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MANAGEMENT OF THE WESTERN RANGE

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HIGHLIGHTS

- The number of livestock raised each year in the Prairie Provinces has not changed in the past 50 years, though cattle have largely replaced horses. However, the stock load per acre is lower. In 1921 only 6.0 acres per animal unit was available for grazing, whereas in 1966 the area was 9.3 acres.
- The increase in cattle numbers has followed a cyclic pattern; on December 1, 1968, the cattle population was 5.2 million, a downturn in the cycle.
- Some 43.8 million acres of range and 5.0 million acres of seeded pasture are used for grazing. The total acreage includes four types of grassland and a parkland.
- The principles of good range management apply to all vegetational types. These principles may be applied by slightly different practices in different districts.
- The critical periods in range management occur in early spring when growth is slow and in fall when the crude protein content of vegetation is less than the amount needed.
- Cultivated pasture crops are recommended for complementary grazing.

INTRODUCTION

Native grasslands of the Canadian Prairies have been grazed by domestic livestock for over 90 years. Previously, the grasslands were grazed by buffalo and other wild herbivores. Hence, the arrival of domestic animals presented no new influence on these lands.

Ranchers were the first to study the prairie grasses, and their observations led to many of the grazing practices that are recommended now. Range research began in 1927 at the Livestock and Range Research Substation, Manyberries, Alberta. Later, grazing studies were undertaken in the Great Sand Hills of western Saskatchewan and near Stavely, in the foothills of the Rocky Mountains. Grazing surveys have been conducted since 1937 to estimate the carrying capacities of different types of grassland.

The results of pasture and range studies are given in this publication. The information applies to the grasslands and adjacent parkland. Relationships among soil, climate, and vegetation and their effect on the growth of grass are discussed.

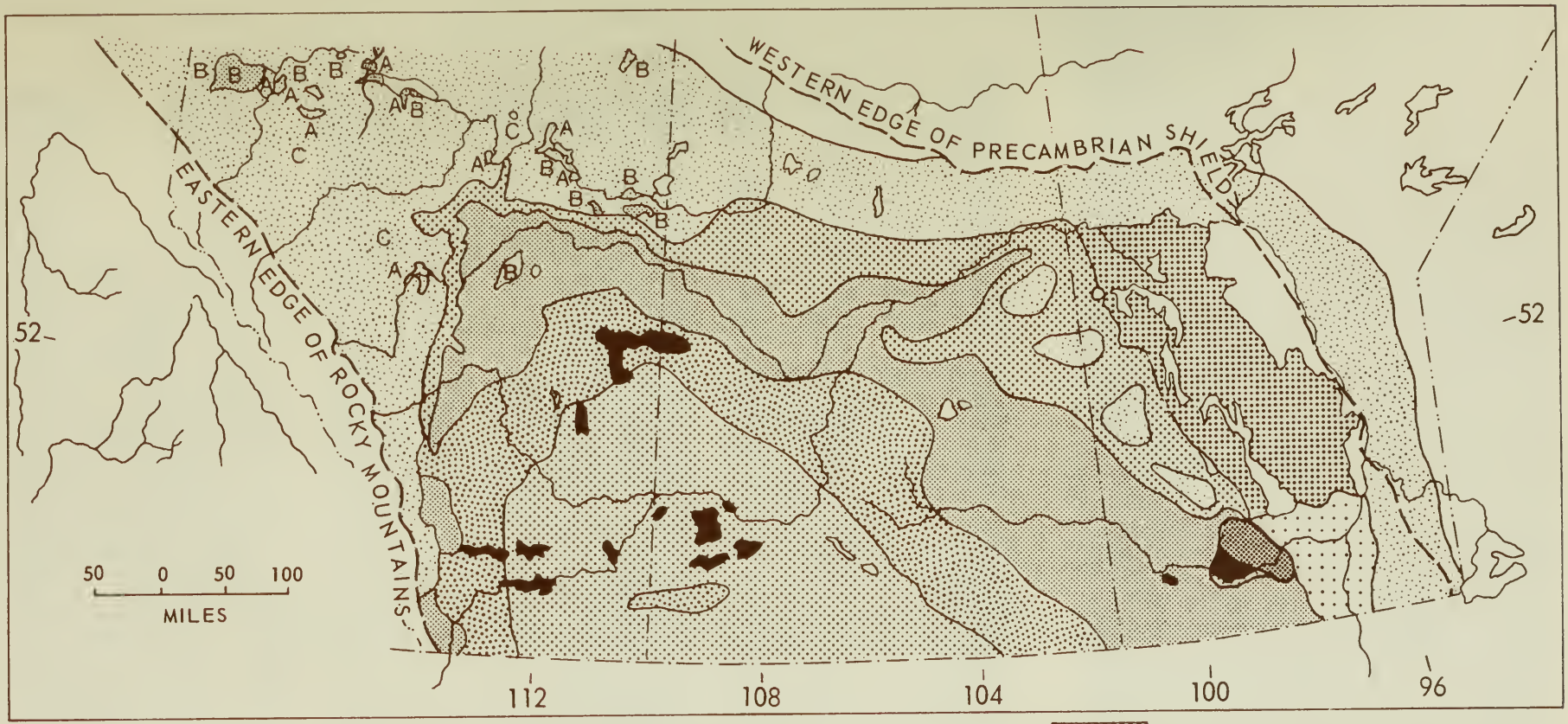
SOILS AND CLIMATE

The western range is an eastward-sloping plain between the Rocky Mountains and the Precambrian shield. Soils are derived mostly from glacial drift deposited by the continental ice sheets. Exceptions occur in an area in southeastern Alberta and southwestern Saskatchewan, where ancient conglomerates, shales, and sandstones are close to the surface, and in outcrops of limestone in the Interlake district of Manitoba and in central Saskatchewan.

Soils of the region include five major groups: Brown, Dark Brown, Black, Gray Wooded, and Dark Gray Wooded (Figure 1). Brown soils developed under semiarid conditions. The brown surface layer is low in organic matter and nitrogen, the profiles are shallow, and the limy subsoils are close to the surface. Dark Brown soils developed under more humid conditions. The surface layer is dark brown, the profiles are thicker, and the soils contain more organic matter and nitrogen than the Brown soils. Black soils developed under still moister conditions, the surface layer is black and is rich in organic matter and nitrogen. The lime layer is usually at depths of 20 to 30 inches. Gray Wooded soils are transitional between the Black soils, which developed under a grass cover, and the Dark Gray Wooded soils, which developed under a tree cover. Gray Wooded soils have an ash-colored, leached surface layer and are low in organic matter and nitrogen.

A belt of solonetzic soils extends across all these soil zones. Solonetzic soils were formed from parent material that was high in sodium salts. In many places the surface layer has been eroded in patches and has been lost, and the subsoil is impervious.

Throughout the western range, level and moderately rolling tracts of clay, silt, or loam soils are farmed. Steeply rolling areas and those with eroded, shallow, sandy, or saline soils produce native grass and are used for grazing.



* A, B, AND C IN SPECIALLY DIFFERENTIATED AREAS OF THESE SOILS INDICATE QUALITY IN DECREASING ORDER.

Figure 1. Generalized soil map of the Prairie Provinces (courtesy Dr. J. D. Newton).

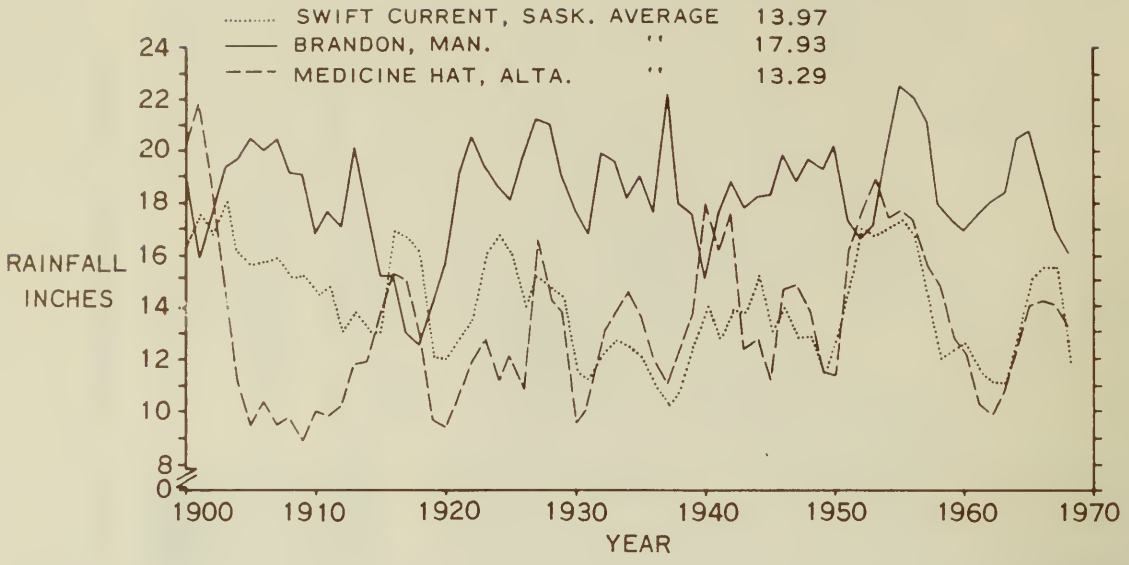


Figure 2. Average precipitation at three locations in the Prairie Provinces. (The amount shown for each year is the average for that year and the previous two years.)

The climate is cool semiarid, merging into cool subhumid in the parkland. Winters are long and cold, summers are short and warm, and rainfall is low and variable (Table 1).

Precipitation data for three locations are given in Figure 2. To show trends, the amount of precipitation for each year is the average for that year and the previous two years. There are two points of interest in Figure 2. First, wet and dry years occur in a fairly consistent pattern at all locations. If a drought occurs at one location, conditions are likely to be drier than average at the others. Therefore, the other districts are not likely to provide extra pasture. Second, years of better-than-average or less-than-average precipitation tend to occur in sequence. One wet or dry year affects only the yield, but two or more wet or dry years affect the cover. Drought reduces the abundance of higher-yielding grasses, whereas successive wet years favor their increase. Therefore, the pattern of precipitation causes yields to vary so that forage may be in short supply or so plentiful that only a portion of the yearly growth can be consumed.

Another characteristic of the rainfall affects the growth of grass. At the border of the prairies, where precipitation is greater and evaporation is less, there is a longer period when summer rainfall is more than 2 inches per month (Table 1). This longer growth period gives greater assurance of summer pasture.

The mean annual temperature decreases northeastward. This lower mean temperature is not a good indicator of growth potential, because the range is narrow for mean July temperatures and wide for mean January temperatures (Table 1). Therefore, mean

Table 1. Weather records from six locations

Site	Precipitation (inches)		Months with over 2 inches of rainfall	P/E ratio*	Mean temperature (°F)		
	Mean annual	May–July			January	July	Annual
Lacombe, Alberta	17.8	8.3	May–August	1.2	8.0	61.3	36.3
Brandon, Manitoba	18.2	7.8	June–August	1.2	1.9	67.3	35.9
Scott, Saskatchewan	13.8	5.9	June, July	0.6	0.0	62.0	33.5
Lethbridge, Alberta	16.2	6.8	May, June	0.7	17.4	64.6	41.3
Swift Current, Saskatchewan	14.8	6.9	June	0.5	7.6	66.0	38.3
Manyberries, Alberta	12.0	5.2	June	0.4	10.2	69.0	40.3

*P/E ratio = annual precipitation / April to August evaporation.

annual temperatures reflect winter conditions and do not show the potential for summer production. However, north of the North Saskatchewan River the main factor limiting crop production is the low summer temperature rather than the lack of moisture.

LIVESTOCK NUMBERS AND PASTURE ACREAGES

Beef cattle on the prairies now number about 5.2 million (Figure 3). The beef cattle population shows two kinds of fluctuations: cyclical and secular. In the early 1900's, cyclical fluctuations occurred at about 16-year intervals, but more recent cycles have been only

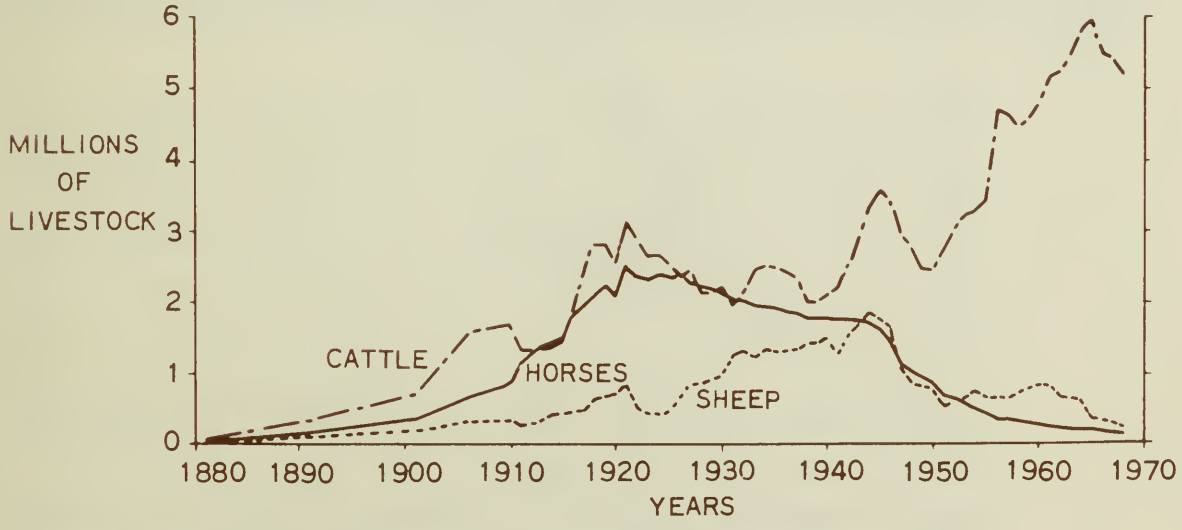


Figure 3. Numbers of beef cattle, horses, and sheep in the Prairie Provinces, 1881–1968.

about 9 years. Secular or long-term trends have been upward, and are likely to continue in this direction.

Sheep have never been important on western ranges. In 1944 the number of sheep reached a peak, but the numbers have decreased steadily ever since. Horses increased in number until about 1921, when tractors began to replace them on farms and ranches. In 1968 in the Prairie Provinces there were 177,000 horses, the lowest population since about 1892. These reductions in numbers of sheep and horses made possible the increase in the number of beef cattle.

In 1968 the total number of animal units (see Appendix) was less than in 1921 (Figure 4). During that time, acreage of native and tame pasture and of hay land increased by 15.5 million acres. These changes reduced grazing pressure and led to improvement of native range. In 1921 the range was overgrazed, but by 1968 the range was in fair to good condition.

Farmers with less than 760 acres of land raised more than 44 percent of the cattle, they have developed 41 percent of the improved pasture, but they have only 25 percent of the native grass (Table 2). Farmers with more than 1,600 acres of land raise less than 25 percent of the cattle, they have developed less than 30

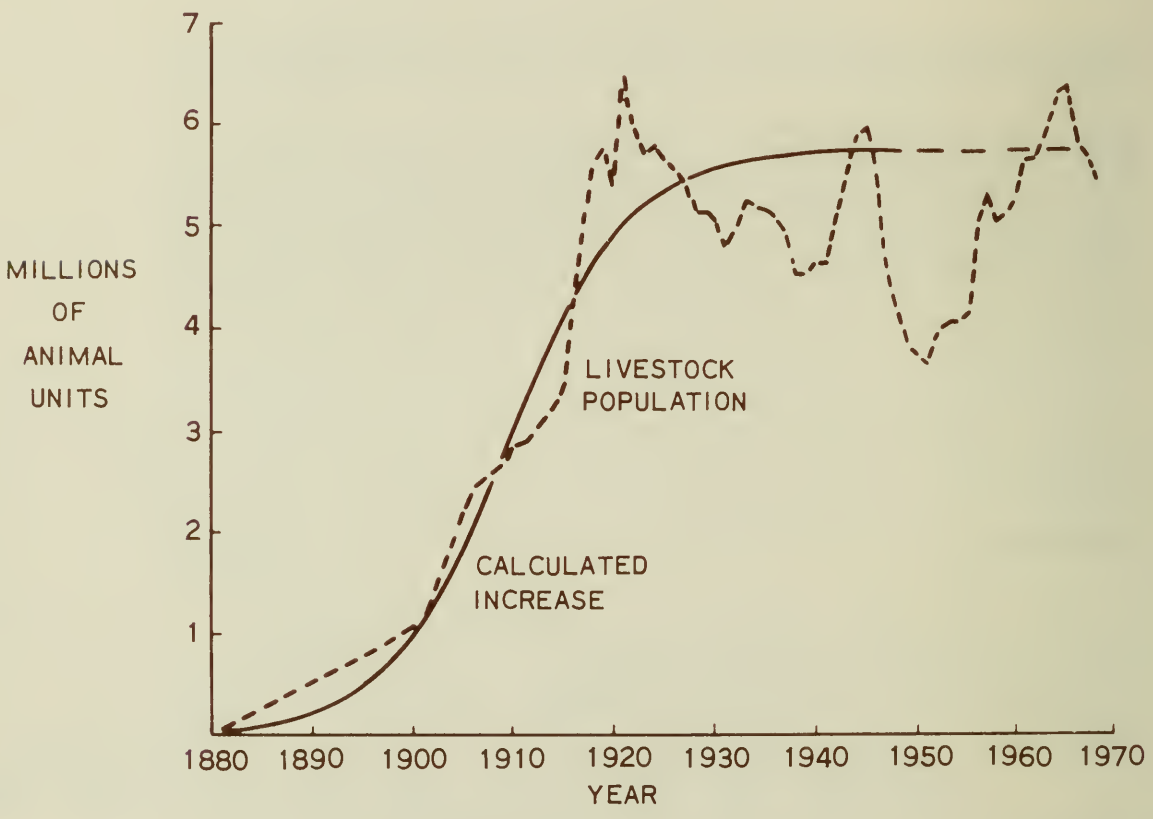


Figure 4. Livestock population and calculated increase in the Prairie Provinces. Numbers of beef cattle, horses, and sheep are given in animal units (one animal unit equals 1.0 cow, 0.8 horse, or 5.0 sheep).

Table 2. Acreages of native range and improved pasture, and cattle inventories for various sizes of farms, June 1, 1966

Size of farm or ranch (acres)	Native grass (thousand acres)	Improved pasture (thousand acres)	Number of cattle		
			thousands	%	
Less than 400	895	194	289		Manitoba
	1,164	145	257		Saskatchewan
	1,643	488	680		Alberta
	3,701	828	1,226	17.6	Total
400–759	1,485	266	396		Manitoba
	2,993	368	612		Saskatchewan
	2,718	603	861		Alberta
	7,196	1,236	1,868	26.7	Total
760–1,599	1,661	206	328		Manitoba
	5,229	617	909		Saskatchewan
	3,881	629	940		Alberta
	10,772	1,452	2,169	31.0	Total
More than 1,600	1,384	104	138		Manitoba
	9,207	780	629		Saskatchewan
	11,605	591	959		Alberta
	22,196	1,475	1,726	24.7	Total
Total	5,425	770	1,151		Manitoba
	18,593	1,910	2,398		Saskatchewan
	19,847	2,311	3,440		Alberta
	43,865	4,991	6,989	100	Total

percent of the improved pasture, yet they have 51 percent of the native range. These figures show the importance of the smaller farm to the livestock industry. The table may distort the situation, because the smaller units appear to use their range and pasture more efficiently. Generally, the larger units practice a more extensive system of grassland management, whereas the smaller ones make greater use of improved pasture and crop residues.

In 1966, 43.8 million acres of native pasture, 4.4 million acres of bush range, 5.0 million acres of seeded pasture, and 6.5 million acres of hay and fodder provided feed for about 5.8 million animal units in the Prairie Provinces. Also, about 12 percent of the grazing was obtained from stubble fields and crop residues.

VEGETATION ASSOCIATIONS

Five vegetation associations are found in the prairie range: Mixed Prairie, Fescue Prairie, True Prairie, Tall-grass Prairie, and Parkland. The grassland merges into parkland at the western, northern, and eastern margins and at the higher elevations. Groves of aspen distinguish the parkland, and white spruce increases in abundance northward.

The grasslands differ in species composition and can be identified by their major dominants. Each vegetation type or plant association includes two or three dominant species. The main vegetation types found in the Mixed Prairie are *Stipa-Bouteloua, Stipa-Bouteloua-Agropyron, Stipa-Agropyron, Agropyron-Koeleria,* and *Bouteloua-Agropyron.* Fescue Prairie is dominated by a single species, *Festuca scabrella.* True Prairie is dominated by *Stipa-Sporobolus,* and Tall-grass Prairie by *Andropogon* species. Parkland contains grassland and aspen forest.

Some of the grasses cure on the stem, retaining their form and most of their nutrients for several months after growth ceases. Cured grasses contain little crude protein or phosphorus but much digestible carbohydrate. Many of the grasses of the Mixed and Fescue prairies cure, whereas few species of the True and Tall-grass prairies or Parkland do.

Mixed Prairie

Stipa-Bouteloua Type — The *Stipa-Bouteloua* type occurs on soils of medium texture in the drier parts of the Brown soil zone. This type occurs also on soils of coarser texture in the Dark Brown soil zone and on sandy loam solonetzic soils. The type is found where average annual precipitation is 10 to 14 inches and the precipitation-to-evaporation ratio is less than 0.4. These dry conditions favor the growth of short grasses. Therefore, this grassland is commonly called the Short-grass Plains. Experience has shown that this land should be used as range.

Needle-and-thread[1] and blue grama have the highest ground cover of the grasses on this type of Mixed Prairie, and are dominant (Figure 5). Other grasses may dominate locally. Associated grasses are June grass, western wheat grass, and Sandberg's blue grass. Thread-leaved sedge is abundant on eroded sites and hillsides. Abundant forbs are moss phlox and little club-moss. Shrubs include pasture sage and silver sagebrush.

Little club-moss is an important constituent of the vegetation. Sometimes its ground cover exceeds all other species combined,

[1]The spelling of common names follows the rules in *Common and Botanical Names of Weeds in Canada,* Can. Dep. Agr. Publ. 1397. 1969.

Figure 5. *Upper left:* Fescue Prairie in the foothills of the Rocky Mountains. The nearly continuous grass phase is shown; carrying capacity decreases as trees and shrubs encroach on the grassland. *Upper right: Stipa-Agropyron* type of Mixed Prairie, which is transitional between Mixed Prairie and Fescue Prairie. *Lower left: Stipa-Bouteloua-Agropyron* type. *Lower right: Stipa-Bouteloua* type of the Mixed Prairie, commonly called the Short-grass Plains.

and comprises from 10 to 35 percent of the total. It provides no forage, but helps to prevent wind and water erosion and reduces the effects of trampling. Grasses readily become established in club-moss stands during years of above-average precipitation but rarely in dry years.

Overgrazing of the *Stipa-Bouteloua* type reduces the amount of needle-and-thread, June grass, and western wheat grass. Blue grama, Sandberg's blue grass, and low sedge may increase, as well as broomweed, plains prickly-pear, moss phlox, and pasture sage.

Stipa-Bouteloua-Agropyron Type — The *Stipa-Bouteloua-Agropyron* type occurs on medium-textured soils developed upon undifferentiated glacial till in the moister parts and north-facing slopes of the Brown soil zone and the drier parts of the Dark Brown soil zone. This type is found where annual precipitation is less than 14 inches and the precipitation-to-evaporation ratio is about 0.4. Medium-tall grasses, or midgrasses, are more abundant than in the *Stipa-Bouteloua* type.

Needle-and-thread, western porcupine grass, blue grama, and the wheat grasses make up about 70 percent of the total vegetation. Other grasses are June grass, reed grasses, Sandberg's blue grass, and green needle grass. Low sedge is common. Associated forbs and shrubs are moss phlox, little club-moss, pasture sage, silver sagebrush, and roses.

With proper management the midgrasses can be maintained in the stand. The first evidence of overgrazing is the disappearance of the midgrasses and an increase in blue grama. As overgrazing progresses pasture weeds increase in density, particularly pasture sage, moss phlox, broomweed, little club-moss, and prairie-crocus.

Stipa-Agropyron Type — The *Stipa-Agropyron* type occurs on well-developed soils of intermediate texture throughout most of the Dark Brown soil zone and the adjacent moister parts of the Brown soil zone. This type occupies rolling topography and sheltered, lower slopes of hills. The type tends to be transitional between the Mixed and Fescue prairies. It is found in areas where annual precipitation is 14 to 18 inches and the precipitation-to-evaporation ratio is 0.5 to 1.0.

Important species are western porcupine grass, needle-and-thread, northern wheat grass, and western wheat grass. These species produce 75 percent of the total forage. Associated grasses are blue grama, June grass, Sandberg's blue grass, and green needle grass. Low sedge is common. Forbs and shrubs are moss phlox, little club-moss, prairie-crocus, roses, pasture sage, and western snowberry.

Low-growing species such as blue grama, June grass, Sand-

berg's blue grass, and low sedge, as well as little club-moss, pasture sage, and other shrubs become abundant on overgrazed range. Most of this type is now farmed. Only the hilly, stony, sandy, or rough areas are used for grazing.

Agropyron-Koeleria Type — The *Agropyron-Koeleria* type occurs on soils developed on uniform clay deposits that occupy the beds of former glacial lakes. The lacustrine clay soils are desirable for farmland, and only a few areas are being used for grazing. This type occurs in the Brown and Dark Brown soil zones.

Dominant grasses are northern and western wheat grass, and June grass. These species produce about 75 percent of the forage. Green needle grass, Sandberg's blue grass, and low sedge occur in small amounts. Fewer forbs are found in this type than in others, but moss phlox and pasture sage are common. Winterfat is characteristic, but blue grama and needle-and-thread are rare or lacking. Wheat grasses are adapted to the shrinking and cracking of clay soils. During drying, the tearing action separates young wheat grass plants from parent plants, whereas it destroys the crowns and roots of bunchgrasses.

When overgrazed, the wheat grasses are reduced in vigor, and low-growing plants such as June grass, Sandberg's blue grass, and low sedge increase in abundance. Weedy forbs and shrubs such as moss phlox, plains prickly-pear, broomweed, and pasture sage increase also.

Bouteloua-Agropyron Type — The *Bouteloua-Agropyron* type occurs on light- to heavy-textured solonetzic soils in the Brown soil zone. During the solonetzic process the Ah horizon was removed in 'burnouts' or eroded patches. The relatively impervious subsoil left exposed is suited to the growth of wheat grasses. Where topsoil remains, blue grama is codominant with the wheat grasses.

Western and northern wheat grasses and blue grama provide about 70 percent of the forage. Associated grasses are needle-and-thread, June grass, Sandberg's blue grass, and plains reed grass. Forbs and shrubs are moss phlox, little club-moss, plains prickly-pear, silver sagebrush, pasture sage, winterfat, and salt-sage atriplex.

When overgrazed the midgrasses decrease in abundance, whereas blue grama and Sandberg's blue grass increase. Low sedge, little club-moss, plains prickly-pear, and pasture sage increase under prolonged heavy grazing.

Other Vegetation Types — Throughout the Mixed Prairie differences in climate, topography, soil depth, soil texture, presence or absence of a water table, and salinity are shown by differences in vegetation. Examples of important types and associated soil conditions follow.

Vegetation type	*Soil description*
Needle-and-thread, blue grama, sand dropseed, sand reed grass, June grass, and western porcupine grass	Upland; sandy loam soil
Needle-and-thread, sand reed grass, northern wheat grass, Canada wild rye, sand dropseed, Indian rice grass, and black choke cherry	Sandhill prairie; stabilized dune sands
Alkali grass, wild barley, Nuttall's salt-meadow grass, alkali cord grass, and seaside arrow-grass	Sloughs and salt meadows; saline soils
Reed grasses, spangletop, manna grass, prairie muhly, slender wheat grass, tufted hair grass, awned sedge, and slough grass	Sloughs and marshes; soils not saline
Western wheat grass, alkali grass, silver sagebrush, and greasewood	Low-lying, level areas; saline soils

Fescue Prairie

Festuca scabrella Type — The *Festuca scabrella* type occurs in the foothills of the Rocky Mountains, in the Cypress Hills, on other hilly areas, and over most of the Dark Brown, Black, and Gray Wooded soil zones in Alberta and Saskatchewan. Only the stony, sandy, or hilly portions are used for grazing; the rest is farmed. This type is found where annual precipitation is 18 to 22 inches and the precipitation-to-evaporation ratio is about 1.0.

The type is characterized by the presence of rough fescue, which may range from completely dominant along the northern fringe to codominant with western porcupine grass along the southern portion.

Associated with rough fescue are Parry oat grass (in the southern foothills of the Rocky Mountains only), Idaho fescue, sheep fescue, wheat grasses, porcupine grass, western porcupine grass, June grass, and wild oat grass. Forbs are prairie-crocus, silvery lupine, northern bedstraw, and chickweed. Shrubby cinquefoil, western snowberry, and roses are common shrubs.

Rough fescue is sensitive to summer grazing and disappears when grazed heavily. Therefore, where rough fescue is present in abundance the range is in good condition. In the southern foothills of the Rocky Mountains, overgrazing results in replacement of rough fescue by Parry oat grass, Idaho fescue, wheat grasses, and June grass. Forbs and shrubs that increase include pussytoes, pasture sage, and shrubby cinquefoil. Elsewhere rough fescue is replaced by western porcupine grass, wheat grasses, June grass, blue grasses, sedges, and numerous weeds.

True Prairie

Stipa-Sporobolus Type — The *Stipa-Sporobolus* type occurs along the eastern edge of the Mixed Prairie. Most of the land of this type has been plowed and used for production of cereals and forages, except for the high-lime soils of the Interlake district of Manitoba and the sandy soils and areas of rough topography along the Manitoba Escarpment. This type has a high carrying capacity during the growing season. Few of the grasses cure on the stem, and the nutritive value of the forage decreases after fall frosts.

Tall-grass Prairie

Andropogon-Sorghastrum Type — Practically all this type is cultivated for cereal, forage, and truck farming. Relict areas show that big bluestem, Indian grass, little bluestem, prairie cord grass, and switch grass were the dominant species.

Parkland

Parkland is grassland interspersed with groves of aspen; grassland occupies the drier situations, and aspen the moister and more sheltered places. Parkland is transitional between prairie and forest. It extends as a fringe along the foothills of the Rocky Mountains in southern Alberta, northeastward as a broad belt across south central Alberta into Saskatchewan, and southeastward into southwestern Manitoba. The northern part of this type is mostly forest with occasional patches of grassland, whereas the southern part is mostly grassland with occasional groves of aspen.

In Alberta and Saskatchewan, Parkland developed largely in Fescue Prairie. True Prairie, and to a lesser extent Mixed and Tall-grass Prairie, composed the cover in Manitoba before the invasion of aspen. Parkland has evolved within about the last 150 years.

The tree cover changes gradually, depending on the area. In the foothills of the Rocky Mountains lodgepole pine, white spruce, and Douglas fir succeed aspen. Jack pine and balsam poplar are plentiful northward on upland, and black spruce grows in low boggy areas. Bur oak, balsam fir, and white birch increase eastward. The grasses are largely those found in the associations from which Parkland developed, though hairy wild rye, slender and awned wheat grass, fringed brome, and wild peavine are common throughout.

MANAGEMENT TO MAINTAIN YIELD

The aim of range management is to maintain a productive sward under a maximum load of animals. The three basic rules of good range management are:

- Maintain a balance between the carrying capacity and the number of animals using the range
- Alternate the periods of grazing and rest to maintain the productivity of the range
- Distribute animals evenly on the range.

Carrying Capacity

Carrying capacity is a measure of the productivity of the range in terms of the number of acres needed to supply feed for a mature beef cow or equivalent (see Appendix). Carrying capacity may be calculated on a monthly or seasonal basis. It is dependent upon the productivity of the vegetation. And because vegetation types differ in productivity, they differ also in carrying capacity (Figure 6).

Within an area dominated by one vegetation type, variations in soils, exposure, and drainage may result in sites of different forage production because of resultant differences in species composition (Table 3). Also, within an area dominated by one vegetation type, differences in carrying capacity may be due to variations in condition of vegetation or to climatic variation.

Climatic variation, especially precipitation, results in high year-to-year variability. At Manyberries, Alberta, in the *Stipa-Bouteloua* type, 3.7 inches of rainfall in May and June are needed to produce 317 pounds of forage per acre. But the rainfall in May and June at Manyberries was 1.8 inches in 1930 and 9.6 inches in 1953, and the yield of dry matter was from 84 to 825 pounds per acre. From these studies equations were developed to show the relationship between rainfall and yield (Table 4). No relationship has been found between rainfall in April and yield. Soil moisture in the fall and the yield of grass in the succeeding year were found to be closely related.

Based on the regression equation for the *Stipa-Bouteloua-Agropyron* type (Table 4), grass yields at Swift Current, Saskatchewan, between 1888 and 1960 were from 20 to 1,650 pounds per acre, and averaged 480 pounds. In 27 of the 72 years, there was not enough growth to maintain the livestock load. During 23 years there was enough grass to meet grazing needs and to provide a carry-over of about 40 percent. Growth exceeded livestock requirements in only 22 of the 72 years.

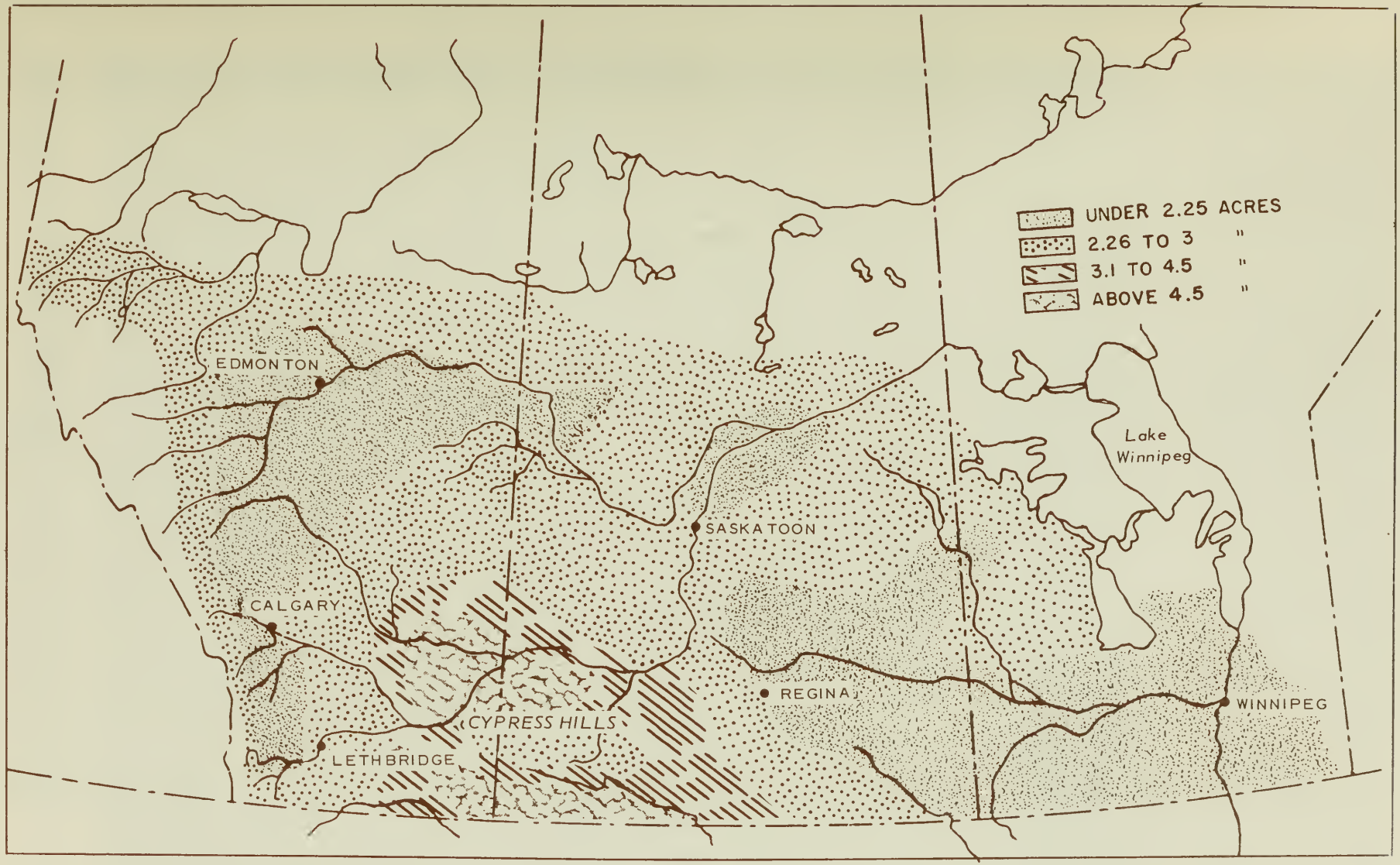


Figure 6. Carrying capacities, in acres per animal unit month, of the native grasslands of the Prairie Provinces.

Carrying capacity can be determined by experience, by trial-and-error grazing tests, or by estimating forage yields.

Average forage yields can be determined by clipping sample plots over a period of time. Another method of estimating forage yield is to determine the ground cover by species, using the point quadrat method of vegetation analysis. These data are converted to pounds of forage per acre by means of forage yield tables.[2] The

Table 3. Percentage ground cover, and estimated mean yields and carrying capacities at two selected sites

Plant species or other cover	Mixed Prairie				Fescue Prairie	
	Stipa-Bouteloua-type		*Stipa-Bouteloua-Agropyron* type		*Festuca scabrella* type	
Blue grama	4.1	7.3	1.8	2.0	—*	—
Needle-and-thread	0.7	1.3	1.4	0.4		
Sandberg blue grass	1.0	0.8	0.5	—	—	—
June grass	0.5	1.0	0.9	1.0	0.4	1.2
Western wheat grass	1.4	0.7	0.7	0.6	1.6	0.7
Sun-loving sedge	0.5	1.7	1.5	1.6	1.3	2.2
Western porcupine grass	—	—	1.9	2.4	1.6	0.1
Northern wheat grass	—	—	0.8	0.5	1.1	0.6
Rough fescue	—	—	0.5	1.6	3.2	4.6
Idaho fescue	—	—	—	—	0.1	1.1
Parry oat grass	—	—	—	—	—	5.0
Other grasses and sedges	0.4	1.1	1.1	0.4	2.1	1.2
Pasture sage	0.5	0.7	1.6	2.5	—	—
Moss phlox	0.2	0.5	0.4	0.2	—	—
Roses	—	—	0.2	0.1	0.9	0.2
Western snowberry	—	—	0.1	0.1	0.4	0.2
Three-flowered avens	—	—	—	—	0.6	0.3
Silvery lupine	—	—	—	—	0.1	0.4
Shrubby cinquefoil	—	—	—	—	0.2	1.3
Other forbs and shrubs	0.7	0.4	1.2	1.1	3.5	3.6
Little club-moss	6.5	8.7	3.2	4.1	0.8	—
Estimated mean annual yield (in pounds dry matter per acre)	270	330	425	550	660	1,080
Acres per animal unit month	4.5	3.5	2.8	2.2	1.8	1.1

* — indicates that this plant is absent.

[2]Lodge, R. W., and J. B. Campbell. 1965. The point method and forage yield tables for determining carrying capacity. Mimeo. Publ., Res. Branch, Can. Dep. Agr. Res. Sta., Swift Current, Sask.

Table 4. Correlation coefficients (r) and regression equations showing relationship between rainfall (x), in inches, and grass yields (y) in pounds/acre

Period of rainfall	Vegetation type			
	Stipa-Bouteloua		*Stipa-Bouteloua-Agropyron*	
	r		r	
April	0.05	—*	0.03	—
May and June	0.86	$y = 27 + 78x$	0.74	$y = 1 + 118x$
April–July	0.84	$y = -78 + 68x$	0.90	$y = 240 + 104x$

* — indicates that there is no value to the regression equation.

sum of the species yields is an estimate of the average total forage yield. To allow for carry-over, only 55 percent of the total yield is used in the calculation of carrying capacity. A 1,000-pound cow needs about 660 pounds (dry matter) of feed per month. Therefore, the number of acres needed to provide feed for a 1,000-pound cow for 1 month is estimated by the equation:

Carrying capacity (in acres per animal unit month) = 660/(0.55 × number of pounds of dry matter per acre).

The carrying capacity of Fescue Prairie has been determined by trial and error at Stavely, Alberta. Four grazing rates were tested: 12, 9, 6, and 3 acres per animal unit for 6 months of summer grazing. Nine acres of range produced enough feed for a cow and calf, and provided a carry-over that maintained a stable cover.

Measurements of plant cover for various rates of grazing of Fescue Prairie showed that rough fescue was greatly reduced under heavy and very heavy grazing (Table 5). As the productive grasses disappeared, shrubs and weeds increased. These changes increased runoff, caused soil erosion, and reduced yield.

Carrying capacity is affected by the "state of health" or condition of the range. For example, the *Stipa-Bouteloua* type varied in carrying capacity from 3.5 to 8.6 acres per animal unit month, depending upon the condition of the range (Table 6).

Carrying capacity may also be expressed in terms of liveweight gain per acre. Yields of animal products and actual gains from grazing tests in various locations in the Mixed and Fescue prairies are given in Table 7. The range of estimated gain per acre allows for differences in the productivity of vegetation from place to place. When allowances are made for this variation in productivity, there is a close relationship between estimated and actual beef yields.

Table 5. Percentage ground cover for Fescue Prairie grazed at five rates for a 6-month summer season

Species	Rate of grazing				
	Ungrazed	Light	Moderate	Heavy	Very heavy
Parry oat grass	5.6	9.7	10.0	7.3	5.4
Rough fescue	6.2	3.1	2.4	0.5	absent
Idaho fescue	1.3	2.0	1.8	1.5	1.6
Western porcupine grass	0.2	0.5	0.6	1.4	1.1
Other grasses and sedges	3.4	3.7	2.0	4.6	5.3
Forbs and shrubs	6.2	5.0	6.5	7.4	8.1
Total ground cover	22.9	24.0	23.3	22.7	21.5
Estimated yield of dry matter (in pounds per acre)	1,109	1,057	967	769	640

Carry-over

Carry-over is the grass that is left on the ground at the end of the grazing season. On summer ranges, the carry-over should be about 45 percent of the current year's growth of grass. Carry-over is easily seen, and may be used as an indicator of range condition.

Carry-over is necessary because plants manufacture their own food in their green leaves. On summer ranges about half the leaves should be left to manufacture food reserves, which are stored in the roots and crowns. Such food reserves ensure continuing vigor, productivity, and longevity. Carry-over also traps snow and increases soil moisture, protects the crowns of plants, and allows for production of seed.

Table 6. Carrying capacity, in acres per animal unit month, as influenced by range condition

Vegetation type	Condition class			
	Excellent	Good	Fair	Poor
Stipa-Bouteloua	3.5	4.3	5.6	8.6
Stipa-Bouteloua-Agropyron	2.7	3.5	4.4	6.3
Agropyron-Koeleria	2.1	2.7	3.4	4.8
Stipa-Agropyron	2.0	2.4	3.3	4.4
Festuca scabrella	1.5	2.0	2.7	3.3

Table 7. Yields of animal products, in pounds per acre, in grazing tests

Vegetation type	In tests			By estimate	
	Yearling ewes	Steers	Total cows and calves	Steers	Total cows and calves
Stipa-Bouteloua	8.3	8 and 9	11–14	7–13	10–16
Stipa-Bouteloua-Agropyron	—*	19	—	12–22	13–25
Festuca scabrella	—	—	54	23–39	25–55
Crested wheat grass	21.7	50	—	30–50	—
Russian wild rye	26.3	65	—	35–65	—

* — indicates that there is no data.

A carry-over of 45 percent every year is an impractical goal. Yields vary widely from year to year and, in a stable livestock operation, carry-over varies widely also. Range is not damaged by overuse during dry years if growth and carry-over are low, because the range will regain vigor during wet years when growth and carry-over are high. For example, on Mixed Prairie from which forage was removed for 6 years to simulate grazing, carry-over was from 32 to 73 percent, and averaged 49 percent. It is best to aim at a rate of grazing that, over several years, will leave about 45 percent of the forage on the ground as carry-over.

Carry-over is not as important on winter ranges as it is on summer ranges, because all the necessary food has already been stored in the roots and crowns before grazing starts. Stocking rates can be increased considerably if grazing is limited to the winter season. Carry-over can be less than 45 percent on cultivated pastures, because the cultivated grasses can tolerate more foliage removal than the native grasses.

The value of carry-over has been demonstrated by clipping plants of rough fescue (Figure 7). Tiller production, root weight, and forage production decreased as clipping intensities were increased (Table 8). Similar decreases occurred when needle-and-thread was utilized too heavily (Table 9).

Grazing may change the composition of a sward. In Mixed Prairie, needle-and-thread often becomes more abundant when a carry-over of about 45 percent or more is maintained. But low-yielding plants such as blue grama and thread-leaved sedge or weedy plants such as pasture sage become more abundant when grazing is intensified. The variation in percentage composition of Mixed Prairie pastures after 10 years of grazing is given in the following table.

Species	Ungrazed (%)	Moderately grazed (%)	Overgrazed (%)
Wheat grasses	70	20	10
June grass	10	0	0
Needle-and-thread	20	40	10
Blue grama	0	20	40
Thread-leaved sedge	0	0	20
Pasture sage	0	20	20

Figure 7. Sods of rough fescue clipped in the greenhouse at different heights every 4 weeks for 5 months. *Left to right:* not clipped; clipped to 5, 3, and 1½ inches. The decrease in food reserves is shown by the decrease in root volume as the intensity of clipping is increased.

Table 8. Tillering and weight of roots and leaves of rough fescue clipped to three heights every 4 weeks for 20 weeks

Treatment	Number of tillers		Weight of 10 plants at the end of test (grams)	
	At the start of test	At the end of test	Roots	Leaves
Not clipped	87	431	147	202
Clipped to 5 inches	77	427	78	160
Clipped to 3 inches	81	192	30	59
Clipped to 1½ inches	73	53	7	18

Table 9. Annual yields and percentage survival of needle-and-thread when clipped every month for 4 summers

Percentage clipped	Yield per 100 plants (grams)	Plants living after 4 years (%)
20	97	100
40	96	100
60	82	100
80	72	77
100	60	50

Grazing Season

There are two concepts of the term grazing season. The first concept refers to the safety of the animals. Animals can graze safely from the time the danger of spring storms is over until snow prevents foraging. The grazing season lasts 7 to 10 months in the southern districts, but is less than 6 months at the northern limits of the Parkland.

The second concept refers to the strength of the sward. It is best to defer grazing until the grasses are manufacturing and storing food. Therefore, the date to begin grazing varies each year. The range is ready when certain well-known plants are in bloom. For the Mixed Prairie, animals can start grazing when the golden-bean is in full flower, usually late in May. For the Fescue Prairie, grazing should start when the shooting-star flowers.

Different grass species start growth at different times. In the Mixed Prairie, the order of growth is Sandberg's blue grass, June grass, western wheat grass, needle-and-thread, western porcupine grass, and blue grama; the last plant is about 6 weeks later than the first. In the Fescue Prairie, the order is rough fescue, Parry oat grass, Idaho fescue, wheat grasses; the wheat grasses are about 4 weeks later than the rough fescue. When grasslands are grazed too early in the spring, one or two species carry the load and their stands and productive capacity become reduced. Growth of most grasses is slow until late May but is fairly fast during June and July (Figure 8). Rapid growth begins when the soil temperature 6 inches below the surface reaches 50–55° F. Crested wheat grass and Russian wild rye start to grow at least 2 weeks earlier than native grasses and at a much lower soil temperature.

The later in May or June that grazing is delayed, the greater the yield of forage. Simulated grazing tests started in late April, late May, and late June showed that yield was highest when clipping was delayed until late June (Figure 9).

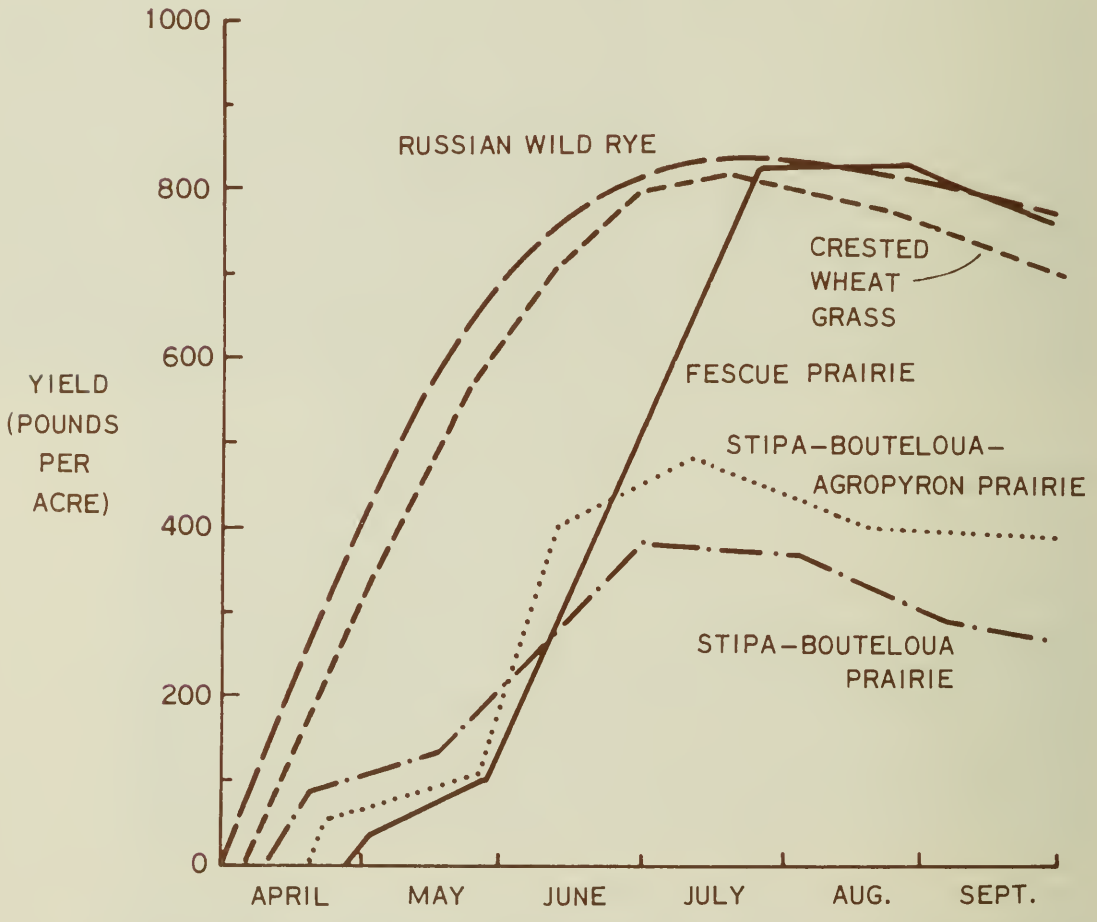


Figure 8. Average yields of dry matter per acre from five types of pasture.

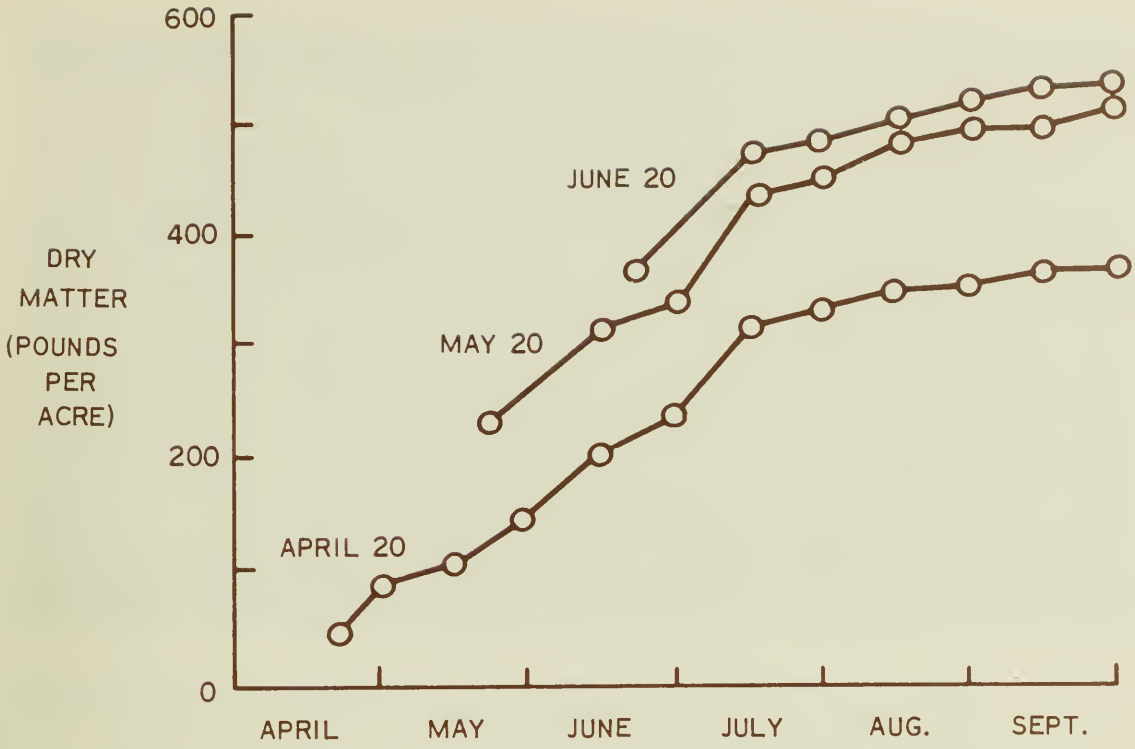


Figure 9. Average cumulative yields of Mixed Prairie when clipping at 2-week intervals was begun on three dates, April 20, May 20, and June 20.

Grazing Methods

Many stockmen have worked out grazing methods that meet their own requirements. Some ranchers use two main fields, one for summer and the other for winter. One method is to subdivide the summer range into two fields and to graze each field every second year with twice the livestock load, or to graze the fields in rotation in a spring–summer and a summer–fall system. Another method is to divide the summer range into three fields and to use each for about one-third of the grazing season.

Some of these systems have been studied in grazing tests. Results show that one field grazed continuously produces as much or more animal gain than two or three fields grazed in rotation at the same rate of stocking. Results were similar on Fescue Prairie, Mixed Prairie, and grass–alfalfa pastures on Mixed Prairie (Table 10). None of the previously mentioned systems has marked advantages, though the grass cover is sometimes greater when a rotation is practiced, and livestock gain per acre is sometimes greater when continuous grazing is practiced. Rotational grazing helps the grass, because the plants can set seed and maintain food reserves.

A test on Mixed Prairie showed the value of grazing crested wheat grass and native range in a complementary system. Crested

Table 10. Comparison of continuous grazing and deferred grazing on three fields in rotation

Item	Liveweight gain per acre (pounds)		Grass cover (%)	
	Continuous grazing	Deferred rotation	Continuous grazing	Deferred rotation
Mixed prairie*				
Steers	8.7	8.0	7.2	7.4
Cows and calves	13.2	11.8	7.4	8.2
Yearling ewes	8.3	no data	10.1	no data
Grass – alfalfa pasture†				
Yearling ewes	50.0	42.2	7.3	7.6

*Manyberries, Alberta.
†Swift Current, Saskatchewan.

wheat grass was grazed until late June, then the native range from late June to mid-October. This system carried 35 percent more animals and produced 6 percent more daily gain per steer than continuous grazing of native range from May to October. Also, the continuously grazed native range was grazed too heavily, but there was no sign of overuse on the native range that was protected until late June.

PASTURE AND HAY RESERVES

Year-round feed reserves are needed. The most practical means of ensuring feed reserves during the spring and summer are to maintain the correct carry-over, use moderate rates of stocking, defer grazing in spring, and use crested wheat grass or Russian wild rye for early pastures. Information on supplementary pasture for fall and on winter feed requirements follows.

Fall Pasture

During fall native grasses are low in protein and phosphorus, and high in carbohydrates. Stockmen overcome the lack of nutritive balance by pasturing annual cover crops, feeding protein supplements, or providing grass–alfalfa pastures.

A mixture of Russian wild rye and Rambler alfalfa provides good pasture in the fall in the Brown and Dark Brown soil zones.

Fall gains of yearling steers grazed on Russian wild rye – Rambler alfalfa and native range were:

Pasture	Gain per steer per day (pounds)	Gain per acre (pounds)
Russian wild rye – Rambler alfalfa	1.4	59
Mixed Prairie range	0.8	8

Results of a grazing test at Manyberries, Alberta, also showed that Russian wild rye pasture yielded three to four times more liveweight gain per acre than did adjacent native range.[3]

In the Fescue and True prairies and in the Parkland, creeping red fescue, brome grass, intermediate wheat grass, pubescent wheat grass, alsike clover, and Rambler alfalfa are the best pasture crops to complement range.

Winter Feed Supplies

Hay requirements for maintenance and gain (Table 11) were obtained from feeding a mixture of oat hay and alfalfa that contained 18 percent oat grain, 12 percent crude protein (CP), and 60 percent total digestible nutrients (TDN). Five-hundred-pound calves gained 1 pound when fed 14 pounds of this roughage daily. Gains would be higher with more grain and less bulk; loss of weight might occur if more straw were added or if the animals ate less.

Good-quality hay has a TDN rating of about 60 percent, and those of lower quality have TDN ratings of 45 to 53 percent (Table 12). Cereal straws have TDN ratings of about 40 percent, but all are low in protein; therefore, oil cake, alfalfa, or grain should be added to rations containing large amounts of straw. The higher TDN values of irrigated pasture crops are related to the high CP contents of the forage as well as to the greater availability of other nutrients in young plants.

The percentage of TDN can be considered to be the pounds of food or nutrients an animal can extract from 100 pounds of feed consumed. For example, if an 800-pound steer needs 15 pounds of forage with a TDN rating of 60 percent the animal would have to consume 18 pounds of hay with a TDN rating of 50 percent, or 20 pounds of feed with a TDN rating of 45 percent, for equal nutrient intake. Hay with low TDN ratings is not eaten readily. Therefore, intake may be reduced materially when livestock are fed roughages with low TDN values.

[3]Seeding Prairie Rangelands by J. K. Wiens, R. W. Lodge, and A. Johnston (1969) outlines seeding and management practices and possible economic benefits related to the seeding of native rangeland to cultivated forage crops.

Table 11. Winter hay requirements of cattle for maintenance and gain

Weight of animal (pounds)	Pounds of 50-50 oat hay – alfalfa fodder		Pounds of hay for maintenance for 150 days
	Maintenance	Gain of 1 pound per day	
351–450	6–8	8–10	1,050
451–550	9–11	12–14	1,500
551–650	10–12	14–16	1,650
651–750	12–14	16–19	2,100
1,000-pound cow in calf	15–18	21–24	2,400

No feed should be given an exact TDN rating if a sample has not been analyzed by a feed-testing laboratory. The stage of grazing or cutting, the methods of curing and handling, the weathering, and the nature of seasonal growth affect the nutritive content. The TDN value of poorly cured hay, or alfalfa that has lost part of its leaves, should be discounted by 5 to 10 percent. The advantages of feed mixtures are shown by comparing the TDN values for rough fescue and for western wheat grass with the higher values for the same grasses when mixed with alfalfa (Table 12).

COMMON AND BOTANICAL NAMES OF PLANTS MENTIONED

Grasses

alkali grass — *Distichlis stricta* (Torr.) Rydb.
alkali cord grass — *Spartina gracilis* Trin.
awned wheat grass — *Agropyron subsecundum* (Link) Hitchc.
beardless wheat grass — *Agropyron inerme* (Scribn. & Smith) Rydb.
big bluestem — *Andropogon gerardi* Vitman
blue grama — *Bouteloua gracilis* (H.B.K.) Lag. ex Steud.
brome grass — *Bromus inermis* Leyss.
creeping red fescue — *Festuca rubra* L.
crested wheat grass — *Agropyron cristatum* (L.) Gaertn.
fringed brome grass — *Bromus ciliatus* L.
green needle grass — *Stipa viridula* Trin.
hairy wild rye — *Elymus innovatus* Beal

Table 12. Percentages of crude protein (CP) and total digestible nutrients (TDN) in selected feeds

Crop	Grain		Good-quality hay		Straw		Irrigated pasture	
	CP	TDN	CP	TDN	CP	TDN	CP	TDN
Oats	12.7	80	9.5	54–60	4.5	42–48	16	65.5
Wheat	13.0	86	8.3	52	2.8	38	—*	—
Barley	12.0	85	9.3	57	3.8	46	—	—
Rye	12.4	85	—	—	2.6	45	—	—
Rough fescue	—	—	7.0	47–55	—	—	—	—
Rough fescue and alfalfa (2:1)	—	—	11.0	58	—	—	—	—
Western wheat grass	—	—	7.0	50–57	—	—	—	—
Western wheat grass and alfalfa (2:1)	—	—	11.0	58	—	—	—	—
Crested wheat grass	—	—	5.9	58	—	—	—	—
Intermediate wheat grass	—	—	5.9	56	—	—	—	—
Russian wild rye	—	—	6–14	57–61	—	—	—	—
Sedges	—	—	8.3	59	—	—	—	—
Reed canary grass	—	—	8.0	55	—	—	17	58.0
Rambler alfalfa	—	—	16.0	54–59	—	—	16	68.6
Rambler alfalfa and crested wheat grass	—	—	—	—	—	—	23	66.1
Rambler alfalfa and intermediate wheat grass	—	—	—	—	—	—	23	66.7
Rambler alfalfa and timothy	—	—	—	—	—	—	24	66.8
Rambler alfalfa and oat hay (1:1)	—	—	12.0	57–62	—	—	—	—

* — indicates that there is no data.

Grasses *(continued)*

Idaho fescue — *Festuca idahoensis* Elmer
Indian grass — *Sorghastrum nutans* (L.) Nash
Indian rice grass — *Oryzopsis hymenoides* (Roem. & Schult.) Ricker
intermediate wheat grass — *Agropyron intermedium* (Host) Beauv.
June grass — *Koeleria cristata* (L.) Pers.
little bluestem — *Andropogon scoparius* Michx.
manna grass — *Glyceria* spp.
needle-and-thread — *Stipa comata* Trin. & Rupr.
nodding wild rye — *Elymus canadensis* L.
northern wheat grass — *Agropyron dasystachyum* (Hook.) Scribn.
Nuttall's salt-meadow grass — *Puccinellia nuttalliana* (Schultes) Hitchc.
panic grass — *Panicum* spp.
Parry oat grass — *Danthonia parryi* Scribn.
plains reed grass — *Calamagrostis montanensis* Scribn.
porcupine grass — *Stipa spartea* Trin.
prairie cord grass — *Spartina pectinata* Link
prairie muhly — *Muhlenbergia cuspidata* (Torr.) Rydb.
pubescent wheat grass — *Agropyron trichophorum* (Link) Richt.

Idaho fescue — *Festuca idahoensis* Elmer
Indian grass — *Sorghastrum nutans* (L.) Nash
Indian rice grass — *Oryzopsis hymenoides* (Roem. & Schult.) Ricker
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prairie muhly — *Muhlenbergia cuspidata* (Torr.) Rydb.
pubescent wheat grass — *Agropyron trichophorum* (Link) Richt.

Grasses *(continued)*

rough fescue — *Festuca scabrella* Torr.
Russian wild rye — *Elymus junceus* Fisch.
slender wheat grass — *Agropyron trachycaulum* (Link) Malte
slough grass — *Beckmannia syzigachne* (Steud.) Fern.
spangletop — *Scolochloa festucacea* (Willd.) Link
switch grass — *Panicum virgatum* L.
timothy — *Phleum pratense* L.
tufted hair grass — *Deschampsia caespitosa* (L.) Beauv.
western porcupine grass — *Stipa spartea* Trin. var. *curtiseta* Hitchc.
western wheat grass — *Agropyron smithii* Rydb.
wild barley or foxtail barley — *Hordeum jubatum* L.
wild oat grass — *Danthonia intermedia* Vasey

Sedges

awned sedge — *Carex atherodes* Spreng.
low sedge — *Carex stenophylla* Wahl. ssp. *eleocharis* (Bailey) Hultén
sun-loving sedge — *Carex pensylvanica* Lam. var. *digyna* Böck
thread-leaved sedge — *Carex filifolia* Nutt.

Forbs, Shrubs, and Trees

alfalfa — *Medicago* spp.
alsike clover — *Trifolium hybridum* L.
aspen — *Populus tremuloides* Michx.
balsam fir — *Abies balsamea* (L.) Mill.
balsam poplar — *Populus balsamifera* L.
black choke cherry — *Prunus virginiana* L. var. *melanocarpa* (A. Nels.) Sarg.
black spruce — *Picea mariana* (Mill.) BSP.
broomweed — *Gutierrezia diversifolia* Greene
bur oak — *Quercus macrocarpa* Michx.
clovers — *Trifolium* spp.
crocus anemone — *Anemone patens* L. var. *wolfgangiana* (Bess.) Koch
Douglas fir — *Pseudotsuga menziesii* (Mirb.) Franco
field chickweed — *Cerastium arvense* L.
golden-bean — *Thermopsis rhombifolia* (Nutt.) Richards.
greasewood — *Sarcobatus vermiculatus* (Hook.) Torr.

Forbs, Shrubs, and Trees *(continued)*

Jack pine — *Pinus banksiana* Lamb.
little club-moss — *Selaginella densa* Rydb.
lodgepole pine — *Pinus contorta* Loud. var. *latifolia* Engelm.
moss phlox — *Phlox hoodii* Richards.
northern bedstraw — *Galium boreale* L.
salt-sage atriplex — *Atriplex nuttallii* S. Wats.
pasture sage — *Artemisia frigida* Willd.
plains prickly-pear — *Opuntia polyacantha* Haw.
pussytoes, or everlasting — *Antennaria* spp.
roses — *Rosa* spp.
seaside arrow-grass — *Triglochin maritima* L.
shooting-star — *Dodecatheon conjugens* Greene
shrubby cinquefoil — *Potentilla fruticosa* L.
silver sagebrush — *Artemisia cana* Pursh
silvery lupine — *Lupinus argenteus* Pursh
three-flowered avens — *Geum triflorum* Pursh

APPENDIX

Animal Unit and Equivalents

In range management an animal unit (AU) is a mature beef cow, with or without a calf. An animal unit month (AUM) is the amount of feed or forage required to support a mature cow for 1 month. Because other classes of animals eat more or less feed per day than a cow, calculations of stocking rates should take into account the differences in forage requirements among different classes of animals. Animal unit equivalents generally used in the Prairie Provinces are:

Class of animal	*Animal unit equivalent*
Cattle:	
Mature cow, with or without an unweaned calf	1.00
Weaned calves to 1 year old	0.60
Yearling heifers and steers	0.75
Bulls, 2 years and older	1.30
Horses:	
Yearlings	0.75
2-year-olds	1.00
Mature light horses	1.25
Sheep:	
Five ewes, with or without unweaned lambs	1.00
Five weaned lambs	0.60

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