Complementary Grazing Systems for Sandhills of the Northern Great Plains

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The Northern Great Plains region extends into the prairie provinces of Canada where it is subdivided into two associations, short grass prairie and mixed prairie (Clarke *et al.* 1942); mixed prairie is further divided into six communities on the basis of different soil types (Campbell *et al.* 1962). One of these six communities, Sandhill prairie, describes the vegetation of the sand and dune sand soils of the Great and Lesser Sandhills. The Sandhills which occupy over 1,300,000 acres in southwestern Saskatchewan are grazed by an estimated 90,000 cattle. April to mid-November is the usual grazing season, with a few cattle grazed year-long. The better Sandhill soils (fine sandy loams and sandy loams) have been used for cereal production but the acreage in grains is becoming smaller. Since 1937 private operators and government agencies have seeded much of the former cropland to crested wheatgrass *(Agropyron cristatum)*. Often only a portion of the farm units was under cultivation and when they were returned to grazing the crested wheatgrass acreage was seldom separated from adjacent Sandhill prairie.

Crested wheatgrass is a cool-season grass, whereas the important native species of Sandhill prairie, needle and thread *(Stipa comata)* western wheatgrass *(Agropyron smithii)*, blue grama *(Bouteloua gracilis)*, prairie sandreed grass *(Calamovilfa longifolia)*, northern wheatgrass *(Agropyron dasystachyum)*, and Indian ricegrass *(Oryzopsis hymenoides)* are warm-season grasses. Under the grazing system commonly used in the Sandhills the warm-season grasses are

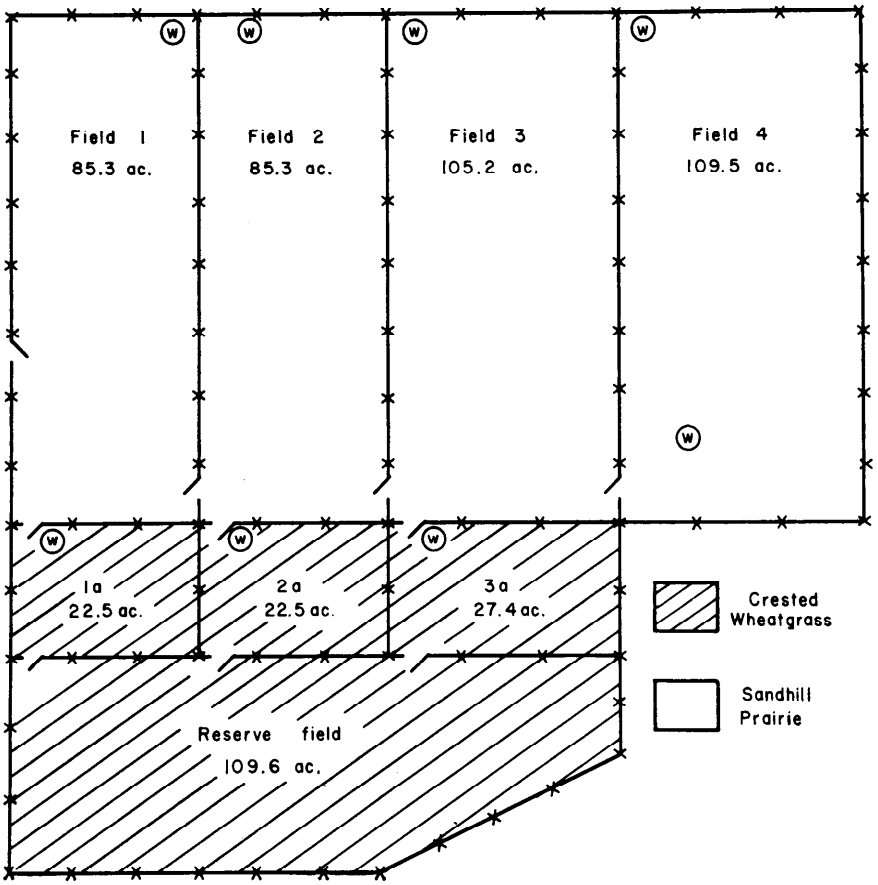

FIGURE 1. Pasture layout, Beverley project, Complementary grazing systems trial, Sandhill prairie. 1954-1961.

abused. Clipping studies and observations indicate that this abuse of the warm-season grasses is reduced when the ratio of crested wheatgrass to Sandhill prairie is between 1 : 4 and 1 : 5. This paper reports on a large scale grazing trial which examined different grazing systems in which crested wheatgrass was grazed in conjunction with Sandhill prairie, and compared these systems with season-long use of Sandhill prairie.

Study Area and Methods

In 1954, a 455-acre area in the Beverley Grazing Project[1] was selected. It contained adjacent stands of crested wheatgrass (72.4 acres) and Sandhill prairie (382.6 acres). The crested wheatgrass acreage was part of a 182-acre field seeded in 1947 on land abandoned in 1945. From 1947 to 1954 the area was lightly grazed.

Fences and watering facilities were installed in 1954. The area was divided into four pastures, three of which were subdivided into two fields, one crested wheatgrass, one Sandhill prairie. In each of these three pastures the crested wheatgrass field was 21 percent of the total area (Figure 1).

Grazing began in 1955. Four grazing systems were studied:

System 1: Crested wheatgrass (field 1a) grazed alone May to mid-June, Sandhill prairie (field 1) grazed alone mid-June through September.

System 2: Both crested wheatgrass (field 2a) and Sandhill prairie (field 2) grazed free choice season long, May through September.

System 3: Crested wheatgrass (field 3a) grazed alone May to mid-June; both crested wheatgrass and Sandhill prairie (field 3) grazed free choice mid-June through September.

System 4: Sandhill prairie grazed from May through September (field 4).

All cattle used were yearling or long-yearling steers. They were provided by several district livestock raisers, and lacked uniformity so the stock allocations were on a gross liveweight per acre rather than an animal numbers basis. Cattle were weighed: in and out of all pastures, when moved from field to field, and at regular intervals. Weighings were made after the cattle had been held off feed and water overnight.

Animal weights, pounds gain, and stocking data were used to compute the stocking rates in animal unit months (A.U.M.; one animal unit month—1,000 pounds of beef animal for 30 days) and the gain in pounds of beef, per animal and per acre for all systems. The stocking rates are given in Table 1. The total digestible nutrients (T.D.N.) per acre produced by each system was computed from cattle weight and gain data using tables prepared by Sylvestre and Williams (1952). Computed T.D.N. is a useful measure of production because it includes an estimate for maintenance requirements and allows an interpretation of the pasture potential for different classes of livestock. The floristic composition and basal area of the vegetation of all crested wheatgrass and Sandhill prairie fields were measured at yearly intervals using the point method of Clarke *et al.* (1942).

Results

Stocking Rate

Grazing began about mid-May each year (earliest date May 6, 1959; latest May 16, 1955, 1956). The cattle in pastures 1 and 3 had access to the Sandhill prairie

Table 1. Stocking rates in acres per animal unit month[1].

	Projected stocking Rate	1955	1956	1957	1958	1959	1960	1961	Av.	Av.[2]
System 1	2.0	2.6	1.7	1.9	2.1	2.0	2.3	9.7	3.2	2.1
System 2	2.0	2.3	1.5	1.9	1.8	2.0	2.1	3.5	2.2	1.9
System 3	2.0	2.7	1.6	2.0	2.8	1.9	2.3	3.4	2.4	2.2
System 4	3.0	2.5	2.3	3.0	3.1	3.4	10.9	4.7	4.3	2.9

[1] Animal Unit Month—1000 lb. of beef animals for 30 days.
[2] 1955 to 1959, incl.

fields after mid-June (earliest date June 8, 1957; latest June 22, 1960). The average stocking rate for fields 1a and 3a was 1.6 acres per A.U.M., and the average grazing season 37 days (longest, 51; shortest, 25 days). The cattle were usually removed in late September or early October (earliest Sept. 7, 1960; latest October 12, 1959). The average grazing season was 137 days.

This trial was conducted over a period which included one of the most severe and long lasting sequences of below average precipitation on record (Table 3). Despite the prolonged drought the individual pastures maintained their allocation of cattle until 1960. In 1960 the cattle were removed from pasture 4 on June 22 after 43 days of grazing. Cattle were not grazed in the Sandhill prairie field of pasture 1 in 1961. In the other three pastures grazing ended on August 3.

Beef Production

The gains per animal from the three grazing systems, 1, 2, and 3, which included crested wheatgrass fields were similar and somewhat higher than those of system 4 which utilized only Sandhill prairie. The combination of higher individual animal gains and higher stocking rates in these systems resulted in very significantly greater total beef production. This is best seen by comparing the annual gains per acre which are given in Table 2. Computed T.D.N. per acre allows an estimate of the amount of nutrients removed by the cattle grazing each system. More T.D.N. was consumed in pastures 1, 2, and 3 than in pasture 4.

Pasture productivity varied from year to year (Table 3). Simple correlations between productivity measurements and annual and May-June precipitation were computed. The best correlations were:

Correlation	Correlation coefficient R	Portion of variation accounted for R^2 (percent)
Annual precipitation: T.D.N. Consumed	0.82	67.2
May-June precipitation: T.D.N. Consumed	0.79	62.4

Table 2. The average production of beef and T.D.N. of four pasture systems.

	Pasture productivity		
	Average annual gain per animal	Average annual gain per acre	Computed average annual T.D.N. consumption per acre
	— — — — (Pounds) — — — —		
System 1	211	34.7	187
System 2	233	38.7	181
System 3	243	34.9	193
System 4	185	20.1	118
Sig. Diff. at 1% level	N.S.	7.2	60

Table 3. Variation in three measures of pasture productivity of Sandhill prairie as influenced by precipitation.

	Precipitation[1]		Pasture productivity		
	Annual	Growing[2] season	Average annual gain per animal	Average annual gain per acre	Average annual T.D.N. consumption per acre
			— — (Pounds) — —		
1955	17.31	5.25	216	38.4	225
1956	13.15	4.89	231	42.6	226
1957	11.80	1.97	275	33.1	170
1958	11.50	1.56	221	28.1	133
1959	13.99	5.44	254	32.4	182
1960	12.43	3.26	184	29.9	148
1961	8.89	2.25	148	20.4	103
76 year average	14.70	4.68			
Sig. Diff. at five percent level			59	7.0	58
Sig. Diff. at one percent level			88	9.6	80

[1] At Swift Current.
[2] May-June rainfall.

[1] *The Beverley Grazing project, a 1200-acre portion of the Webb-Swift Current P.F.R.A. Community Pasture, is a joint undertaking of district livestock raisers; the Research Branch, Canada Department of Agriculture; and the Prairie Farm Rehabilitation Administration, Canada Department of Agriculture. It is located in the Lesser Sandhills 14 miles west of Swift Current, Saskatchewan.*

Table 4. Basal area of crested wheatgrass fields.

Species	1955	1959				1961			
		Field				Field			
	Area	1a	2a	3a	Reserve	1a	2a	3a	Reserve
	(Percent)								
Crested wheatgrass	3.7	8.0	5.0	5.4	3.6	6.7	4.8	4.7	3.2
Other grasses		1.2	1.0	1.0	0.1	0.7	0.6	0.1	0.7
Forbs		T	0.1	0.3	0.1	T	0.1	0.1	0.2
Annual weeds		0.2	T	0.4	0.2	0.6	T	0.5	0.3
Total	3.7	9.4	6.1	7.1	4.0	8.0	6.5	5.4	4.4

The years of below average precipitation years had a progressive effect on production. This effect was very significant in terms of gain per animal and gain per acre after four years of low rainfall. On the other hand, the effect of drought on T.D.N. consumption (computed) became significant after one dry year.

Vegetation Studies

Crested wheatgrass basal area was low in 1955 prior to the trial but increased in all fields by 1959 (Table 4). In 1961 it was down from 1959 but greater than in 1955. The basal area in the reserve field (Figure 1) did not change appreciably from 1955 to 1961. Visual observations were that the system fields were more productive than the less heavily used, reserve field. The reasons for this and the increased basal area are not readily apparent. Somewhat similar increases in production were observed (Lodge 1960) on spring grazed crested wheatgrass which received additional inputs of dung and urine as a result of sheep congregating on burned plots. The differences in basal area between fields 1a, 2a and 3a in 1959 and in 1961 may be related to the grazing patterns of the animals. In field 1a the cattle had access to crested wheatgrass only in the May-June period. They could graze fields 2a and 3a from May to September. Utilization of the crested wheatgrass field 2a in the May-June period was less than that of fields 3a and 1a. However, in pasture 3 the cattle seemingly became conditioned to using crested wheatgrass and were observed to return to field 3a throughout July, August, September and October. This use of field 3a was associated with weather conditions. When cool, moist weather prevailed the cattle habitually returned to the crested wheatgrass. This tendency to use crested wheatgrass in inclement weather increased as the grazing season progressed. Additional use of crested wheatgrass also occurred in pasture 2 but was less marked. These different degrees of summer use may have influenced the basal area. The decrease in basal area of crested wheatgrass in all fields 1a, 2a, and 3a from 1959 to 1961 is probably an effect of the progression of drought years. Basal area data for species other than crested wheatgrass show that there was little invasion of the stands, and that the incidence of other species had no particular relation to the different grazing treatments.

The basal area of Sandhill prairie and the principal species indices of the various fields in certain years were compared using the basal area of the principal species (needle-and-thread, blue grama and wheatgrasses) of field 1 in 1955 as the base index (basal area principal species field 1, 1955 = 8.0 = 100). It

Table 5. Change in basal area of Sandhill grassland fields under four grazing systems.

Species	1951	1955				1959				1962			
		Field				Field				Field			
	Area	1	2	3	4	1	2	3	4	1	2	3	4
	(Percent)												
Needle and thread	2.9	4.2	4.3	3.2	3.0	3.4	3.6	2.9	3.4	1.6	0.7	1.7	1.4
Blue grama	1.6	1.3	1.2	2.0	1.3	0.6	1.6	1.4	0.4	0.4	0.5	0.5	0.2
Wheatgrasses[1]	1.1	2.5	2.5	2.7	3.0	1.5	1.1	2.2	2.9	0.6	1.2	1.6	2.0
Principal species indices	70	100	100	99	91	69	79	81	84	33	30	48	45
Principal species	5.6	8.0	8.0	7.9	7.3	5.5	6.3	6.5	6.7	2.6	2.4	3.8	3.6
Percent of total	54	55	56	62	66	62	59	53	66	48	51	51	65
Other grasses & sedges[2]	3.1	3.8	3.1	2.9	1.7	2.3	3.6	4.2	1.8	0.6	0.9	0.7	1.0
Pasture sage	1.7	1.6	2.1	1.7	2.0	0.8	0.3	0.8	1.1	0.6	0.6	0.6	0.6
Other forbs	T	1.0	0.8	0.2	0.1	0.2	0.4	0.7	0.5	1.5	0.5	0.4	0.3
Annual weeds	—	—	—	—	—	—	—	—	—	0.1	0.3	T	T
Total	10.4	14.4	14.0	12.7	11.1	8.8	10.6	12.2	10.1	5.4	4.7	5.5	5.5

[1] Principally Northern wheatgrass, also Western wheatgrass.

[2] Principally Plains reedgrass, Sandberg's bluegrass, Sand reed grass, Junegrass, Thread-leaved sedge, Sun-loving sedge.

should be remembered that the annual precipitation for this area was below average from 1945 to 1949, above average from 1950 to 1955 and that this area was under-utilized from 1947 to 1955.

Comparison of the principal species indices shows that the principal species increased between 1951 and 1955, and that all grazing treatments reduced the principal species basal area in the first five years of this trial. The 1959 indices for field 2, 3, and 4 were greater than the index for 1951. Indices for 1962 show dramatic basal area reductions after two more years of grazing and two additional years of drought. In general this reduction can be attributed to drought. However, the several grazing treatments also had their effect. Field 3 was stocked at an average rate of 2.2 acres per A.U.M., comparable to the average rates for fields 1 and 2 of 2.1 and 1.9 acres per A.U.M., respectively. Despite this, the principal species index for field 3 stood at 48 in 1962, comparing favorably with the index of 45 for field 4 which was stocked at the considerably lighter average rate of 2.9 acres per A.U.M.

Table 5 shows that needle and thread, blue grama, and wheatgrasses together had a basal area of 5.6 percent of a total basal area of 10.4 in 1951; that is, they comprised 54 percent of the total basal area. Despite drought or different grazing treatments, it is significant that the valuable forage species did not markedly decline in relative abundance during this trial.

There are very considerable advantages in the use of grazing systems which utilize crested wheatgrass. Gain per animal is increased, and because these systems allow heavier stocking the gain per acre is increased. These system then are not supplementary but complementary in that they allow a twofold production increase. The rapidly increasing cattle population of the area is increasing the demand for range pasture. The adoption of these systems will help satisfy this demand.

The question of which system is the better cannot be answered from the evidence but there are certain inferences that can be made. The crested wheatgrass fields, despite the continuing drought, always produced sufficient forage for animal maintenance and gain. The story of the Sandhill prairie fields is not as satisfactory as it was found necessary to shorten the grazing season in 1960 and 1961. However, it should be pointed out that substantial reductions in use were necessary only in systems 1 and 4. Of the three systems with crested wheatgrass, system 1 was the least satisfactory. The animal production figures show no significant differences between system 2, use of both crested wheatgrass and Sandhill prairie from May to October, and system 3, use of crested wheatgrass only in May and June, and use of both Sandhill prairie and crested wheatgrass from June on. However, the reaction of the Sandhill prairie to these two systems should be considered. In 1955 at the start of the grazing trial the vegetation of these fields was comparable. At the end of seven years the Sandhill prairie of field 3 had a higher basal area of the valuable forage grasses and a higher total basal area. In 1962 it was the only field which still had more than trace amounts of high yielding western porcupine grass (*Stipa spartea* var. *curtiseta*). The complementary grazing system with the most merit was that in which one acre of crested wheatgrass and four acres of Sandhill prairie were used, and the crested wheatgrass was grazed in the spring and both the Sandhill prairie and crested wheatgrass were grazed in summer and fall.

Summary

Three grazing systems which utilized crested wheatgrass and Sandhill prairie were compared with each other and with Sandhill prairie used alone. All three of these grazing systems had equal ratios of crested wheatgrass and Sandhill prairie but the length of season of use or accessibility of the crested wheatgrass was different. The three complementary grazing systems studied had advantages compared to Sandhill prairie alone. They gave increased liveweight gain on yearling steers, and as a result of increased carrying capacity, increased beef production per acre.

The system, spring use of crested wheatgrass, summer-fall use of both crested wheatgrass and Sandhill prairie, appeared to have merit over the other two systems. At the end of seven years of grazing the vegetation of the Sandhill prairie had a greater basal area of the valuable forage grasses.

LITERATURE CITED

CAMPBELL, J. B., R. W. LODGE, A. JOHNSTON AND S. SMOLIAK. 1962. Range management of grasslands and adjacent parklands in the prairie provinces. Can. Dept. Agr. Pub. 1133 : 31 pp.

CLARK, S. E., J. A. CAMPBELL AND J. B. CAMPBELL. 1942. An ecological and grazing capacity study of the native grass pastures in southern Alberta, Saskatchewan and Manitoba. Can. Experimental Farm Service Pub. 738, Tech. Bul. 44 : 31 pp.

LODGE, R. W. 1960. Effects of burning, cultivating and mowing on the yield and consumption of crested wheatgrass. Jour. Range Mangt. 13 : 318-321.

SYLVESTRE, P. E. AND S. B. WILLIAMS. 1952. Methods of measuring the relative productivity of pasture experiments with livestock. Can. Dept. Agr. Mimeo. Bul. 16 pp.