Reseeding, Fertilizing, and Renovating in an Ungrazed Mixed Prairie[1]

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IN THE western states studies of relic areas have yielded much information necessary in the management of range vegetation. Such an area of approximately 20 acres is present on the North Montana Branch of the Montana Agricultural Experiment Station near Havre, Montana.

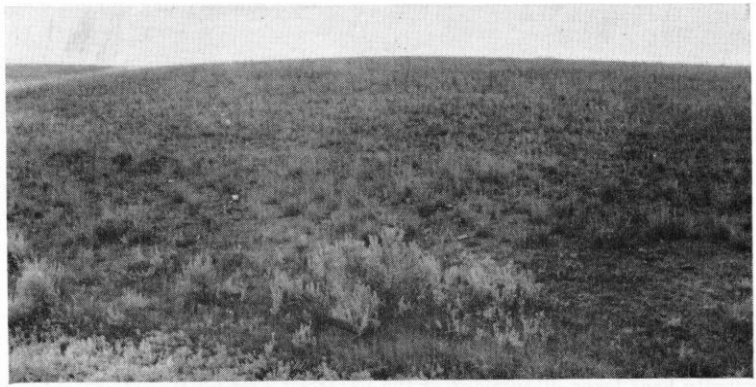

FIGURE 1. General view of relic area which shows the rolling topography, mixed prairie community in the background, and a small community of Palouse prairie in the foreground.

For 32 years prior to 1911 the area was a part of Fort Assinniboine and no doubt was grazed mostly by horses. Between 1911 when the Fort was abandoned and 1915 when the State of Montana gained control, records indicate that trespass livestock grazed the area. The relic area is located within a field fenced since 1915 for plots used in agronomic studies. However, the area has never been plowed because of poor soil and rough topography.

[1] The field work and compilation of data from annual reports of the North Montana Branch Station were completed in 1947 while the author was on the staff of the Department of Animal Industry and Range Management, Montana State College.

A prairie fire burned the dry grass in the early spring of 1925.

Annual rainfall averages 13.07 inches per year. The temperature range is extreme with a July average of 68.3 degrees F. and January average of 12.9 degrees. The topography is rolling (Fig. 1). The soil is a dark grayish brown sandy loam in the upper 10–15 inches, below which is glacial till of which the upper 8–13 inches has a high concentration of lime. The area was examined closely in the summer of 1947 to check three items: (1) the composition of vegetation after 32 years of protection; (2) a reseeding experiment started in 1936; and (3) a renovation and fertilization trial started in 1925.

NATURAL VEGETATION

The vegetation on the more level uplands was dominated by typically mixed prairie while the north facing slopes of the small drainages had small communi-

ties of Palouse prairie. In the former, needle-and-thread (*Stipa comata*), blue grama (*Bouteloua gracilis*), and June grass (*Koeleria cristata*) were the major dominants. This community was apparently similar to the Stipa-Bouteloua faciation described by Coupland (1950) for the part of southeastern Alberta, Canada, nearest to the relic area. In the Palouse prairie community bluebunch wheatgrass (*Agropyron spicatum*) and the first two species mentioned above were most important in the percentage composition. Several other species of grasses were present, but at the time of the survey they were relatively unimportant (Table 1).

TABLE 1

Average percentage composition and basal area of plants in eight square-meter plots in each community, 1947

SPECIES	MIXED PRAIRIE COMMUNITY	PALOUSE PRAIRIE COMMUNITY
Needle-and-thread	72.02	5.43
Blue grama	13.84	6.00
June grass	5.08	1.14
Thread leaf sedge	2.23	3.72
Western wheatgrass	2.06	
Sandberg bluegrass	1.99	T
Bluebunch wheatgrass		81.71
Green needlegrass		T
Mountain muhly		0.86
Pussytoes	2.78	1.14
Total	100.00	100.00
Basal area in percent	3.36	7.00
Selaginella, basal area in percent	28.47	28.68

However, vegetation is dynamic and the relative rank of the grasses and other plants has no doubt changed through the years. Even though no records are available, observations by staff personnel at the North Montana Branch Station indicated that many plants of the dominant species died during the severe drought of 1934–37 and they did not again become abundant until 1940 or later. Workers in the Northern Plains during 1934 to 1940 have found that many annual plants and Sandberg bluegrass (*Poa secunda*) increased, and total density of plants greatly decreased during the drought (Lommasson, 1939; Woolfolk, 1949).

Shrubs and herbs were not present in large numbers nor were they conspicuous in the aspect during July. Earlier in the year and in the fall a few flowers were present which broke the monotony of the grassland by their color. Such species as Hoods phlox (*Phlox hoodi*), cudweed sage (*Artemisia gnaphalodes*), scurfpea (*Psoralea tenuiflora*), Arkansas rose (*Rosa arkansana*), hairy goldaster (*Chrysopsis villosa*), and purple prairieclover (*Petalostemon purpureus*) were the most conspicuous. The shrubs and herbs, in total, accounted for less than five percent of the vegetation, either on a basis of basal area or estimated ground cover.

The percent of the ground surface occupied by seed plants was low, 3.36 percent in the mixed prairie and 7.00 percent in the Palouse prairie. The latter was the greater because the individual bunch of bluebunch wheatgrass occupied much more area than the small plants of needle-and-thread.

One cannot examine the relic without noticing the large amounts of selaginella (*Selaginella densa*). Mats of this species covered approximately 28 percent of the ground. This small clubmoss-like plant is very short but it grows in dense mats that completely cover the ground. It is drought resistant but, like the mosses, it grows with light rains. Apparently, in locations where the ground is made bare by continued and excessive use by livestock or by severe drought selaginella frequently increases in the vicinity of Havre to the extent that it restricts establishment of grasses, either native or reseeded. However, in grazing trials from

1932 to 1938 at Manyberries, Alberta, Canada, Clarke, Tisdale and Skoglund (1943) found that selaginella made the greatest increase with light grazing. Coupland (1950) observed in the plains section of Canada that it increased under protection and decreased with the trampling of livestock. The exact relationships of selaginella in the management of range lands in the Northern Plains are yet to be determined.

Seeding Crested Wheatgrass into Native Grass

Crested wheatgrass (*Agropyron cristatum*) is an important introduced plant used for early spring forage throughout the northern Great Plains. Often one hears the question: "If it is so good, why shouldn't the whole ranch be seeded?" One reason is that it is best for early spring forage while other species are better during the summer, fall, and winter. Still another reason is that the native sod will have to be broken before crested wheatgrass will become established. A series of seedings along the south side of the relic area demonstrates this point very clearly.

In the fall of 1936 one drill width of crested wheatgrass was seeded at the rate of five pounds per acre. Similar plantings were made in the falls of 1937, 1938, 1940, and 1941. In July 1947 when the percentage composition of plants in each planting was determined, the differences between years were striking. In the 1936 and 1937 plantings crested wheatgrass composed 84 and 94 percent of the stand, but in the 1941 seeding less than one percent. On the other hand there was less than one percent of needle-and-thread in the 1936 seeding, and over 70 percent in both the 1941 seeding and unseeded adjacent area (Table 2 and Fig. 2). The decrease in establishment of crested wheatgrass with the later years of seeding was gradual as was the increase of needle-and-thread. Except for the 1937 seeding, the percentage of the other grasses remained about the same. Percent of basal area occupied by grass decreased as crested wheatgrass decreased. These individual plants were larger than the native grasses.

The only information available which explains these differences comes from statements in the annual reports from

TABLE 2

Average percentage composition and basal area of plants in 1947 in plots seeded to crested wheatgrass from 1936 to 1941

SPECIES	YEAR OF SEEDING TO CRESTED WHEATGRASS					CONTROL (NO SEEDING)
	1936	1937	1938	1940	1941	
1. Crested wheatgrass	84.05	94.22	51.27	35.77	0.95	0
2. Needle-and-thread	0.97	1.48	28.72	39.95	72.03	85.46
3. Blue grama	13.39	1.59	13.14	8.60	16.61	4.68
4. June grass	1.07	2.71	2.24	11.69	5.05	5.49
5. Thread leaf sedge	0.38	T	3.09	0.18	1.02	0.72
6. Western wheatgrass	0.04	T	1.17	3.16	1.49	1.67
7. Sandberg bluegrass	0.10	0	0.37	0.65	2.85	1.98
Percent grasses except 1	15.95	5.78	48.73	64.23	99.05	100.0
Percent grasses except 1 and 2	14.98	4.30	20.01	24.28	27.02	14.54
Basal area grasses (percent)	6.84	7.12	6.24	3.99	4.21	4.19
Basal area selaginella (percent)	2.74	0.50	2.15	16.41	31.87	16.36
Total basal area (percent)	9.58	7.62	8.39	20.40	36.08	20.55

the North Montana Branch Station. The years 1936 and 1937 were near the end of the drought. The density of native vegetation was low and the few plants offered little competition to seedlings of crested wheatgrass. In 1940 and especially 1941 the native stand had thickened and prevented the establishment of the seeded grass. This trial and experience throughout the West indicates that reseeding should not be attempted in closed stands of other plants unless that cover is at least partially destroyed in the planting

Effects of Manuring and Renovation

In 1925 sixteen plots one-third acre in size and measuring 66 feet by 200 feet were established near the north side of the relic area. These were treated between the years 1925 and 1935 according to the schedule shown in Table 3. Manuring, renovation, and seeding were done about the first of April each year. The application of manure was at the rate of 10 tons per acre. Disking was considered a light renovation and disking plus spring toothing a heavy renovation. Seeding of sweet-

Figure 2. Mixed Prairie Seeded to Crested Wheatgrass

A. Good stand of crested wheatgrass resulting from the 1937 reseeding. B. A relatively poor stand from the 1940 seeding. C. No stand from the 1941 seeding, where needle-and-thread (light colored) comprises more than 72 per cent of the grasses. Photos, July 1947.

operation. Similar statements have been made for crested wheatgrass in the northern Great Plains (Allred, 1940) and for five promising grasses seeded into closed communities of cheatgrass (*Bromus tectorum*) and big sagebrush (*Artemisia tridentata*) in Utah, Nevada, and southern Idaho (Robertson and Pearse, 1945).

Not only did crested wheatgrass occupy the community to the exclusion of most plants of needle-and-thread but also selaginella was less prevalent than in the native stands. This is shown by measurements of basal area (Table 2).

clover and crested wheatgrass were also in April and at the recommended rates for the area. However, in neither case was a stand obtained. After the forage had completed its growth hay yields were obtained by harvesting and weighing the forage from the entire plot with the usual haying equipment.

Yields were not taken in 1925, 1926, 1928, 1931, 1934 and 1936, because drought prevented the growth of a harvestable crop or because of unknown reasons. In 1934 hail on June 26 greatly reduced all the yields.

Descriptions in the annual reports of the North Montana Branch Station indicated that in 1925 blue grama, western wheatgrass (*Agropyron smithii*), June grass and needle-and-thread were the major species. A considerable amount of selaginella was present at that time. Renovation destroyed part of the selaginella and damaged some of the blue grama. Western wheatgrass increased with renovation and especially so if early rainfall occurred. Reseeding well-established native sod with sweetclover or crested wheatgrass was to no avail.

TABLE 3

Yield of hay in pounds per acre from one-third acre plots of native unused mixed prairie treated variously by renovation and with applications of barnyard fertilizer, 1927–1947

PLOT NO.	MANURED AT 10 TONS PER ACRE IN APRIL IN YEARS OF:	RENOVATION IN APRIL IN YEARS OF:	YIELD IN POUNDS PER ACRE						
			1927	1929	1932	1933	1935	1947	Avg.
IIa	1925, 28, 31, 34	None	760*	162	525	264	327	486	421
IIb	1925	None	760	99	119	73	125	360	256
IIIa	1925–26, 28–29, 31–32, 34–35	None	1550	614	686	409	185	870	719
IIIb	1925–26	None	1550	310	152	109	50	336	418
IVa	1925–34	None	2540	1023	1538	620	228	1092	1174
IVb	1925–27	None	2540	1069	832	429	136	996	1000
Va	1925, 28, 31, 34	Disked 1925, 28, 31, 34	2230	1010	1241	495	108	870	992
Vb	1925	Disked 1925	2230	430	323	178	42	396	600
VIa	None	Disked 1925, 28, 31	620	158	449	188	44	540	333
VIb	None	Disked 1925	620	83	158	66	33	300	210
VIIa	None	Disked & springtooth 1925, 28, 31	940	356	739	350	61	588	506
VIIb	None	Disked & springtooth 1925	940	248	383	132	64	312	347
VIIIa	None	Disked-sown to sweet clover 1925, 28	740	182	541	238	69	456	371
VIIIb	None	None	395	23	69	26	47	564	187
IXa	None	Disked-sown to crested wheatgrass 1925, 28	295	92	383	337	110	429	285
IXb	None	None	180	23	59	23	30	168	81

* Yields not separated for the plots with Roman numeral series II–VII inclusive, in 1927.

Within two years it was evident that both manuring and renovation promoted increase in the grasses and decrease of selaginella.

Yields of hay and general observations before 1936 indicated that manuring improved yields more than did renovation, that the grass stand was improved with manuring (Table 3). Severe cultural ren-

Hay yields for 1947 were generally in line with the above conclusions even though 12 years had passed since any treatment had occurred. However, the composition of the stand had changed. Needle-and-thread was the most important grass and small amounts of several other grasses were present. The appearance for all plots was much like that de-

scribed earlier for the untreated portion of the relic area, and the percentage composition of vegetation in the plots indicated little difference between them that could be attributed to the treatments. Selaginella was prevalent in all plots. Evidently the natural changes in the composition since 1935 were more controlled by weather than by previous treatment. The yields of plots VIII b, IX a, and IX b were low for the entire trial due to shallower soil than in the other plots.

Differences in height of needle-and-thread were apparent between some of the treatments. Height measurements of 50 randomly selected plants in each treatment showed that the effects of more than four applications of manure were still present in 1947. No significant differences were found in treatments with less than three applications.

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