n. Gravelly texture or gravel substrate.....	Gravelly
n. Not gravelly	
o. Coarse texture (s, fs, ls, lfs).....	Sand
o. Moderately coarse texture (sl, fl, vl).....	Sandy loam
o. Medium to moderately fine texture (l, sil, cl, sicl, scl, fcl vcl).....	Loam
o. Fine texture (c, sic, hc).....	Clay

3.2 Mapping of range ecosites

The Land Resource Unit of Agriculture and Agri-Food Canada has developed a seamless digital soil map for southern Saskatchewan. The areas on the map are linked to databases of soil properties. These databases made it possible to translate the soil map into a map of range ecosites.

First, the database of soil series was used to determine equivalent range ecosites, by interpretation of properties such as mode of deposition, parent material texture, gleying and mottling, salinity, and erosion (see Tables 2 and 3 in Section 3.1). The result was the Soil Series Table (Publication 2), in which individual series can be looked up to determine the equivalent

proportions of decrease and increase. These variables were used in a manual sorting process aimed at grouping similar plots. In either approach, types represented by fewer than 10 plots were either eliminated or combined with other types, as appropriate.

Knowledge of successional relationships was used to interpret a reference community for each ecoregion/ecosite combination, defined as the community that would be expected under ungrazed or lightly grazed conditions. Percent similarity of other community types to the reference community was determined by Sorensen’s index (Mueller-Dombois and Ellenberg 1974). Communities were arranged in a state-and-transition diagram showing the interpreted relationships among them.

Data for community types were summarized by calculating the mean and the 10th and 90th percentiles of vegetation structure and composition variables. Plant species were separated by growth-forms:

- graminoids – grass-like plants, including grasses, sedges, and rushes
- forbs – herbaceous plants (i.e. die back to the ground each year) that are not grass-like
- half-shrubs – plants that are woody at the base, but with mostly herbaceous growth (i.e. most of the above-ground growth dies back each year)
- shrubs – woody plants (i.e. above-ground growth persists from year to year)
- cactus – succulent plants with spines

Minor species within each growth-form were grouped and only the total for the grouped species was shown. The results were shown in standardized community descriptions.

4.3 Using the community descriptions

Descriptions of the communities for each ecosite are presented in a series of separate publications. For example, Publication 4 shows the communities found on the Loam Ecosite. Descriptions for additional ecosites will be published as they are developed.

Each description shows:

- a code for the community type (e.g. MG-LM-A, meaning Mixed Grassland Ecoregion, Loam Ecosite, community type A)
- the name of the community type based on the dominant species
- a general description of the community type, including its interpreted successional relationships with other types
- the structure of the vegetation, represented by the percent cover of each vegetation layer, as well as litter cover and exposure of bare soil
- the species composition, represented by major species in each vegetation layer with abundance values (either percent biomass or percent cover, depending on available data); note that mosses, lichens, and clubmoss (*Selaginella densa*) are shown under Vegetation Structure, and are not included in the composition data.
- percent similarity of the community to the reference community for that ecoregion/ecosite
- average forage production, if sufficient data were available
- recommended stocking rates (see Section 5)

data	source
SRC survey of Cowessess I.R.	Godwin and Thorpe 2004a
SRC survey of Moose Mountain Provincial Park	Thorpe 1994
SRC survey of Old Man on his Back	Thorpe and Godwin 1998b, 1999a
SRC survey of Saskatchewan Landing Provincial Park	Godwin and Thorpe 1994b, 2002b
SRC survey of Silverwood area	Godwin and Thorpe 1992
SRC survey of the Manito Sand Hills	Thorpe and Godwin 1993a
SRC surveys in Douglas Provincial Park and Elbow PFRA Pasture	Thorpe and Godwin 1992, Godwin and Thorpe 1994c, 1999
SRC surveys in Old Wives area	Thorpe and Godwin 1999b
SRC surveys in the Great Sand Hills	Thorpe and Godwin 1997
SRC surveys of Saskatoon Natural Grasslands	Thorpe and Godwin 1993b, Godwin and Thorpe 2004b

A standard data format was developed, and data from the various sources were edited to fit the standard format. This allowed data from different sources to be combined in analysis. The basic unit of data was considered to be the vegetation plot. This could be a sample area (e.g. a 5 m by 5 m square plot), or it could be a transect (e.g. a 100 m line laid out across the landscape). In the case of plots or transects sampled by a series of small quadrats (e.g. ten placements of a 50 cm by 50 cm frame), the averages of the quadrat values were considered to be the plot values. Each plot can be visualized as a column in the dataset, while the rows include location information, environmental attributes (e.g. slope, aspect, soil type), production measurements, vegetation structure, and abundance values for individual plant species. Plot locations were used with GIS data to assign values for ecoregion, climate variables, and mapped soil information. Plots were assigned to ecoregions based on the Ecoregions of Saskatchewan map (Padbury and Acton 1994) and the mapped climatic data. Plots were assigned to ecosites based on environmental data (e.g. observed topography, soil texture, or range site identification) and the soil survey map.

The data included a variety of species abundance measures, with most using either percent cover (i.e. the percent of the ground area covered by the species) or percent biomass (i.e. the percent contributed by each species on a weight basis). One of the fields in the database recorded the type of abundance measure, so that plots with the same measure could be grouped. However, for some analyses, species abundance values were transformed to ranks within growth-forms (e.g. the rank of each herbaceous species in relation to all herbaceous species). Rank-transformed data were considered to be comparable between plots using different abundance measures.

Plots were separated by ecoregion and ecosite. In some cases, particular combinations of ecoregion and ecosite had insufficient numbers of plots for analysis, so were combined with other similar combinations. For example, Mixed Grassland and Dry Mixed Grassland were separated for the Loam Ecosite, but were combined for several other ecosites with lower plot numbers.

Classification of communities within an ecoregion/ecosite combination used two main approaches. One was a Twinspan analysis (McCune and Mefford 1999) on ranked data, followed by interpretation of the successional status of the resulting classes. The other was a supervised approach in which each plot was represented by a few variables, including percent exotics, percent shrubs, dominant herbaceous species, and a successional index based on

range ecosite. However, soil maps do not show soil series directly. Rather, they show soil map units, which are complexes of soil series. Each map unit has a dominant series, and the range ecosite corresponding to that series was assigned to the map unit. The result was the Map Unit Table (Publication 3), in which the most probable range ecosite for each map unit can be looked up. Ecosite assignments were then modified using other attributes of the mapped areas, including surface texture and slope class.

The final assignment of ecosites to mapped areas was used to generate the Range Ecosite Map in the centrefold of this report. Because the focus of the classification is native grassland, the map was limited to the Prairie Ecozone (ESWG 1996). The map was also limited to areas of rangeland, by using the Saskatchewan Research Council's South Digital Land Cover map to mask out non-rangeland (cropland, forage, farms/settlements, roads, and water).

The Range Ecosite Map shows the general pattern of ecosites across southern Saskatchewan. A digital version of the map, which will be distributed separately, can be used to zoom in on a particular area and show the pattern of range ecosites at a larger scale. However, the underlying soil maps are intended to be used at a scale of 1:100,000, and are too generalized for mapping at finer scales. For mapping a small area (e.g. a map of a ranch at 1:10,000) the Range Ecosite Map can be used for a "first draft". However, the map should then be refined by field observations and interpretation of air photos.

3.3 Steps in Identifying Range Ecosites

Identifying range ecosites depends on the knowledge and experience of the observer. The following list of steps illustrates a detailed identification process using all available information:

- read the soil map for the area
- look at the land surface
- dig a soil pit and look at the soil profile
- determine the texture of the soil
- look at the vegetation
- read the descriptions of the possible ecosites, and pick the most appropriate

More experienced observers will develop shortcuts, and may not always follow every step. However, everyone will benefit from doing more complete assessments (e.g. digging a soil pit) from time to time to improve their identifications. The steps are discussed in Sections 3.3.1 and 3.3.2, while Section 3.4 gives more detailed descriptions of the individual ecosites.

3.3.1 Using soil maps to identify range ecosites

The first step in identifying range ecosites is to read the soil map for the area. The soils of southern Saskatchewan have been mapped by the Land Resource Unit of Agriculture and Agri-Food Canada. Soil maps and reports can be ordered from:

The Saskatchewan Land Resource Centre
 5C26 Agriculture Building
 University of Saskatchewan Campus
 51 Campus Drive
 SASKATOON SK S7N 5A8
 (306) 975-4060
<http://www.ag.usask.ca/departments/scsr/land/map/index.html>

The areas shown on a soil map are called **map units**. Each map unit has a different distribution of **soil series** within it. For example, the soil map for the area around Saskatoon (Acton and Ellis 1978) shows that Biggar soils (Dark Brown soils formed on gravelly parent materials) occur in three map units: Biggar 1, Biggar 2, and Biggar 3. In all three, the dominant soil series (the one occupying the largest area) is Biggar Orthic Dark Brown. However, in the Biggar 2 map unit there is also a significant area of Biggar Orthic Regosols, while in Biggar 3 there is a significant area of Biggar Carbonated and/or Saline Chernozemic Dark Brown soils. Usually, the range ecosite is based on the dominant soil series in the map unit. The soil map also shows the surface soil texture and the slope class in each mapped area.

The Map Unit Table (Publication 3) shows how to determine the most likely range ecosite based on the soil map unit. The Soil Series Table (Publication 2) shows how to determine the range ecosite if the soil series is known. For example, if the map unit is Biggar 3, the Map Unit Table shows that the most likely ecosite is Gravelly. However, ecosites can be determined in more detail by using the soil series makeup of the map unit. In Biggar 3, the dominant series (Biggar Orthic Dark Brown) corresponds to the Gravelly Ecosite, while the secondary series (Biggar Carbonated and/or Saline Chernozemic) corresponds to the Saline Upland Ecosite.

The Map Unit Table shows that the surface texture and slope class shown on the soil map may be used in identifying ecosites in some cases. For example, a soil which would normally be considered Sandy Loam Ecosite may have a surface texture of gravelly sandy loam. In this case, the ecosite would change to Gravelly. Similarly, a soil which would normally be considered Loam Ecosite may occur on very steep slopes (slope class 7), which would change the ecosite to Thin. Areas of wind-blown sand are usually mapped as Antelope, Vera, or Edam soils. However, the ecosite depends on the topography. Areas of gentle relief (slope classes 1, 2, or 3) are considered Sand Ecosite, areas of moderate relief (slope classes 4 or 5) are considered Low Dunes Ecosite, and areas of steep slopes (slope classes 6 or 7) are considered High Dunes Ecosite.

On the Range Ecosite Map (centrefold of this report), ecosites have already been determined using the above relationships. A digital version of this map, which will be distributed separately, will allow users to zoom in on areas of interest.

Determining the range ecosite from soil maps or the Range Ecosite Map will often give the right answer. However, because these maps are somewhat generalized, the information may not be detailed enough to identify the range ecosite being considered. The land surface and the soil profile must be examined in the field to ensure that the ecosite has been determined correctly.

4. COMMUNITIES

4.1 Introduction

Sections 2 and 3 show how the rangelands of southern Saskatchewan are divided into ecoregions (which depend on climate) and ecosites (which depend on landform and soil). Within a given ecoregion and ecosite, a number of different plant communities may be found. The main reason for this is differences in history. Some areas may be heavily grazed over several years, causing the taller or more palatable species to decrease, while other areas are only lightly grazed. Repeated fires may eliminate the shrubs from some areas, while prolonged absence of fire may allow shrubs to expand. Some communities are altered by invasion of exotic plant species. The result is a range of possible plant communities on a given ecosite.

4.2 Methods

Classification of plant community types was based on analysis of existing data. PCAP partners contributed grassland composition data from a wide range of locations across southern Saskatchewan (Table 6). The range condition database collected by AAFC-PFRA in community pasture surveys accounted for about half of the data.

Table 6 Data sources used for classification of plant community types.

data	source
AAFC-PFRA range condition surveys	AAFC-PFRA staff - personal communication
Saskatchewan Watershed Authority surveys	SWA staff - personal communication
Ducks Unlimited surveys	DU staff - personal communication
Saskatchewan range benchmarks	PFRA staff - personal communication
Original grassland data collected by R.T. Coupland and his students	R.T. Coupland, personal communication
Matador IBP site	Coupland 1973
U. of S research in the Coteau Hills	J. Romo, U of S, personal communication
M.Sc. Thesis on the Dundurn Sand Hills	Houston 1999 and personal communication
Other U of S theses	Brayshaw 1951, Heard 1953, Hird 1957, Hulett 1962, Baines 1964, Martens 1979
Prairie Biodiversity Survey	A. Riemer, Sask. Environment, personal communication
Saskatchewan Environment survey in the Great Sand Hills	A. Riemer, Sask. Environment, personal communication
SRC range condition survey of Cypress Hills Provincial Park	Godwin and Thorpe 1994a
SRC range condition survey of Danielson Provincial Park	Thorpe and Godwin 1994
SRC research on farm biodiversity	Godwin et al. 1998
SRC research on range monitoring methods	Thorpe and Godwin 1998a
SRC research on sage grouse habitat	Thorpe and Godwin 2003
SRC research on WDF lands	Thorpe and Godwin 2001, 2002
SRC survey of Batoche National Historic Site	Godwin and Thorpe 2002a
SRC survey of Battle Creek valley	B. Godwin, SRC, unpublished data

- sea milkwort
- silverweed
- common arrowgrass

Saline Shallow Marsh (SMHSA)

The Saline Shallow Marsh Ecosite consists of wetlands that are normally flooded until July or early August, with high salinity. The potential vegetation is dominated by salt-tolerant wetland plants.

Things to look for in identifying the Saline Shallow Marsh Ecosite:

- Soil map shows saline gleysolic soils (e.g. Marsh Saline Gleysolic)
- Wetlands that are flooded for extended periods
- White salt crust on drying soil surfaces
- Soil profile shows Gleysol profile with dull colours and/or prominent mottles
- Plant indicators
 - whitetop
 - creeping spikerush
 - threesquare bulrush
 - Nevada bulrush
 - Nuttall's alkali grass
 - narrow-leaf water-plantain
 - samphire
 - sea-blite

Saline Deep Marsh (DMHSA)

The Saline Deep Marsh Ecosite consists of wetlands that are normally flooded throughout the growing season (non-use areas), with high salinity. The potential vegetation consists of a few species of salt-tolerant emergent plants.

Things to look for in identifying the Saline Deep Marsh Ecosite:

- Wetlands that are almost always flooded
- White salt-crust on drying soil surfaces
- Vegetation consists of tall emergent plants
- Plant indicators
 - alkali bulrush
 - hardstem bulrush

3.3.2 Examining range ecosites in the field

To identify range ecosites in the field, first look at the shape and appearance of the land surface. Some features to look for:

- steep slopes – steepness is measured as a percentage: if the land rises 1 metre over a horizontal distance of 5 metres, the steepness is 20%.
- signs of erosion – e.g. formation of rills and gullies, individual plants that appear to be on pedestals because soil around them has been washed away.
- alluvial landforms – land surfaces that have been formed by moving water. These will always occur in lower parts of the landscape, such as valley bottoms. Alluvial landforms include:
 - floodplains – level areas bordering streams that are occasionally flooded during high water
 - alluvial fans and aprons – gently sloping areas at the foot of a steep slope or the mouth of a coulee, formed by soil washed down from the higher land.
- wet areas
- saline areas – usually low-lying areas with white salt crusts appearing on the soil surface, and with salt-tolerant plant species.
- sand dunes – land surfaces in which sand has been pushed up into hills and ridges by wind action.
- exposed bedrock

Dig a soil pit about 60 cm (2 feet) deep, and study the layers (soil horizons). Soil layers may also be viewed in road-cuts or gopher-holes. Consult a soils textbook or seek advice from a soils expert to recognize features in the soil profile. Some of the features that are used in identifying range ecosites:

- Signs of erosion – e.g. soils where the A-horizon⁴ appears to be thinner than normal because topsoil has been removed.
- Regosolic soil profiles – soils with very little development of horizons, usually on land that has been recently deposited by wind or water.
- Chernozemic soil profiles – typical grassland soils with a dark-coloured A-horizon.
- Solonetzic soil profiles – soils with a hard, impermeable B-horizon⁵ with a columnar structure.
- Gleysolic soil profiles – soils formed by prolonged saturation with water, and characterized by dull gray colours or prominent rust-colored mottles⁶.
- Gleyed soils – soils that appear similar to upland Chernozemic or Solonetzic soils, but have some mottles in the B or C-horizon⁷, indicating intermittent saturation with water.
- Layers of gravel.
- Soil texture of the various horizons.

⁴ The A-horizon is the uppermost soil layer, which in grassland soils is a dark-coloured topsoil.

⁵ The B-horizon is the subsoil layer below the A-horizon, and has been modified by material washed out of the A-horizon.

⁶ Mottles are spots of different color interspersed with the dominant soil color.

⁷ The C-horizon is the unaltered parent material below the A and B-horizons.

Soil texture is how coarse or fine the soil is, and is determined by the proportions of different particle sizes: sand, silt, and clay. Determining soil texture in the field is a skill that requires training and practice. However, Table 4 gives a key that should lead to approximately the correct texture class. To use this key, take a handful of soil from the profile, and add water to form a moist ball that can be worked in the hand. Try to form the moist soil into a ribbon. Add more water and rub the wet soil between the fingers to determine how it feels: a gritty feel indicates sand; a smooth, soapy feel indicates silt; and a sticky feel indicates clay.

Table 4 Key for determining soil texture by hand (modified from Thien 1979)

1 soil does not form a ball	sand
1 soil forms a ball	
2 soil does not form a ribbon	loamy sand
2 soil forms a weak ribbon less than 2.5 cm long before breaking	
3 soil feels very gritty	sandy loam
3 soil feels very smooth	silt loam
3 neither grittiness nor smoothness predominates	loam
2 soil forms a medium ribbon 2.5 to 5 cm long before breaking	
4 soil feels very gritty	sandy clay loam
4 soil feels very smooth	silty clay loam
4 neither grittiness nor smoothness predominates	clay loam
2 soil forms a strong ribbon 5 cm or longer before breaking	
5 soil feels very gritty	sandy clay
5 soil feels very smooth	silty clay
5 neither grittiness nor smoothness predominates	clay

After examining the land surface and the soil profile, use Table 5 to determine the range ecosite. Before making a final decision, look at the descriptions of the ecosites in Section 3.4 to make sure that you have picked the most appropriate one.

- Upland locations
- No mottling or gleying in soil profile
- Mixture of salt-tolerant and normal upland plants
- Plant indicators
 - salt grass

Saline Dry Meadow (DMDSA)

The Saline Dry Meadow Ecosite consists of low-lying land that is moist but rarely flooded, with high salinity. The potential vegetation is dominated by salt-tolerant plants.

Saline Dry Meadow Ecosites occurs on saline and gleyed series of a variety of Chernozemic or Solonchic associations (e.g. Alluvium Saline Gleyed).

Things to look for in identifying the Saline Dry Meadow Ecosite:

- Soil map shows saline and gleyed soils.
- White salt crust on surface
- Low-lying, moist land, but not usually flooded
- Usually bordering wetter ecosites (Saline Wet Meadow, Saline Marsh)
- Soil profile shows faint to distinct mottles
- Plant indicators
 - salt grass
 - western wheat grass
 - greasewood

Saline Wet Meadow (WMDSA)

The Saline Wet Meadow Ecosite consists of wet low-lying wetlands that are normally flooded for three to four weeks in spring, with high salinity. The potential vegetation is dominated by salt-tolerant wetland plants.

Soils corresponding to Saline Wet Meadow ecosites may include Alluvium Saline Gleysols, Meadow Saline Gleysols, Saline Complex, or saline and gleysolic series of a variety of other soil associations.

Things to look for in identifying the Saline Wet Meadow Ecosite:

- Soil map shows saline gleysols
- Low-lying wetlands that are usually flooded in spring
- White salt crust on surface
- Soil profile shows Gleysol profile with dull colours and/or prominent mottles
- Plant indicators
 - northern reed grass
 - alkali cordgrass
 - Baltic rush
 - foxtail barley
 - salt grass

Things to look for in identifying the Shallow Marsh Ecosite:

- Low-lying wetlands that are flooded for extended periods (until July or early August in an average year)
- Soil profile shows Gleysol profile with dull colours and/or prominent mottles
- Plant indicators
 - awned sedge
 - water sedge
 - woolly sedge
 - whitetop
 - tall manna grass
 - giant bur-reed
 - slough grass
 - creeping spikerush
 - reed canary grass
 - water smartweed
 - water parsnip

Deep Marsh (DMH)

The Deep Marsh Ecosite consists of wetlands that are normally flooded throughout the growing season. The vegetation consists of a few species of very tall, coarse grasses and sedges (e.g. cattails, bulrushes). Deep Marsh Ecosites would be mapped out as non-use areas for livestock.

Soils corresponding to the Deep Marsh Ecosite include Marsh Complex and Wetland Complex.

Things to look for in identifying the Deep Marsh Ecosite:

- Almost always flooded
- Vegetation consists of tall emergent plants
- Plant indicators
 - cat-tail
 - soft-stem bulrush
 - hard-stem bulrush
 - giant reed grass

Saline Upland (UPSA)

The Saline Upland Ecosite consists of drier transitional or upland sites where the soil is saline. Salt may appear on the surface in dry periods. Potential vegetation includes a mixture of salt-tolerant plants and plants typical of normal upland sites.

Soils supporting the Saline Upland Ecosite include saline series of a variety of Chernozemic or Solonetzic soils.

Things to look for in identifying the Saline Upland Ecosite:

- Soil map shows saline soils
- White salt crust on surface

Table 5 Key for identifying range ecosites in the field.

a. Exposed bedrock.....	Badlands
a. Not exposed bedrock	
b. Saline sites	
c. Wet sites, soils poorly drained (Gleysols)	
d. Normally flooded throughout the summer.....	Saline Deep Marsh
d. Normally flooded until July or early August.....	Saline Shallow Marsh
d. Normally flooded for 3 to 4 weeks in spring.....	Saline Wet Meadow
c. Moist sites, but rarely flooded; soils imperfectly drained (e.g. Gleyed Chernozems).....	Saline Dry Meadow
c. Well-drained sites, no mottling or gleying in soil	
d. Alluvial landforms, extra moisture from run-in or stream overflow.....	Saline Overflow
d. Not alluvial landforms; transitional to upland ecosites.....	Saline Upland
b. Not saline	
e. Wet sites, soils poorly drained (Gleysols)	
f. Normally flooded throughout the summer.....	Deep Marsh
f. Normally flooded until July or early August.....	Shallow Marsh
f. Normally flooded for 3 to 4 weeks in spring.....	Wet Meadow
e. Moist sites, but rarely flooded; soils imperfectly drained (e.g. Gleyed Chernozems).....	Dry Meadow
e. Well-drained sites, no mottling or gleying in soil	
g. Alluvial landforms, extra moisture from run-in or stream overflow	
h. Solonetzic soils.....	Solonetzic Overflow
h. Not Solonetzic.....	Overflow
g. Not alluvial landforms	
i. Sand dunes	
j. Local relief more than 3 metres.....	High Dunes
j. Local relief 1 to 3 metres.....	Low Dunes
j. Local relief less than 1 metre.....	Sand
i. Not sand dunes	
k. Slopes steeper than 20%.....	Thin
k. Not steep slopes	
l. Signs of erosion.....	Thin
l. Not eroded	
m. Solonetzic soils.....	Solonetzic
m. not Solonetzic	
n. Gravelly material.....	Gravelly
n. Not gravelly	
o. Coarse texture (sand, loamy sand).....	Sand
o. Moderately coarse texture (sandy loam).....	Sandy Loam
o. Medium to moderately fine texture (loam, silt loam, clay loam).....	Loam
o. Fine texture (clay).....	Clay

3.4 Descriptions of range ecosites

Badlands (BD)

Badlands Ecosites are areas where the bedrock material is exposed, with very little vegetation cover. Badlands in southern Saskatchewan usually consist of clay deposits. They are not solid rock, but they are called “bedrock” because they are much older than the glacial deposits that make up most of the Saskatchewan landscape. These exposed bedrock clays erode very rapidly, forming steep slopes with many water channels where vegetation is slow to establish. In transitional areas, if there is at least 10% bedrock exposure, the ecosite should be called Badlands. Areas mapped as Badlands Ecosites may include vegetated islands that are too small to map separately.

Soils corresponding to the Badlands Ecosite include Exposure and Short Creek.

Things to look for in identifying the Badlands Ecosite:

- Soil map shows Exposure or Short Creek soils.
- Exposed uniform clay material.
- Obvious signs of water erosion (even livestock manure may be washed away)
- Very low vegetation cover.
- Plant indicators
 - povertyweed
 - rabbit brush
 - rillscale
 - Nuttall’s atriplex
 - silver sagebrush

Thin (TH)

Most Thin Ecosites are on steep slopes, such as the sides of large valleys. Rainwater tends to run off over the surface on these slopes, so there is more water erosion than on other landforms. This means that the soil does not build up a normal A-horizon because material is continually being removed from the surface. Whether or not the slope is steep, any area in which the A-horizon is very thin as a result of high natural levels of erosion should be considered Thin Ecosite.

On soil maps, most areas of Thin Ecosite are mapped as the Hillwash Complex. Thin Ecosites may also occur on eroded and regosolic series of a variety of other soil associations.

Note that some steep slopes are placed in ecosites other than Thin. Steep slopes with exposed bedrock should be placed in the Badlands Ecosite, and steep slopes of wind-blown sand should be placed in the High Dunes Ecosite.

Things to look for in identifying the Thin Ecosite:

- Steep slopes (greater than 20%, i.e. the land rises more than 1 metre over a distance of 5 metres).
- Very thin A-horizon.

- Usually bordering wetter ecosites (Wet Meadow, Marsh).
- Soil profile is similar to upland soils (Chernozemic or Solonchic), but with faint to distinct mottles in the B or C-horizon.
- Plant indicators
 - western wheat grass
 - slender wheat grass
 - Kentucky blue grass
 - wild licorice
 - dandelion
 - western snowberry
 - Woods rose

Wet Meadow (WMD)

The Wet Meadow Ecosite consists of low-lying wetlands that are normally flooded for three to four weeks in spring. Poorly drained soils show signs of prolonged saturation, such as dull colours or prominent mottles (Gleysolic soils). The vegetation tends to be very diverse, with many flowering herbs, and with a variety of grasses, sedges, and rushes. The grass and sedge species found on Meadow Ecosites are shorter and finer-leaved than on Marsh Ecosites. Tall willows may be scattered through the grassland, especially in the Aspen Parkland Ecoregion.

Soils corresponding to the Wet Meadow Ecosite include Alluvium Gleysolic soils, Meadow Complex, Big Muddy, or gleysolic series of a variety of other soil associations.

Things to look for in identifying the Wet Meadow Ecosite:

- Low-lying wetlands that are usually flooded in spring
- Soil profile shows Gleysol profile with dull colours and/or prominent mottles
- Plant indicators
 - marsh reed grass
 - northern reed grass
 - fowl blue grass
 - Kentucky blue grass
 - Baltic rush
 - basket willow, pussy willow, beaked willow

Shallow Marsh (SMH)

The Shallow Marsh Ecosite consists of wetlands that are normally flooded until July or early August. Poorly drained soils show signs of prolonged saturation, such as dull colours or prominent mottles (Gleysolic soils). The vegetation is less diverse than on Meadow Ecosites, and the dominant grasses and sedges are taller and coarser.

Soils corresponding to the Shallow Marsh Ecosite include Marsh Complex and Wetland Complex.

Things to look for in identifying the Overflow Solonetzic Ecosite:

- Soil map shows soils that develop on alluvial or colluvial deposits (e.g. Alluvium Solonetzic soils, Runway Solonetzic soils, Hellfire, McEachern, Morgan, Porcupine Creek, and solonetzic series of other soils on alluvial deposits).
- Valley bottom sites, including floodplains along streams and fans developed at the foot of the valley slope.
- Soil profile does not indicate imperfect or poor drainage (no mottling or gleying)
- Soil profile shows hard B-horizon with round-topped columnar structure
- Scattered burnouts
- Plant indicators
 - western wheat grass
 - silver sagebrush

Saline Overflow (OVSA)

The Saline Overflow Ecosite consists of Overflow sites with saline soils. These may be found along floodplains in southwestern Saskatchewan. High salinity is indicated by white salt crusts on the soil and/or the presence of salt-tolerant plants.

Soils corresponding to the Saline Overflow Ecosite include Alluvium Saline soils, Flat Lake Complex, Grill Lake Complex, and saline series of other soils on alluvial landforms (e.g. Runway, Eastend, Ellisboro, Gap View, Horse Creek, Lark Hill, Rock Creek, Tantallon, Val Marie, Wascana, White Fox).

Things to look for in identifying the Overflow Saline Ecosite:

- Soil map shows soils that develop on alluvial or colluvial deposits
- Valley bottom sites, including floodplains along streams and fans developed at the foot of the valley slope.
- Soil profile does not indicate imperfect or poor drainage (no mottling or gleying)
- White salt crust on soil surface
- Salt-tolerant plants are abundant:
 - salt grass
 - Nuttall's alkali grass

Dry Meadow (DMD)

The Dry Meadow Ecosite consists of low-lying land that is moist but rarely flooded. Imperfectly drained soils are similar to upland soils, but show signs of occasional saturation such as faint to distinct mottles (e.g. Gleyed Chernozems). Dry Meadow Ecosites may be found along floodplains, but are moister than the Overflow sites.

Soils corresponding to the Dry Meadow Ecosite include Alluvium Gleyed soils and gleyed series of a variety of other Chernozemic or Solonetzic soils.

Things to look for in identifying the Dry Meadow Ecosite:

- Low land, but not usually flooded.

- Obvious signs of water erosion, such as rills, gullies, and pedestalled plants, even in undisturbed areas (e.g. ungrazed areas).
- Plant indicators
 - plains muhly
 - thread-leaved sedge
 - broomweed
 - creeping juniper

Gravelly (GR)

Gravelly Ecosites are well-drained uplands with gravel at the surface, or with a thin surface layer of finer material over a gravel substrate. Gravelly Ecosites are usually found on glacio-fluvial plains, where gravel and sand have been deposited by streams flowing out of the melting glaciers.

Soils corresponding to Gravelly ecosites include Chaplin, Biggar, Whitesand, Glenbush, and Welby. Gravelly ecosites may also be found on soil series with gravel substrates or gravelly surface textures in a variety of other associations.

Things to look for in identifying the Gravelly Ecosite.

- Soil map shows soils that are found on gravel deposits (e.g. Chaplin).
- Soil map shows gravelly texture (e.g. gsl – gravelly sandy loam)
- Soil profile shows a significant layer of gravelly material, either at the surface or as a subsoil underlying finer material.

Dunes (DN)

Dunes are sand deposits that have been acted on by wind to create distinctive hills and ridges. The young, recently eroded soils in Dunes tend to be Regosols – soils with little development of a soil profile, often with only the first signs of an A-horizon. Dunes usually have more woody cover than other landscapes in the prairies. The potential vegetation consists of a mosaic of grassland, shrubland, and forest, varying with aspect⁸ and slope position. Dunes usually occur over fairly large blocks of land. Within these blocks of dunes, it is often possible to map out areas of higher relief (High Dunes) and lower relief (Low Dunes).

High Dunes (HDN)

The High Dunes Ecosite consists of landscapes in which the tops of the dunes tend to be more than 3 metres (10 feet) above the hollows. Ridges are often sharp, and slopes tend to be steep (more than 15%). Ridge-tops and south-facing slopes often have sparse vegetation or patches of bare sand. In some cases, whole dunes are bare, and the wind is actively moving the soil – these are called active dunes. Normally an area mapped as High Dunes would include a number of individual dunes as well as the hollows between them.

⁸ Aspect is the direction that a slope faces. South-facing slopes are warmer and drier than north-facing slopes.

Things to look for in identifying the High Dunes Ecosite:

- Soil map shows soils formed on sand dunes (e.g. Antelope, Vera, Edam, Dunesand) with slope class 6 or 7.
- Sand material with characteristic dune-shaped hills
- High local relief
- Steep slopes
- Plant indicators
 - sand reed grass
 - sand dropseed
 - Indian rice grass
 - lance-leaved psoralea
 - silver sagebrush
 - creeping juniper
 - chokecherry

Low Dunes (LDN)

The Low Dunes Ecosite consists of landscapes in which the tops of the dunes are roughly 1 to 3 metres (3 to 10 feet) above the hollows. These areas appear to have been stabilized for a long time, and the hills tend to be rounded off and have gentle to moderate slopes (5% to 15%). There is usually complete vegetation cover over all slope positions. Between dunes, there may be patches where the terrain is almost flat, usually covered with grassland. If these level areas are large enough, they should be mapped out separately as Sand Ecosite.

Things to look for in identifying the Low Dunes Ecosite:

- Soil map shows soils formed on sand dunes (e.g. Antelope, Vera, Edam, Dunesand) with slope class 4 or 5.
- Sand material with characteristic dune-shaped hills
- Low to moderate local relief
- Gentle to moderate slopes
- Plant indicators
 - sand reed grass
 - sand dropseed
 - lance-leaved psoralea
 - hairy golden-aster
 - silver sagebrush
 - creeping juniper
 - chokecherry

Solonetzic (SO)

The Solonetzic Ecosite consists of uplands with Solonetzic soils. These are soils that are high in sodium, which causes clay particles to disperse and form a hard, impermeable B-horizon. Digging a cross-section of this B-horizon shows a series of round-topped columns. A distinctive feature of some Solonetzic soils is a scattering of shallow depressions (called “burnouts” or

Clay (CY)

The Clay Ecosite consists of stable well-drained uplands with fine to very fine-textured soils (clay, heavy clay). Soils are Chernozems or Vertisols. Much of the area of Clay Ecosite is found on flat glacial lake-bed deposits like the Regina Plain.

Soils corresponding to the Clay Ecosite include Allan, Balcarres, Bear, Indian Head, Keatley, Meadow Lake, Melfort, Regina, Sceptre, Sutherland, Tisdale, Touchwood, and Willows.

Things to look for in identifying the Clay Ecosite:

- Soil map shows clay or heavy clay textures
- Glacial lake beds – flat plains with heavy soils.
- Soil texture determined in the field is clay or heavy clay
- Plant indicators
 - high dominance of northern or western wheat grass

Overflow (OV)

Overflow Ecosites receive additional moisture because of their topographic position, but are not wet enough to be Meadow or Marsh Ecosites. Some Overflow ecosites are along floodplains of streams, where they are occasionally flooded when the stream overflows during high water. Others are at the foot of a slope or the mouth of a coulee (e.g. alluvial fan deposits), where runoff from the higher land supplies extra moisture. The vegetation is typically more productive than on normal upland sites. However, the soil does not show the mottling or gleying that indicates Meadow or Marsh Ecosites, and plants requiring moist soils, such as tall sedges, are not present.

Things to look for in identifying the Overflow Ecosite:

- Soil map shows soils that develop on alluvial or colluvial deposits (e.g. Alluvium, Runway, Eastend, Ellisboro, Gap View, Horse Creek, Lark Hill, Rock Creek, Tantallon, Val Marie, Wascana, White Fox).
- Valley bottom sites, including floodplains along streams and fans developed at the foot of the valley slope.
- Soil profile does not indicate imperfect or poor drainage (no mottling or gleying)
- Plant indicators
 - western wheat grass
 - silver sagebrush
 - western snowberry
 - Woods rose

Solonetzic Overflow (OVSO)

The Solonetzic Overflow Ecosite consists of Overflow sites with Solonetzic soils. These are often found along floodplains in southwestern Saskatchewan. While the ecosite would be expected to receive additional moisture from stream overflow, there are frequent bare patches (burnouts) and overall productivity is low.

Soils corresponding to the Sandy Loam Ecosite include Hatton, Asquith, Meota, Nisbet, Perley, and Shell Lake. Note that in some cases these soils may have a surface texture of loamy sand. However, the parent material of these soils is usually sandy loam, and the Sandy Loam Ecosite should be used.

Things to look for in identifying the Sandy Loam Ecosite:

- Soil map indicates sandy loam texture.
- Well-drained uplands.
- Soil texture determined in the field is sandy loam.
- Plant indicators
 - spear grasses usually dominant

Loam (LM)

The Loam Ecosite consists of stable, well-drained uplands with medium to moderately fine-textured soils (loam, silt loam, clay loam). Soils are Chernozems, characterized by a dark A-horizon and none of the features of Solonetzic or Gleysolic soils. The Loam Ecosite accounts for more of the rangeland in Saskatchewan than any other ecosite. Much of the area of Loam Ecosite is found on moraines, which are deposits of glacial till – a mixture of rocks, sand, silt, and clay deposited directly from the melting ice. If there are scattered rocks, but there is fine material between them, the deposit is glacial till. Moraines may cover large areas with a distinctive rolling “knob-and-kettle” topography, and almost all of this area will fall in the Loam Ecosite. However, some areas of Loam Ecosite are found on glacial lake-bed deposits with medium-textured sediments. Other Loam Ecosites are on loess deposits, which are blankets of silty material deposited by the wind.

Some of the soils that support Loam Ecosites include:

- glacial till deposits, e.g. Amulet, Ardill, Climax, Edgeley, Fremantle, Frontier, Haverhill, Horsehead, Lorenzo, Mayfair, Naicam, Oxbow, Paddockwood, Pelly, Ryerson, Wadena, Weyburn, Whitewood, Yorkton
- glacial till deposits that are influenced by underlying bedrock, e.g. Cypress, Fairwell, Fife Lake, Jones Creek, Klintonel, Rocanville, Scotsguard, Wood Mountain.
- medium-textured glacial lake-bed deposits, e.g. Arcola, Birsay, Blaine Lake, Bradwell, Bredenbury, Canora, Craigmore, Cudworth, Cutknife, Elstow, Fox Valley, Hamlin, Hoey, Kamsack, Krydor, Scott, Shellbrook, Tiger Hills, Valor, Weirdale.
- loess deposits, e.g. Swinton.

Note that in some cases, these soils may have a surface texture of sandy loam. However, the parent material of these soils is usually loam to clay loam, and the Loam Ecosite should be used.

Things to look for in identifying the Loam Ecosite:

- Soil map indicates loam, silt loam, or clay loam texture.
- Well-drained uplands.
- Soil texture determined in the field is loam, silt loam, or clay loam.
- Moraine deposits (knob-and-kettle topography, rocks in the soil).
- Plant indicators
 - both spear grasses and wheat grasses usually important.

“blowouts”) where the soil has been eroded down to the hard B-horizon. Burnouts may be completely bare, or western wheat grass and other plants may have recolonized them. Solonetzic soils tend to support lower grassland production compared to other well-drained uplands (Chernozemic soils).

Soils corresponding to the Solonetzic Ecosite include Brooking, Echo, Estevan, Flaxcombe, Gilroy, Grandora, Hanley, Instow, Kelstern, Kettlehut, Kindersley, Macworth, North Portal, Onion Lake, Robsart, Rosemae, Speers, Tantallon, Trossachs, Tuxford, Waseca, and Wingello.

Things to look for in identifying the Solonetzic Ecosite:

- Soil map shows Solonetzic soils.
- Soil surface shows scattered burnouts.
- Soil profile shows hard B-horizon with round-topped columnar structure.
- Plant indicators
 - western wheat grass colonizing burnouts

Sand (SD)

The Sand Ecosite consists of stable, well-drained uplands with coarse-textured soils (sand, loamy sand), but without dune topography. Soils are Chernozems, characterized by a dark A-horizon and none of the features of Solonetzic or Gleysolic soils. Sand Ecosites are usually on sand plains deposited by meltwater from the glaciers. Sand Ecosites may appear as level grassland patches within or adjacent to sand dunes, or they may occur without any neighbouring dunes.

Soils corresponding to the Sand Ecosite include Antelope, Vera, Edam, or Dune Sand, with low relief (slope class 1 to 3).

Things to look for in identifying the Sand Ecosite.

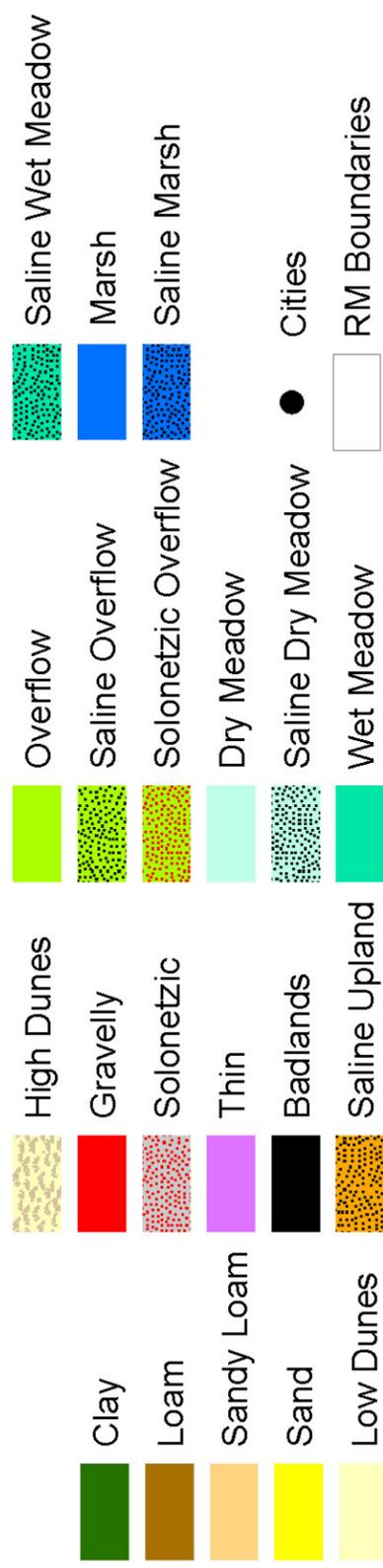
- Soil map indicates sand texture.
- Soil texture determined in the field is sand or loamy sand.
- Land surface is level or undulating, but not formed into dunes.
- Plant indicators
 - spear grasses usually dominant
 - sand reedgrass
 - sand dropseed
 - hairy golden-aster
 - lance-leaved psoralea

Sandy Loam (SL)

The Sandy Loam Ecosite consists of stable, well-drained uplands with moderately coarse-textured soils (sandy loam). These soils are usually found on glacio-fluvial deposits (i.e. plains of sandy material deposited by streams of water melting from the glaciers). Soils are Chernozems, characterized by a dark A-horizon and none of the features of Solonetzic or Gleysolic soils.

Range Ecosites of Southern Saskatchewan

Legend



1:2,500,000

