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Forage production on selected native prairie sites in southern Alberta

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SUMMARY

Forage yields were determined on native range sites in southern Alberta that were protected from grazing. The clipping trial was initiated in 1969 on five sites and by 1981 was expanded to 26 sites. Carrying capacities were calculated on the basis of dry matter production and the feed requirements of a 450-kg (1,000 lb) cow for one month. When compared with grazing trials at Manyberries and Stavely, the calculated carrying capacities had to be adjusted to reflect production on grazed range. Grazed range produced 40% as much forage as did comparable protected or ungrazed range.

RESUME

Cette publication présente les résultats d'études sur les rendements fourragers de parcours naturels non broutés dans le sud de l'Alberta. 1969 marque le début des essais de coupe à 5 endroits d'abord, puis s'étendent progressivement jusqu'à 26 emplacements en 1981. Les taux de chargement ont été calculés d'après la production de matière sèche et les besoins alimentaires d'une vache de 450 kg pendant un mois. Aux fins de comparaison avec les essais de paissance menés à Manyberries et à Stavely, il a fallu corriger les taux de chargement calculés afin de tenir compte de la production fourragère des parcours broutés, cette dernière s'établissant à 40 % de celle de parcours comparables non broutés.

INTRODUCTION

Rangelands have always been associated with grazing animals. In Alberta, the early grazing animals were bison, deer, pronghorned antelope, and wapiti or elk. With the advent of settlers and the near-extermination of the bison, most of the wild grazing animals were replaced by cattle, sheep, and horses. Today, only a portion of the grasslands is used for grazing.

About 10% of the total land area in Alberta is rangeland--about 6.6 million hectares (16.2 million acres) of rangeland in 63.8 million hectares (157.7 million acres) total land area. Farmland occupies 12.5 million hectares (31.0 million acres), or about 20% of the total land area. Of the 6.6 million hectares of rangeland about 55% is leased from public agencies and 45% is privately owned.

Early settlement began on the readily accessible and more fertile soils. Thus, the grasslands were the first to be settled by ranchers and farmers. The rangelands that were left in their native state were not farmed because they were too steep, too dry, too rocky, too stony, or had too short a growing season for cultivated crop production.

During the period of rapid settlement, 1900-1925, much land suitable only for grazing was plowed and farmed. However, abandonment, which began in the late twenties, became general during the drought years of the thirties. Slowly, these lands were allowed to revert to native vegetation.

Nature tries to keep the soil covered with vegetation. If the original cover of the taller-growing grasses is destroyed by grazing or cultivation, nature will provide a cover of either weedy, woody, or unpalatable plants, or grasses so short that they will escape close grazing.

Most of the rangeland in Alberta, over the last 50 years, has been grazed fairly heavily. As a result, about 50% of the native range produces less forage than it is capable of growing. Native range on large ranches is generally in good condition; native range on small ranches in predominantly farming areas is generally in fair condition; and grazed small holdings of 16 hectares (40 acres) or less are generally in poor condition.

Range in pristine state may be found in areas that are ungrazed or only slightly grazed during the growing season, or grazed during the dormant season. Generally, such native range is located far from water, is otherwise inaccessible, or is located on well-managed winter fields.

Fortunately, there are such ungrazed or lightly grazed areas in Alberta. In addition, areas protected from grazing can be found along road allowances, railway right-of-ways, cemeteries, and inaccessible areas on

cropland or hay fields. Still other areas have been established as exclosures, set up as International Biological Program (IBP) Natural Areas or located in Provincial Parks. These areas still have the original or near-climax vegetation and are recognized as being ecological standards or benchmarks for monitoring and comparing presently existing vegetation to nature's potential.

Such benchmarks are very useful to various agencies dealing with grazing leases, grazing management systems, land assessment, and soil capability classification. These areas are also of great interest to ranchers and to students and research personnel at colleges, universities, and research establishments. They are widely distributed throughout southern Alberta representing numerous geographical areas and range sites (16).

Forage yields determined on these range sites can be used to estimate carrying capacity (the maximum stocking rate possible without inducing damage to vegetation or related resources). The carrying capacity is the area of land required to support an animal-unit (AU)[1] for a specified period of time. Carrying capacity may be expressed as a ratio in various forms such as: ha or ac/AU, AU/ha or ac, or AU/section, and may be calculated on a monthly, seasonal, or yearly basis. Because range sites and vegetation types differ in productivity, they will also differ in carrying capacity.

The forage data presented here give a measure of harvestable yield and are used synonymously with production, although it has been shown (5) that yield measurements based upon a single harvest of the maximum standing crop may be unreliable because shoot production continues from early spring until fall. In addition, the peak standing crop of a mixed stand of species may be difficult to measure as each species has a different growth habit. However, for the purposes of this report, the forage data obtained are indicative of the amount of vegetation available for grazing and will be used to determine carrying capacity.

To obtain the forage data, a clipping study was undertaken to document the production of forage on selected native range sites in southern Alberta and to provide a means for determining their carrying capacity in areas where grazing studies have not been carried out. The forage yields and established carrying capacities at the Manyberries (2) and Stavely (11, 15) Research Substations provide a means for comparing and estimating carrying capacity at locations where only long-term forage yields are available.

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[1]An animal unit (AU) is defined as one mature (450 kg or 1,000 lb) cow with or without an unweaned calf at side, or equivalent animals, and is based upon the average daily consumption of 11.8 kg or 26 lb dry matter.

PROCEDURE

Clipping trials were initiated in 1969 at five locations, including sites at the Manyberries and Stavely Research Substations where grazing trials have established carrying capacities for the areas. Three more sites were established in 1971, nine in 1972, four in 1976, two in 1977, and three in 1981. Thus, a total of 26 range sites was sampled for dry matter yields (Table 1). The locations of the clipping sites are indicated in Figure 1.

Range sites selected for the clipping trial included exclosures or areas receiving little or no grazing. These areas were generally located in corners of large grazing leases, unused corners of hay fields, or cultivation leases, road allowances, railway right-of-ways, abandoned school yards, cemeteries, Provincial Parks, and enclosures representing IBP Natural Areas (Table 1).

The dry matter yields were estimated by hand-clipping ten 0.25-m^2 areas at each location at the end of the growing season, usually in September. The 0.25-m^2 plot has been shown to be the most appropriate size in sampling mixed prairie grassland and 10 such plots provide acceptable estimates of forage production (4). The plots were randomly located and all vegetation inside was clipped at ground level. The vegetation was separated into current growth of grass, forbs, and shrubs. All dead material, representing growth from previous years, was harvested as litter, beginning in 1971. All samples were air-dried at room temperature for 30 to 60 days and then weighed. Dry matter yields were expressed as kilograms per hectare (kg/ha).

Detailed information on species composition and cover (1, 3, 10) and soil type (7) was obtained for most range sites. Precipitation data were not available for all sites but are presented in summary form for some locations near the study area. Long-term mean monthly precipitation totals (Table 2) are for the years 1969 to 1984 and are shown for representative locations (Fig. 1) for which continuous records were available.

RESULTS AND DISCUSSION

Dry matter yields

Mean dry matter yields of grasses, forbs and shrubs, total yield, litter, and total biomass are presented for each sampling site in Table 3. Mean yields of grasses ranged from a low of 204 kg/ha at Turin (Site 23) to a high of 2374 kg/ha on the north slopes at Big Valley (Site 5). The mean yield of forbs and shrubs ranged from a low of 51 kg/ha at Schuler (Site 19) to a high of 495 kg/ha at Milk River Ridge (south) (Site 3b). Forage yields at each of the 26 sites are given in the Appendix.

Table 1. Location of the 26 selected native range sites in Alberta (all locations west of 4th Meridian).

Site	Locality	Near	Legal description Sec.; T; R	Remarks
1	Research Substation	Manyberries	NE1/4,16;2;4	Exclosure
2	Research Substation	Stavely	NW1/4,22;14;29	Exclosure
3a	Milk River Ridge	Owendale	NW1/4,12;2;22	Exclosure (north)
3b	Milk River Ridge	Owendale	NW1/4,12;2;22	Exclosure (south)
4	Pinhorn*	Comrey	N1/2,18;2;6	IBP Natural Area
5a	Big Valley(N slope)	Scollard	NW1/4,14;34;19	IBP Natural Area
5b	Big Valley(S slope)	Scollard	NW1/4,14;34;19	IBP Natural Area
6	Twin River*	Del Bonita	E1/2,E1/2,4&9;1;18	IBP Natural Area
7	Claresholm	Claresholm	N1/2,22;12;28	Road allowance
8	Willow Creek	Stavely	NW1/4,28;13;28	Provincial Park
9	Little Fish Lake	Craigmyle	SW1/4,30;28;16	Road allowance
10	Sunnynook	Sunnynook	E1/2,19;27;12	Railway right-of-way
11	Berry Creek	Pollockville	SW1/4,15;25;11	Cemetery
12	Big Stone	Big Stone	SW1/4,15;26;9	Uncultivated portion
13	Neutral Hills	Consort	NE1/4,32;36;6	Uncultivated portion
14	Spencer	Loyalist	SW1/4,15;35;7	Uncultivated portion
15	Veteran	Veteran	NW1/4,32;34;8	Uncultivated portion
16	Loyalist	Loyalist	NW1/4,9;34;7	School yard
17	Misty Lake	New Brigden	SW1/4,30;32;4	Road allowance
18	Antelope Lake	Scotfield	SW1/4,13;31;10	Cemetery (Edwards)
19	Schuler	Schuler	NE1/4,16;17;2	Exclosure
20	Cypress Hills	Fox	SE1/4,29;7;1	Exclosure
21	Border Co-op*	Wildhorse	SW1/4,4;1;1	Exclosure
22a	Picture Butte	Picture Butte	NW1/4,29;10;20	Exclosure (north)
22b	Picture Butte	Picture Butte	NW1/4,29;10;20	Exclosure (south)
23	Turin	Turin	SW1/4,28;12;19	Exclosure
24	Hays*	Hays	SW1/4,17;13;13	Exclosure
25	Bow Island*	Suffield	SW1/4,28;13;10	Exclosure
26	Many Island Lake	Walsh	NE1/4,18;13;1	Exclosure

*Grazing reserve.

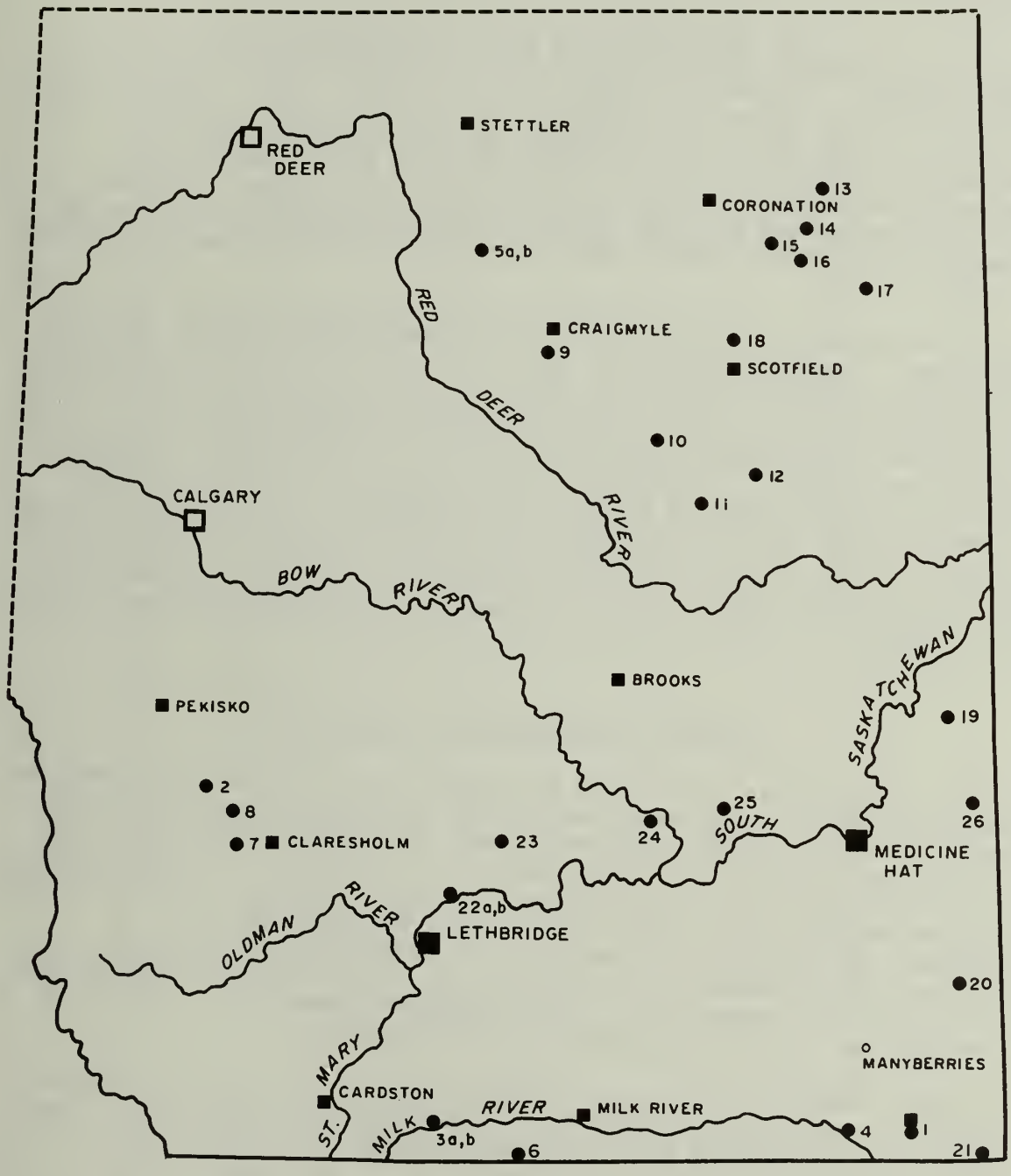

Fig. 1. Locations of selected clipping sites (●) and meteorological stations (■) in southern Alberta.

The mean yield of the total grass, forbs, and shrubs ranged from a low of 456 kg/ha at Turin (Site 23) to a high of 2,680 kg/ha at the Stavely Research Substation (Site 2). Amounts of litter and total biomass were lowest at Turin (Site 23) and greatest at the Stavely Research Substation (Site 2).

Litter contribution ranged from 22% (Site 23) to 69% (Site 2) of the total biomass. The generally greater percentage of litter, compared with the total grass, forbs, and shrubs in the biomass in this study, can be explained on the basis of our attempt to remove all dead material resulting from the growth in previous years on the assumption that weathered leaves were not part of the current year's crop. However, these values are not much out of line with those reported for nine IBP grassland study sites in North America (4), where litter ranged from 24% to 82%.

Annual variations in the dry matter yields generally were not great at each site. The large departures were the production of total vegetation at Stavely (Appendix Table 2) in 1970; forbs at Milk River Ridge (North) (Appendix Table 3) in 1978; litter at Pinhorn (Appendix Table 5) in 1972; litter and total biomass at Big Valley north slopes (Appendix Table 6) in 1974; grass and total vegetation at Big Valley south slopes (Appendix Table 7) in 1974; grass at Willow Creek (Appendix Table 10) in 1973; litter and total biomass at Berry Creek (Appendix Table 13) and Big Stone (Appendix Table 14) in 1972; forbs and shrubs at Misty Lake (Appendix Table 19) in 1978; grass and total vegetation at Schuler (Appendix Table 21) in 1982; and shrubs and total biomass at Border Co-op (Appendix Table 23) in 1981.

Effects of grazing on forage yields

Studies on the Mixed Prairie and the Fescue Prairie areas have shown that grazing, especially at heavy rates, reduces the plant vigor, decreases density of taller plants, reduces amounts of litter, and increases the risk of soil erosion. Soil temperature and soil moisture evaporation are also increased. Other studies suggest that grazing has a great influence upon the metabolism of a plant (13). With the reduction of photosynthetic tissue comes reduction in carbohydrate and nitrogen reserves, and decreased forage production. The volume and depth of the root system of a range plant is also affected by grazing. A reduction in food reserves slows the growth of the entire plant.

The lower production from grazed plants may also be associated with the effects of defoliation on tillering. Generally, the numbers of tillers produced by a plant are reduced by defoliation; the greater the severity of defoliation, the greater the decrease in tiller numbers (17). Defoliation through leaf removal retards tillering through a reduction of photosynthetically active tissue with a resulting reduction in carbon assimilation. The available carbohydrate supplies may be used for

Table 2. Long-term mean monthly precipitation totals (mm[1]) at selected locations near study sites.

Location	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Total
Brooks	19.5	16.9	14.1	29.7	36.9	74.2	33.9	39.1	40.5	16.0	16.4	20.0	357.2
Cardston	35.3	28.5	33.6	52.2	68.5	91.5	45.7	56.3	49.8	24.5	27.0	36.8	549.7
Claresholm	28.2	20.0	26.9	47.8	67.8	75.6	38.2	51.9	38.7	18.7	18.1	26.8	448.7
Coronation	21.5	17.1	20.7	23.8	36.0	57.6	63.0	51.6	32.7	15.0	15.0	19.6	373.6
Craigmyle	16.0	14.5	17.8	19.5	40.9	64.8	63.8	52.1	44.7	23.9	17.5	15.7	391.2
Lethbridge	23.6	18.9	24.2	42.7	50.8	78.2	43.5	47.1	37.2	17.8	16.8	21.9	422.7
Manyberries	21.1	17.0	21.6	28.2	38.9	70.1	31.2	29.2	24.1	16.0	14.0	16.8	327.2
Medicine Hat	22.7	16.6	18.5	30.2	40.1	63.5	40.4	36.4	32.4	16.2	14.6	16.3	347.9
Milk River	9.4	9.9	12.4	25.2	39.1	73.4	34.0	31.8	26.9	16.3	12.4	13.0	303.8
Pekisko	37.3	39.2	47.9	78.6	80.9	115.1	61.6	71.8	57.9	34.5	30.3	41.0	696.1
Scotfield	12.1	10.1	11.9	17.7	36.0	53.9	53.6	37.8	32.4	10.5	11.6	9.0	296.6
Stettler	20.8	20.1	18.8	19.5	35.8	79.2	77.7	61.0	37.6	16.5	16.8	16.3	420.1

[1]To convert precipitation total in table to inches, multiply by 0.039.

Table 3. Summary of mean yields (kg/ha) on ungrazed sites arranged on basis of total forage yield.

Site		Grass	Forbs	Shrubs	Total forage	Litter	Total biomass
23	Turin	204	250	2	456	130	586
26	Many Island Lake	376	120	0	496	244	740
24	Hays	436	93	3	532	331	863
25	Bow Island	538	99	0	637	427	1,061
11	Berry Creek	610	112	-*	722	437	1,159
1	Manyberries	562	143	43	748	434	1,156
21	Border Co-op	691	124	33	848	675	1,523
19	Schuler	816	50	1	867	462	1,329
22b	Picture Butte (S)	628	122	122	872	321	1,193
18	Antelope Lake	664	288	-	952	414	1,366
4	Pinhorn	909	96	5	1,010	908	1,902
10	Sunnynook	871	200	-	1,071	678	1,749
7	Claresholm	800	186	271	1,257	1,029	2,286
22a	Picture Butte (N)	1,294	82	104	1,480	790	2,270
20	Cypress Hills	1,232	166	87	1,485	1,477	2,962
8	Willow Creek	1,356	131	4	1,491	1,396	2,942
12	Big Stone	1,472	62	-	1,534	1,983	3,517
6	Twin River	1,357	198	23	1,578	1,731	3,309
3b	Milk River Ridge (S)	1,400	279	65	1,804	2,581	4,385
17	Misty Lake	1,751	99	-	1,850	1,832	3,682
5b	Big Valley (S)	1,709	190	5	1,904	1,134	3,091
13	Neutral Hills	1,911	86	-	1,997	2,123	4,120
14	Spencer	1,934	84	-	2,018	3,160	5,178
15	Veteran	2,209	114	-	2,323	1,874	4,197
3a	Milk River Ridge (N)	2,044	258	23	2,325	2,882	5,219
9	Little Fish Lake	2,273	86	-	2,359	4,173	6,532
16	Loyalist	2,124	239	-	2,363	3,302	5,665
5a	Big Valley (N)	2,374	59	37	2,470	3,408	5,932
2	Stavely	2,242	315	123	2,680	5,759	8,359

*Yield of shrubs included with that of forbs.

renewal of the leaf growth first and tiller growth last. A shortage of carbohydrates caused by defoliation also reduces the root system of grasses, and, in turn, affects the development of top growth. These processes would affect most of the native grasses when grazed and would help explain the lower forage productivity on grazed areas. However, the leaf replacement potential of a grass has been shown to be dependent upon time and rate of defoliation, environmental conditions, location of apical meristems, and species (6).

Grazing also alters, through defoliation, the microenvironment which results in changes in growth form, size or density of canopy, or in species composition of the community (9). The factors affecting microenvironment include moisture regime, interception and redistribution of precipitation by plant material, infiltration as influenced by standing vegetation, litter accumulation, and trampling. Any change in any one of the above factors, induced directly or indirectly by grazing, has an effect on the overall microenvironment.

Studies on the microclimate of Mixed Grass prairie (14) have shown that the reduced mass of plant material on a grazed site could be expected to have substantial microenvironment influences. Air temperatures over the grazed vegetation averaged 1.5°C higher than temperatures over ungrazed vegetation, while soil temperatures to a depth of 120 cm were also higher under the grazed vegetation, averaging 21.4°C for the season on the grazed and 17.9°C on ungrazed plots. Wind movement at 15 cm averaged 2.1 km/hr on the grazed area and 0.6 km/hr on the ungrazed. Soil moisture was slightly greater in the ungrazed area than in the grazed area until after midsummer, but available moisture was exhausted about the same time on both areas. Relative humidity and vapor pressure deficit differences were relatively small between the two areas but the results indicate that evaporative conditions near the ground were somewhat more severe on the grazed than on the ungrazed area. Some measurements of net radiation and soil heat flux indicated that there were differences in the energy budgets under the two grazing treatments.

Determining carrying capacity

Carrying capacity can be determined by experience, by experimental grazing tests, or by estimating forage yield.

Forage yields have been used most frequently to determine carrying capacity in the absence of grazing trials or local experience. Forage production per unit area can be easily related to animal unit requirements. However, attempts to relate forage production to carrying capacity have generally been unsuccessful, especially when yield determinations were obtained in areas protected from grazing for a number of years. Forage production data obtained on grazed areas, and representing the current year's growth, have given much better estimates of carrying capacity. The carrying capacity based on forage production

obtained over a number of years also is more reliable than when based on production from a single year.

To allow for carry-over, only 55% of the total yield is used in calculating the carrying capacity. A 450-kg (1,000 lb) cow needs about 350 kg (780 lb) of dry-matter feed per month. Therefore the number of hectares needed to provide feed for a 450-kg cow for one month (AUM, animal unit month) is estimated by the following equation:

$$\text{Carrying capacity (ha/AUM)}^{1} = 350/(0.55 \times \text{kg dry matter/ha})$$

The carrying capacity of the *Stipa-Bouteloua* type of Mixed Prairie has been determined over a 17-year period by grazing trials at Manyberries, Alberta. Fields were stocked at three grazing rates: 16.2, 12.2, and 8.1 ha (40, 30, and 20 acres) per animal unit for 7 months of summer grazing. The appropriate grazing capacity was slightly more than 12.2 ha (12, 9, 6, and acres) per head. Subsequent grazing studies showed that 14.0 ha (35 acres) of range provided enough feed for a cow and calf over a 7-month grazing season with sufficient carry-over to maintain a stable vegetative cover. In addition, four grazing rates on Fescue Prairie were tested at Stavely, Alberta: 4.9, 3.6, 2.4, and 1.2 ha (12, 9, 6, and 3 acres) per animal unit for 6 months of summer grazing. Enough feed for a cow and calf, with sufficient carry-over, was provided by 3.6 ha of range.

Using the formula to estimate carrying capacity based on the average yield of total vegetation on ungrazed rangeland at Manyberries and Stavely Research Substations given in Appendix Tables 1 and 2, respectively, we find:

$$\text{Manyberries} = \frac{350}{0.55 \times 748} = 0.85 \text{ ha per AUM, and}$$

$$\text{at Stavely} = \frac{350}{0.55 \times 2680} = 0.24 \text{ ha per AUM}$$

When comparing the carrying capacity values, we find that the estimated values were about 2.5 times the actual values determined by grazing trials at Manyberries (1.9/0.85 = 2.2 times) and at Stavely (0.6/0.24 = 2.5 times). Further comparisons showed that when carrying capacity estimates were based on forage yields obtained on moderately grazed

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[1]To convert ha/AUM to ac/AUM, multiply by 2.5

areas, these values were very similar to those obtained in grazing trials. A closer look at the forage yields obtained on ungrazed areas and those obtained on adjacent moderately grazed areas revealed that ungrazed areas produced about 2.5 times as much forage as did grazed areas (Smoliak, unpublished data). Conversely, the grazed areas produced 40% as much forage as did comparable protected or ungrazed areas. This observation is substantiated by results obtained on Mixed Prairie grassland in southeastern Alberta where forage production on grazed range averaged 37% of that on ungrazed range (12), and in southern Saskatchewan where the total standing crop on ungrazed range varied from 39 to 44% of that on ungrazed range (4). In western North Dakota (14) the standing vegetation of grazed Mixed Prairie range was 44% of that on ungrazed range, while total above-ground plant material on grazed range was 37% of that on ungrazed range. In summarizing results from 12 studies, Lacey and van Poollen (8) concluded that these rangelands produced more herbage under protection than they did under moderate livestock grazing.

Carrying capacity estimates based on dry matter yields obtained on protected or ungrazed areas in southern Alberta therefore should be calculated on 40% of the average total forage production. The new formula for calculating carrying capacity based upon yield of total vegetation on areas protected from grazing becomes:

$$\text{Carrying capacity, ha/AUM} = \frac{350}{0.22 \times \text{kg total dry matter yield}}$$

Estimated carrying capacity, based on the above formula, calculated for each site is presented in Table 4. The carrying capacity is given in ha/AUM; AUM/ha; ac/AUM; AUM/ac; and ac/AU/year.

The use of dry matter yields of the grass-only component in determining carrying capacity proved unreliable. Estimates of carrying capacity based on grass-only production were satisfactory only in areas where the cover was dominated by grasses, as in the Fescue Prairie Association, but were unrealistic in areas where forbs contributed considerably towards total yield of vegetation, as in the Mixed Prairie Association.

The relationship of the various sites to carrying capacity and total forage yield is shown in Figure 2. The chart indicates that there are six distinct groupings:

1. Turin, Many Island Lake, Hays, and Bow Island sites in the 3.0 ha/AUM or 90 ac/AU/year group;

2. Berry Creek, Manyberries, Border Co-op, Schuler, and Picture Butte (S) sites in the 2.0 ha/AUM or 60 ac/AU/year group;

Table 4. Estimated carrying capacity of the various sites based on total vegetation production.

Site	Mean total forage production (kg/ha)	Estimated carrying capacity				
		ha/AUM	AUM/ha	ac/AUM	AUM/ac	ac/AU/ year
23	456	3.49	0.28	8.72	0.11	105
26	496	3.20	0.31	8.00	0.12	96
24	532	2.99	0.33	7.48	0.13	90
25	637	2.50	0.40	6.25	0.16	75
11	722	2.20	0.45	5.50	0.18	66
1	748	2.13	0.47	5.32	0.19	64
21	848	1.88	0.53	4.70	0.21	56
19	867	1.83	0.55	4.56	0.22	55
22b	872	1.82	0.55	4.55	0.22	55
18	952	1.67	0.60	4.18	0.24	50
4	1,010	1.58	0.63	3.95	0.25	47
10	1,071	1.48	0.68	3.70	0.27	44
7	1,257	1.26	0.79	3.15	0.32	38
22a	1,480	1.07	0.93	2.68	0.37	32
20	1,485	1.07	0.93	2.68	0.37	32
8	1,491	1.07	0.93	2.68	0.37	32
12	1,534	1.04	0.96	2.60	0.38	31
6	1,578	1.01	0.99	2.50	0.40	30
3b	1,804	0.88	1.14	2.20	0.45	26
17	1,850	0.86	1.16	2.15	0.46	26
5b	1,904	0.84	1.19	2.10	0.48	25
13	1,997	0.80	1.25	2.00	0.50	24
14	2,018	0.79	1.26	1.98	0.50	24
15	2,323	0.68	1.47	1.70	0.59	20
3a	2,325	0.68	1.47	1.70	0.59	20
9	2,359	0.67	1.49	1.68	0.60	20
16	2,363	0.67	1.49	1.68	0.60	20
5a	2,470	0.64	1.56	1.60	0.62	19
2	2,680	0.59	1.69	1.48	0.68	18

3. Antelope Lake, Pinhorn, Sunnynook, and Claresholm sites in the 1.5 ha/AUM or 45 ac/AU/year group;

4. Picture Butte (N), Cypress Hills, Willow Creek, Big Stone, and Twin River sites in the 1.0 ha/AUM or 30 ac/AU/year group;

5. Milk River Ridge (S), Misty Lake, Big Valley (south slope), Neutral Hills, and Spencer sites in the 0.8 ha/AUM or 24 ac/AU/year group;

6. Veteran, Milk River Ridge (N), Little Fish Lake, Loyalist, Big Valley (north slope), and Stavely sites in the 0.67 ha/AUM or 20 ac/AU/year group.

CONCLUSION

This study has recognized six types of rangeland vegetation based upon range sites and their productivity in southern Alberta. Carrying capacities for the range sites have been determined and compared with those established through grazing trials at the Research Substations at Manyberries and Stavely. The carrying capacity of additional sites can be estimated by obtaining forage production data on these sites and comparing the values with those given in Figure 2, or by calculation using the formulae given in the text.

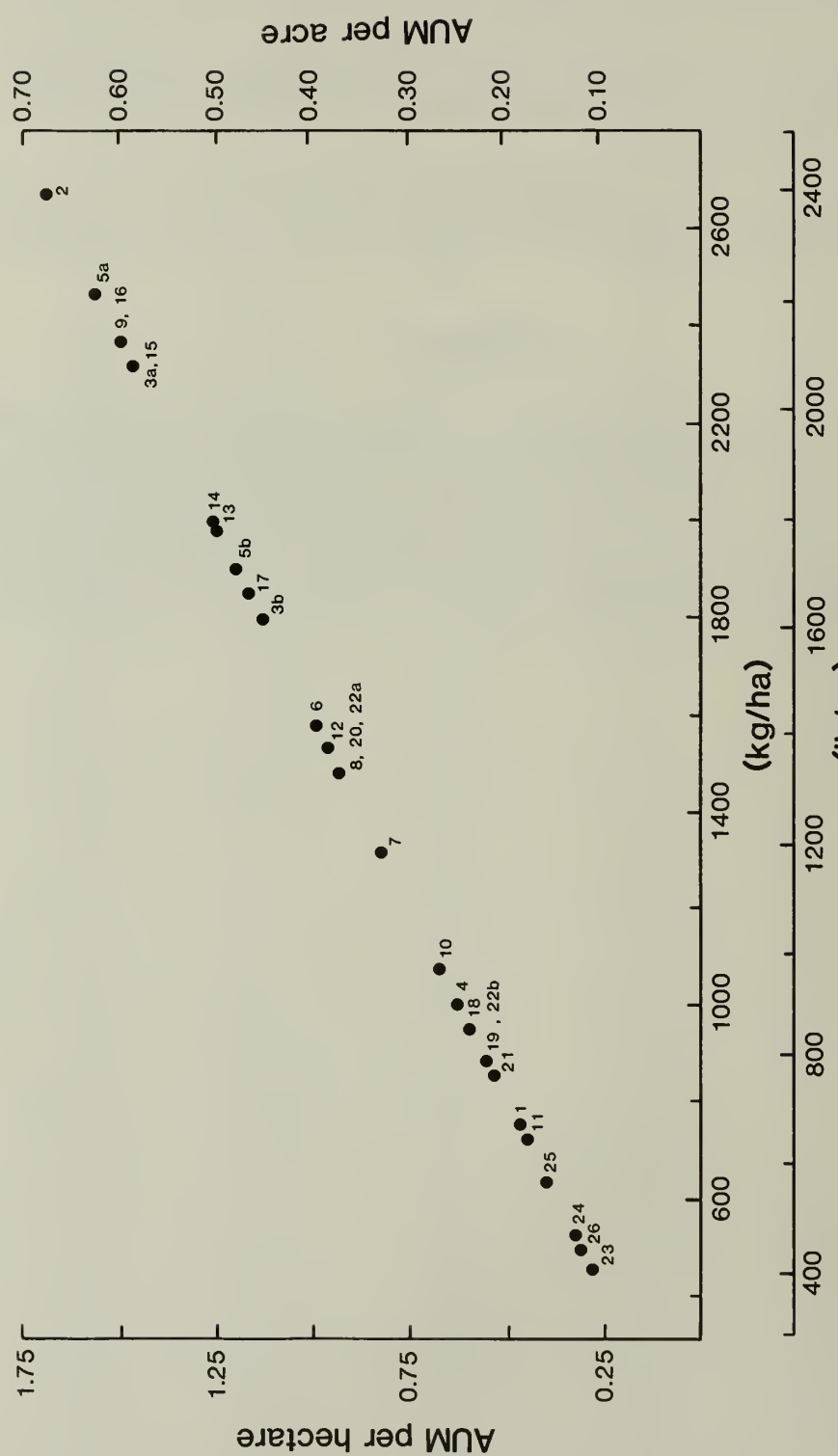

Fig. 2. Relationship of the various sites to carrying capacity and total forage yield.

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APPENDIX

Yield of vegetation (kg/ha) on ungrazed rangeland and soil and vegetation types at 26 sites

(To convert kg/ha to lb/ac, multiply by 0.89)

Appendix Table 1. Manyberries Research Substation (NE1/4 Sec. 16, T. 2, R. 4, W4th), Site 1

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1969	668	112	64	844	-[1]	-[1]
1970	605	330	35	970	-[1]	-[1]
1971	664	48	0	712	924	1,636
1972	497	68	135	700	1,162	1,862
1973	573	0	128	701	577	1,278
1974	757	70	24	851	448	1,299
1975	808	76	108	992	164	1,156
1976	652	192	4	848	504	1,352
1977	396	136	61	593	480	1,073
1978	679	266	0	945	372	1,317
1979	636	216	0	852	192	1,004
1980	330	128	40	498	154	652
1981	364	256	20	640	320	960
1982	503	56	8	567	112	679
1983	391	104	56	551	212	763
1984	469	227	0	696	452	1,148
Mean	562	143	43	748	434	1,156
SE	145	94	46	156	301	343

[1]No data available.

Soil: Orthic Brown Chernozemic, sandy loam.

Vegetation: *Stipa comata* with some *Agropyron smithii* and *Bouteloua gracilis*, belonging to the *Stipa-Bouteloua-Agropyron* faciation of Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 2. Stavely Research Substation (NW1/4 Sec. 22, T. 14, R. 29, W4th), Site 2

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1969	2,221	446	56	2,723	-[1]	-[1]
1970	3,050	526	194	3,770	-[1]	-[1]
1971	2,716	184	52	2,952	7,885	10,837
1972	2,752	47	105	2,904	5,112	8,016
1973	2,131	233	142	2,506	6,610	9,116
1974	2,286	238	28	2,552	8,316	10,868
1975	2,800	128	85	3,013	6,219	9,232
1976	2,308	140	220	2,668	7,002	9,670
1977	2,299	110	166	2,575	4,678	7,253
1978	2,419	532	86	3,037	4,552	7,589
1979	2,291	544	13	2,848	5,251	8,099
1980	2,487	296	112	2,895	4,123	7,018
1981	1,809	422	289	2,520	3,018	5,538
1982	1,217	437	210	1,864	4,618	6,482
1983	1,397	562	211	2,170	4,814	6,984
1984	1,698	202	0	1,900	8,424	10,324
Mean	2,242	315	123	2,680	5,759	8,359
SE	504	177	85	465	1,672	1,676

[1]No data available.

Soil: Orthic Black Chernozemic, silty loam.

Vegetation: Predominantly *Festuca scabrella*, with some *Danthonia parryi*, belonging to the Fescue Prairie Association.

Range site: Loamy, 450-550 mm (18-22 in.) precipitation zone.

Appendix Table 3. Milk River Ridge (North) (NW1/4 Sec. 12, T. 2, R. 22, W4th), Site 3a

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1969	2,384	232	12	2,628	-[1]	-[1]
1970	1,612	263	0	1,875	-[1]	-[1]
1971	2,468	400	0	2,868	3,389	6,257
1972	2,984	352	0	3,336	3,472	6,808
1973	1,815	80	32	1,927	4,534	6,461
1974	1,054	425	30	1,509	1,034	2,543
1975	1,805	338	68	2,211	1,392	3,603
1976	1,961	165	8	2,134	2,160	4,294
1977	2,667	176	0	2,843	2,016	4,859
1978	2,315	756	12	3,083	2,950	6,033
1979	1,888	40	56	1,984	2,299	4,283
1980	2,268	260	0	2,528	3,135	5,663
1981	-[1]					
1982	-[1]					
1983	1,447	104	100	1,651	3,355	5,006
1984	1,947	25	0	1,972	4,845	6,817
Mean	2,044	258	23	2,325	2,882	5,219
SE	509	193	31	559	1,157	1,356

[1]No data available.

Soil: Orthic Black Chernozemic, sandy loam.

Vegetation: Predominantly *Festuca scabrella*, with some *F. idahoensis*, and *Carex and Agropyron* spp., belonging to the Fescue Prairie Association.

Range site: Loamy, 450-550 mm (18-22 in.) precipitation zone.

Appendix Table 4. Milk River Ridge (South) (NW1/4 Sec. 12, T. 2, R. 22, W4th), Site 3b

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1979	1,332	210	62	1,604	2,243	3,847
1980	1,733	388	120	2,241	2,753	4,994
1981	-[1]					
1982	-[1]					
1983	1,136	240	192	1,568	2,746	4,314
1984	-[1]					
Mean	1,400	279	125	1,804	2,581	4,385
SE	304	95	65	378	292	577

[1]No data available.

Soil: Orthic Black Chernozemic, sandy loam.

Vegetation: Predominantly *Festuca scabrella*, with some *F. idahoensis*, and *Carex and Agropyron* spp., belonging to the Fescue Prairie Association.

Range site: Loamy, 450-550 mm (18-22 in.) precipitation zone.

Appendix Table 5. Pinhorn Grazing Reserve (N1/2 Sec. 18, T. 2, R. 6, W4th), Site 4

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1969	1,140	60	0	1,200	-[1]	-[1]
1970	854	200	0	1,054	-[1]	-[1]
1971	1,012	32	0	1,044	1,800	2,844
1972	756	20	8	784	2,749	3,533
1973	700	30	38	768	453	1,221
1974	917	195	0	1,112	686	1,798
1975	880	84	8	972	265	1,237
1976	1,058	151	0	1,209	632	1,841
1977	1,140	70	0	1,210	748	1,958
1978	944	216	28	1,188	400	1,588
1979	964	56	0	1,020	568	1,588
1980	679	62	0	741	1,018	1,759
1981	604	108	0	712	612	1,324
1982	1,059	80	0	1,139	756	1,895
1983	1,059	44	0	1,103	1,016	2,119
1984	784	125	0	909	1,007	1,916
Mean	909	96	5	1,010	908	1,902
SE	168	64	11	177	649	624

[1]No data available.

Soil: Orthic Brown Chernozemic, loam.

Vegetation: Predominantly *Stipa comata* and *Agropyron* spp., with *Koeleria cristata and Carex* spp., representative of the *Stipa-Agropyron* faciation of the Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 6. Big Valley north slopes (NW1/4 Sec. 14, T. 34, R. 19, W4th), Site 5a

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1969	1,944	46	22	2,012	-[1]	-[1]
1970	2,067	130	37	2,234	-[1]	-[1]
1971	2,524	36	16	2,576	3,280	5,856
1972	3,080	12	160	3,252	3,241	6,493
1973	3,668	36	0	3,704	3,129	6,833
1974	3,399	157	0	3,556	5,837	9,393
1975	2,557	16	31	2,604	2,840	5,444
1976	2,652	28	40	2,720	4,493	7,213
1977	2,111	0	32	2,143	3,291	5,434
1978	2,227	66	0	2,293	3,182	5,475
1979	1,502	31	96	1,629	3,381	5,010
1980	2,710	120	64	2,894	2,751	5,645
1981	1,899	54	62	2,015	3,883	5,898
1982	847	108	0	955	1,590	2,545
1983	2,417	48	0	2,465	3,412	5,877
1984	-[1]					
Mean	2,374	59	37	2,470	3,408	5,932
SE	715	47	44	717	981	1,524

[1]No data available.

Soil: Orthic Dark Brown Chernozemic, light loam, Hughenden profile.

Vegetation: Predominantly *Festuca scabrella* and *Carex* spp., representative of Fescue Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 7. Big Valley south slopes (NW1/4 Sec. 14, T. 34, R. 19, W4th), Site 5b

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1969	926	226	12	1,164	-[1]	-[1]
1970	1,642	281	31	1,954	-[1]	-[1]
1971	2,003	24	8	2,035	1,240	3,275
1972	1,919	120	0	2,039	832	2,871
1973	1,792	164	0	1,956	588	2,544
1974	3,078	354	0	3,432	750	4,182
1975	1,629	180	16	1,825	1,252	3,077
1976	2,105	349	0	2,454	680	3,134
1977	1,368	128	0	1,496	1,118	2,614
1978	2,083	207	0	2,290	1,066	3,356
1979	1,168	128	0	1,296	692	1,988
1980	1,087	304	0	1,391	472	1,863
1981	1,891	156	0	2,047	2,299	4,346
1982	931	48	0	979	1,466	2,445
1983	2,017	188	0	2,205	2,289	4,494
1984	-[1]					
Mean	1,709	190	5	1,904	1,134	3,091
SE	564	99	8	606	592	844

[1]No data available.

Soil: Rego Dark Brown Chernozemic, loam.

Vegetation: *Stipa spartea* var. *curtiseta* and some *Bouteloua gracilis*, and *Carex and Agropyron* spp., characteristic of the *Stipa-Agropyron* faciation of the Mixed Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 8. Twin River Grazing Reserve (E1/2 of E1/2 Sec. 4 and 9, T. 1, R. 18, W4th), Site 6

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1971	1,476	112	0	1,588	1,796	3,384
1972	1,428	262	0	1,690	1,364	3,054
1973	1,269	47	37	1,353	1,359	2,712
1974	861	318	0	1,179	1,140	2,319
1975	1,208	300	56	1,564	1,749	3,313
1976	1,580	180	0	1,760	1,320	3,080
1977	1,500	296	28	1,824	2,335	4,159
1978	1,863	280	87	2,230	1,488	3,718
1979	1,263	96	56	1,415	1,532	2,947
1980	1,621	270	0	1,891	1,733	3,624
1981	-[1]					
1982	-[1]					
1983	1,271	59	12	1,342	2,687	4,029
1984	943	155	0	1,098	2,276	3,374
Mean	1,357	198	23	1,578	1,731	3,309
SE	283	101	29	323	474	531

[1]No data available.

Soil: Orthic Dark Brown Chernozemic, silty loam.

Vegetation: *Festuca scabrella*, *F. idahoensis*, and *Agropyron* spp., characteristic of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 9. Claresholm (N1/2 Sec. 22, T. 12, R. 28, W4th), Site 7

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1971	924	72	4	1,000	1,637	2,637
1972	1,376	168	48	1,592	1,616	3,208
1973	1,196	167	321	1,684	1,410	3,094
1974	936	355	787	2,078	937	3,015
1975	729	328	224	1,281	452	1,733
1976	804	176	676	1,656	1,079	2,735
1977	975	188	48	1,211	1,651	2,862
1978	868	376	232	1,476	600	2,076
1979	460	76	130	666	457	1,123
1980	911	80	304	1,295	1,028	2,323
1981	276	172	0	448	290	728
1982	332	164	508	1,004	608	1,612
1983	615	92	240	947	1,623	2,570
1984	-[1]					
Mean	800	186	271	1,257	1,029	2,286
SE	319	105	251	448	516	783

[1]No data available, site vandalized.

Soil: Calcareous Dark Brown Chernozemic, sandy loam. Brocket profile.

Vegetation: Predominantly *Stipa spartea* var. *curtiseta* and *Festuca scabrella* intermixed with *Stipa comata*, *Calmovilfa longifolia* and *Agropyron* spp., characteristic of the Fescue Prairie Association.

Range site: Limey, 450-550 mm (18-22 in.) precipitation zone.

Appendix Table 10. Willow Creek Provincial Park (NW1/4 Sec. 28, T. 13, R. 28, W4th), Site 8

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1971	1,000	0	0	1,000	-[1]	-[1]
1972	1,596	244	0	1,840	1,212	3,052
1973	2,298	115	0	2,413	1,711	4,124
1974	1,473	193	0	1,666	1,477	3,143
1975	1,376	176	0	1,552	1,292	2,844
1976	1,680	208	0	1,888	1,884	3,772
1977	1,299	64	0	1,363	1,883	3,246
1978	1,235	168	40	1,443	728	2,171
1979	732	104	0	836	1,000	1,836
1980	-[1]					
1981	-[1]					
1982	-[1]					
1983	-[1]					
1984	872	39	0	911	1,378	2,289
Mean	1,356	131	4	1,491	1,396	2,942
SE	451	79	13	493	392	749

[1]No data available.

Soil: Orthic Regosol, silty loam soil.

Vegetation: *Festuca scabrella* and *Stipa spartea* var. *curtiseta* predominant, and characteristic of the Fescue Prairie Association.

Range site: Shallow to gravel, 450-550 mm (18-22 in.) precipitation zone.

Appendix Table 11. Little Fish Lake (SW1/4 Sec. 30, T. 28, R. 16, W4th), Site 9

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	3,112	64	3,176	5,292	8,468
1973	2,760	112	2,872	3,381	6,253
1974	2,416	104	2,520	4,049	6,569
1975	2,160	0	2,160	4,040	6,200
1976	2,629	115	2,744	6,080	8,824
1977	1,260	140	1,400	2,688	4,088
1978	1,572	68	1,640	3,685	5,325
Mean	2,273	86	2,359	4,173	6,532
SE	661	46	656	1,154	1,664

Soil: Orthic Dark Brown Chernozemic, silty loam soil.

Vegetation: *Festuca scabrella* and *Carex* spp., characteristic of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 12. Sunnynook (E1/2 Sec. 19, T. 27, R. 12, W4th), Site 10

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	960	200	1,160	1,120	2,280
1973	1,116	112	1,228	756	1,984
1974	1,028	92	1,120	492	1,612
1975	919	360	1,279	600	1,879
1976	704	176	880	768	1,648
1977	596	300	896	836	1,732
1978	776	164	940	176	1,116
Mean	871	200	1,071	678	1,749
SE	186	97	164	296	361

Soil: Brown Solonetz, sandy loam. Hemaruka profile.

Vegetation: Predominantly *Stipa comata* and *Agropyron smithii*, characteristic of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Blowouts, 20%, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 13. Berry Creek (SW1/4 Sec. 15, T. 25, R. 11, W4th), Site 11

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	748	72	820	1,064	1,884
1973	604	112	716	319	1,035
1974	780	60	840	372	1,212
1975	640	159	799	360	1,159
1976	492	100	592	520	1,112
1977	600	112	712	240	952
1978	408	172	580	184	764
Mean	610	112	722	437	1,159
SE	131	41	106	296	352

Soil: Brown Solonetz, sandy loam. Hemaruka profile.

Vegetation: *Stipa comata* and *Agropyron smithii* predominate, characteristic of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Blowouts, 50%, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 14. Big Stone (SW1/4 Sec. 15, T. 26, R. 9, W4th), Site 12

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	2,040	0	2,040	5,748	7,788
1973	1,764	96	1,860	1,808	3,668
1974	2,008	24	2,032	1,188	3,220
1975	1,680	40	1,720	1,280	3,000
1976	1,232	60	1,292	1,632	2,924
1977	928	64	992	1,064	2,056
1978	652	152	804	1,160	1,964
Mean	1,472	62	1,534	1,983	3,517
SE	542	50	505	1,682	1,980

Soil: Brown Solod, loam texture. Cecil profile.

Vegetation: Characterized by *Stipa comata* and *Stipa spartea* var. *curtiseta* and belonging to *Stipa-Agropyron* faciation of the Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 15. Neutral Hills (NE1/4 Sec. 32, T. 36, R. 6, W4th), Site 13

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	1,841	79	1,920	1,240	3,160
1973	1,860	204	2,064	1,528	3,592
1974	1,813	24	1,837	1,433	3,270
1975	2,160	80	1,240	2,121	4,361
1976	2,472	132	2,604	1,596	4,200
1977	1,556	0	1,556	2,848	4,404
1978	1,676	87	1,763	4,093	5,856
Mean	1,911	86	1,997	2,123	4,120
SE	310	68	345	1,024	920

Soil: Orthic Dark Brown Chernozemic, sandy loam. Hughenden profile.

Vegetation: Predominantly *Festuca scabrella*, with some *Stipa spartea* var. *curtiseta*, and representative of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 16. Spencer (SW1/4 Sec. 15, T. 35, R. 7, W4th), Site 14

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	2,280	80	2,360	2,280	4,640
1973	2,448	136	2,584	2,528	5,112
1974	2,088	72	2,160	2,953	5,113
1975	1,680	159	1,839	3,160	4,999
1976	2,360	80	2,440	3,761	6,201
1977	944	0	944	2,184	3,128
1978	1,740	64	1,804	5,253	7,057
Mean	1,934	84	2,018	3,160	5,178
SE	528	52	558	1,073	1,232

Soil: Orthic Dark Brown Chernozemic. Hughenden profile.

Vegetation: Characterized by *Festuca scabrella*, with *Stipa spartea* var. *curtiseta* on south-facing slopes. Bluffs of poplar and willow are scattered. Part of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 17. Veteran (NW1/4 Sec. 32, T. 34, R. 8, W4th), Site 15

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	3,280	240	3,520	1,400	4,920
1973	2,648	248	2,896	1,200	4,096
1974	2,249	140	2,389	3,372	5,761
1975	1,841	80	1,921	680	2,601
1976	2,184	64	2,248	1,348	3,596
1977	1,492	0	1,492	1,584	3,076
1978	1,771	24	1,795	3,537	5,332
Mean	2,209	114	2,323	1,874	4,197
SE	603	99	695	1,116	1,185

Soil: Dark Brown Solod. Brownfield profile.

Vegetation: Predominantly *Festuca scabrella*, with *Stipa spartea* var. *curtiseta*, characteristic of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 18. Loyalist (NW1/4 Sec. 9, T. 34, R. 7, W4th), Site 16

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	2,040	280	2,320	2,200	4,520
1973	2,548	300	2,848	1,788	4,636
1974	1,264	96	1,360	2,816	4,176
1975	2,200	319	2,519	3,121	5,640
1976	3,404	356	3,760	4,917	8,677
1977	1,640	60	1,700	3,560	5,260
1978	1,772	260	2,032	4,712	6,744
Mean	2,124	239	2,363	3,302	5,665
SE	699	114	792	1,186	1,580

Soil: Orthic Dark Brown Chernozemic, loam textured. Hughenden profile.

Vegetation: *Festuca scabrella*, with some *Stipa spartea* var. *curtiseta*, characteristic of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 19. Misty Lake (SW1/4 Sec. 30, T. 32, R. 4, W4th), Site 17

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1972	2,120	48	2,168	2,040	4,208
1973	2,320	87	2,407	1,616	4,023
1974	1,392	40	1,432	2,312	3,744
1975	1,920	80	2,000	2,600	4,600
1976	2,116	60	2,176	2,076	4,252
1977	1,116	56	1,172	1,016	2,188
1978	1,276	319	1,595	1,164	2,759
Mean	1,751	99	1,850	1,832	3,682
SE	480	99	455	589	880

Soil: Orthic Dark Brown Chernozemic, loam textured.

Vegetation: *Festuca scabrella* over most of the area, and *Stipa spartea* var. *curtiseta*, on south-facing slopes and drier sites. Characteristic of the Fescue Prairie Association.

Range site: Loamy, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 20. Antelope Lake (SE1/4 Sec. 13, T. 31, R. 10, W4th), Site 18

Year	Grass	Forbs and shrubs	Total	Litter	Total biomass
1976	796	228	1,024	580	1,604
1977	544	280	824	319	1,143
1978	652	356	1,008	344	1,352
Mean	664	288	952	414	1,366
SE	126	64	111	144	230

Soil: Rego Brown Chernozemic, sandy textured. Vendisant-Antelope mixed profile.

Vegetation: Characteristic of shrub-grassland type. *Rosa* spp. and *Symphoricarpos* spp. are predominant shrubs, while the grassland is dominated by *Artemisia frigida*, *Koeleria cristata* and *Calamovilfa longifolia*. Part of the Mixed Prairie Association.

Range site: Choppy sandhills, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 21. Schuler (NE1/4 Sec. 16, T. 17, R. 2, W4th), Site 19

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1976	388	24	0	412	148	560
1977	660	52	0	712	500	1,212
1978	1,240	54	0	1,294	170	1,464
1979	-[1]					
1980	587	15	8	610	816	1,426
1981	694	16	0	700	404	1,104
1982	1,755	156	0	1,911	464	2,375
1983	648	28	0	676	548	1,224
1984	563	59	0	622	648	1,270
Mean	816	50	1	867	462	1,329
SE	452	46	3	492	226	506

[1]No data available.

Soil: Orthic Brown Chernozemic, heavy loam texture.

Vegetation: Predominantly *Stipa comata*, *Bouteloua gracilis*, and *Agropyron* spp., characteristic of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 22. Cypress Hills (SE1/4 Sec. 29, T. 7, R. 1, W4th), Site 20

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1976	1,224	308	396	1,928	1,504	3,432
1977	1,164	132	0	1,296	1,207	2,503
1978	1,419	344	312	2,075	1,028	3,103
1979	1,307	32	0	1,339	876	2,215
1980	1,118	80	0	1,198	1,102	2,300
1981	1,479	192	76	1,747	1,415	3,162
1982	1,187	243	0	1,430	1,767	3,197
1983	1,031	80	0	1,111	1,603	2,714
1984	1,160	82	0	1,242	2,797	4,039
Mean	1,232	166	87	1,485	1,477	2,962
SE	144	111	155	345	573	588

Soil: Orthic Brown Chernozemic, light loam texture.

Vegetation: *Festuca scabrella* and *Stipa spartea* var. *curtiseta*, characteristic of the Fescue Prairie Association.

Range site: Shallow to gravel, 350-450 mm (14-18 in.) precipitation zone.

Appendix Table 23. Border Co-op (SW1/4 Sec. 4, T. 1, R. 1, W4th), Site 21

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1976	788	188	40	1,016	740	1,756
1977	643	152	12	807	992	1,799
1978	819	154	0	973	364	1,337
1979	1,036	89	0	1,125	268	1,393
1980	684	118	0	802	716	1,518
1981	644	236	248	1,128	1,499	2,627
1982	704	39	0	743	188	931
1983	352	92	0	444	336	780
1984	552	47	0	599	974	1,573
Mean	691	124	33	848	675	1,523
SE	188	65	82	234	431	537

Soil: Orthic Brown Chernozemic, with sandy loam texture.

Vegetation: *Stipa comata* and *Boutelous gracilis* dominant; characteristic of the *Stipa Bouteloua* faciation of the Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 24. Picture Butte (North) (NW1/4 Sec. 29, T. 10, R. 20, W4th), Site 22a

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1977	-[1]					
1978	1,048	188	0	1,236	0	1,236
1979	1,427	120	0	1,547	436	1,983
1980	1,572	0	328	1,900	464	2,364
1981	2,007	168	0	2,175	304	2,479
1982	1,016	0	0	1,016	703	1,719
1983	1,503	40	400	1,943	1,983	3,926
1984	486	59	0	545	1,636	2,181
Mean	1,294	82	104	1,480	790	2,270
SE	490	77	178	581	734	842

[1]Exclosure established in grazed area.

Soil: Orthic Dark Brown Chernozemic, sandy texture.

Vegetation: Predominantly *Stipa comata* and *Boutelous gracilis*; representative of the *Stipa Bouteloua* faciation of the Mixed Prairie Association.

Range site: Sandy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 25. Picture Butte (South) (NW1/4 Sec. 29, T. 10, R. 20, W4th), Site 22b

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1980	936	0	448	1,384	152	1,536
1981	1,030	128	0	1,158	304	1,462
1982	392	0	0	392	87	479
1983	640	92	160	892	720	1,612
1984	144	391	0	535	343	878
Mean	628	122	122	872	321	1,193
SE	370	160	195	415	247	494

Soil: Orthic Dark Brown Chernozemic, sandy texture.

Vegetation: Predominantly *Stipa comata* with some *Calamovilfa longifolia* representative of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Sandy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 26. Turin (SE1/4 Sec. 28, T. 12, R. 19, W4th), Site 23

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1977	74	140	4	218	0	218
1978	132	508	0	640	0	640
1979	164	344	0	508	196	704
1980	216	286	0	502	226	728
1981	224	192	0	416	84	500
1982	87	40	0	127	40	167
1983	304	192	12	508	327	835
1984	427	303	0	730	168	898
Mean	204	250	2	456	130	586
SE	118	143	4	201	118	271

Soil: Orthic Dark Brown Chernozemic, sandy texture.

Vegetation: Predominantly *Bouteloua gracilis* and *Stipa comata* representative of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Sandy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 27. Hays (SW1/4 Sec. 17, T. 13, R. 13, W4th), Site 24

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1981	392	92	0	484	136	620
1982	-[1]					
1983	444	72	8	524	383	907
1984	471	116	0	587	475	1,062
Mean	436	93	3	532	331	863
SE	40	22	5	52	175	224

[1]No data available.

Soil: Orthic Brown Chernozemic, loamy texture.

Vegetation: Predominantly *Stipa comata* and *Bouteloua gracilis* representative of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 28. Bow Island (SE1/4 Sec. 28, T. 13, R. 10, W4th), Site 25

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1981	724	177	0	901	286	1,187
1982	319	39	0	358	308	666
1983	671	96	0	767	544	1,311
1984	437	84	0	521	559	1,080
Mean	538	99	0	637	424	1,061
SE	192	57	0	244	147	280

Soil: Orthic Brown Chernozemic, silty loam texture.

Vegetation: Predominantly *Stipa comata* and *Bouteloua gracilis* representative of the *Stipa-Bouteloua* faciation of the Mixed Prairie Association.

Range site: Loamy, 250-350 mm (10-14 in.) precipitation zone.

Appendix Table 29. Many Island Lake (NE1/4 Sec. 18, T. 13, R. 1, W4th), Site 26

Year	Grass	Forbs	Shrubs	Total	Litter	Total biomass
1981	344	204	0	548	232	780
1982	388	111	0	499	240	739
1983	411	120	0	531	256	787
1984	363	44	0	407	247	654
Mean	376	120	0	496	244	740
SE	29	66	0	63	10	61

Soil: Orthic Brown Chernozemic, fine sands.

Vegetation: Predominantly *Stipa comata* with *Calamovilfa longifolia*, representative of the *Stipa-Bouteloua-Agropyron* faciation of the Mixed Prairie Association.

Range site: Sandy, 250-350 mm (10-14 in.) precipitation zone.