Grazing Crested Wheatgrass by Sheep

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PLANTING depleted spring-fall range with adapted grasses in the Intermountain region is now an important enterprise. Crested wheatgrass (*Agropyron cristatum*) is presently the best for seeding these ranges and is in widespread use. This species has already been planted on approximately 1 million acres in the Intermountain West and prospects are that there are at least 10 million acres where crested wheatgrass will be sown and where the grazing industry will ultimately depend on it. Seeded ranges represent an outlay of from 5 to 12 dollars per acre and the grass usually requires protection from 2 to 4 years for successful establishment. To retain the income-producing value of such an investment these ranges should be grazed in a manner to maintain highest production over a long period of time. As a guide to management this paper reports the results of the first 7 years' grazing of crested wheatgrass and secondary grasses with sheep on typically spring-fall range near Ephraim, Utah. Although results are not final, they provide information that is useful in guiding management of seeded spring-fall ranges.

Methods

Six 1½-acre pastures were constructed on a 1940 seeding in which crested wheatgrass was the dominant species. Other seeded grasses occurring in the stand were beardless bluebunch wheatgrass (*Agropyron inerme*) and bulbous bluegrass (*Poa bulbosa*). These were included in the mixture at a rate of 1 pound per acre. Five other grasses and two forbs were included at ½ to 2 pounds per acre. Three of the grasses, Sandberg bluegrass (*Poa secunda*), tall oatgrass (*Arrhenatherum elatius*) and slender wheatgrass (*Agropyron trachycaulum*) failed to establish themselves as part of the stand. The two forbs *Viguiera multiflora* and arrowleaf balsamroot (*Balsamorhiza sagittata*) also failed to successfully establish. Indian ricegrass (*Oryzopsis hymenoides*) and low creeping wildrye (*Elymus simplex*) were established as very minor constituents.

Beginning in the spring of 1945 and continuing through 1951 the crested wheatgrass has been grazed with ewes and lambs to average utilization intensities of 59 percent (light), 71 percent (moderate), and 88 percent (heavy), which are reasonably close to the original standards of 55, 70, and 90 percent planned for the respective intensities. In no year did removal of crested wheatgrass vary more than 5 percent from the desired utilization. These intensities may be unduly heavy for adequate soil protection, since recent research has indicated the importance of a cover of vegetation and litter for minimizing surface runoff and soil erosion (Packer, 1951; Ellison, Croft and Bailey, 1952). Pastures have been moderately grazed in the fall (usually in November) in years when regrowth was adequate.

Percentage utilization by weight was determined by estimate (Pechanec and Pickford, 1937) on thirty 9.6-square-foot plots in each pasture (Frischknecht and Plummer, 1949).

Two pastures were assigned at random to each grazing intensity. Grazing was started on one pasture of each grazing intensity when crested wheatgrass was 2 to 3 inches high (early), and on the other at an average of 13 days later when grass was 4 to 5 inches high (deferred). Spring grazing closed on all pastures at about the same date. April 14 and 27 have been the average starting dates for the respective grazing treatments and May 25 the average spring closing date.

Rambouillet sheep were used throughout the study. From two to five mature ewes between 3 and 6 years of age with single lambs were put in each pasture in the spring. Holdover ewe lambs, yearling ewes, and mature ewes were used in the fall. All sheep were weighed in the morning after a 12-hour shrink. A sheep day is considered to be a ewe for one day or a lamb for one day, since a ewe and her lamb will consume twice as much green forage as a dry ewe (Fleming, Miller and Young, 1930, 1931, and 1938).

The study area is at an elevation of 5,600 feet and is representative of much of the foothill range in the Intermountain region with level to moderately sloping terrain. Average annual precipitation for the period of this study, 1945 through 1951, was 10.19 inches, slightly less than the 22-year average of 10.38 inches. Annual precipitation ranged from 13.91 inches in 1945 to only 6.81 inches in 1951. Soil is a clay-loam, interspersed with occasional large boulders. Many smaller rocks ½ to 1 inch in diameter occur through the soil profile. A hardpan of predominately calcium carbonate exists at a depth varying from 12 to 18 inches. As a result of very heavy grazing the original native cover of bunchgrasses, winterfat (*Eurotia lanata*) and big sagebrush (*Artemisia tridentata*) was completely killed. At the time of planting in October 1940 the land was supporting chiefly Russian thistle (*Salsola kali tenuifolia*) of very low grazing value. A few sparse patches of cheatgrass brome (*Bromus tectorum*) and scattered patches of European glory-

bind (*Convolvulus arvensis*) occurred, but they were not thick enough to be a particular problem in getting the seeded grasses established.

Effects on Vegetation

As far as can be seen from the first 7 years of record, there is no difference in vegetation between pastures where spring grazing started when crested wheatgrass was 2 to 3 inches high (early) or approximately 13 days later when crested wheatgrass was 4 to 5 inches high (deferred).

Spring herbage production fluctuated from year to year due to the effects of climate (Table 1). Spring growing conditions were better than average in 1945, 1947 and 1949, about average in 1946 and 1948, and below average in 1950 and 1951. The general reduction in grass yields in all treatments in 1950 and 1951 is largely associated with the lowest available moisture for growth in any period since 1934. Some of the general decrease in grass production after 1947 probably resulted from natural causes associated with aging of the stand and commonly referred to as decadence. Similar trends after 1947 were determined in each pasture on a 12 x 14 foot plot that was completely protected from grazing during the 7-year period. This parallelism in trends indicates that factors other than grazing caused the general decline in yield. Barnes and Nelson (1950) noted a similar trend in Wyoming where seeded pastures, including crested wheatgrass, declined 25 percent from the second to the seventh year and 55 percent by the ninth year.

Table 1 reflects the differential effect of the three grazing intensities on production of crested wheatgrass just prior to early grazing. Yields at this period are used because they permit an evaluation without the complication of current grazing and are a fairly good indicator of vigor. Production of crested wheatgrass under the three grazing intensities was similar at the beginning of the study. A relative decline in production was apparent under heavy grazing after 2 years of treatment, as shown in the 1947 herbage inventory. By the seventh year pronounced differences were manifest under heavy as compared with light and moderate grazing. Little difference could be detected between light and moderate grazing.

Evidently taking as much as 71 percent of the herbage permitted crested wheatgrass to maintain production that was comparable on the average to production under 59 percent utilization. Even under 88 percent utilization, crested wheatgrass shows remarkable ability to persist, although there is no doubt that the plants have been severely injured. One of the first signs of heavy use was the tendency of the grass foliage to lie almost prostrate on the ground in the early spring. Another indicator of deterioration was the marked tendency for crested wheatgrass clumps to die in the middle and break up into apparently individual plants.

The most striking indicator of grass stand deterioration under heavy grazing was a progressive increase of Russian thistle from 1948 to 1951. In 1951 production of this summer-growing annual under heavy use was approximately five times greater than under light or moderate use (Table 2). Russian thistle plants in the lightly and moderately grazed pastures were confined to scattered openings and small, heavily-used spots. Under heavy grazing they were general over the pastures and in many places were actually growing out of the centers of weakened plants of crested wheatgrass. Because Russian thistle makes most of its growth in

Table 1. Green weight production at time sheep entered early-grazed pastures

Year	Crested Wheatgrass	Bluebunch Wheatgrass	Bulbous Bluegrass	Cheatgrass Brome	Perennial Weeds	Total
	Pounds per acre					
Lightly Grazed						
1945*	220	—	—	T	T	315
1947	382	46	247	10	4	689
1948	264	24	86	T	1	375
1949	303	50	78	T	6	437
1950	228	74	46	T	4	352
1951	116	47	58	T	2	223
Moderately Grazed						
1945*	250	—	—	T	T	358
1947	334	33	260	2	4	633
1948	293	12	101	T	T	406
1949	300	52	94	T	3	449
1950	198	70	48	T	2	318
1951	115	35	59	T	2	211
Heavily Grazed						
1945*	243	—	—	T	T	341
1947	287	18	226	1	4	536
1948	236	6	76	3	T	321
1949	244	2	112	T	8	366
1950	133	1	54	T	6	194
1951	68	T	51	T	2	121

* In 1945 no separation was made between bluebunch wheatgrass and bulbous bluegrass.

the summer, it provided no forage in the spring months.

Bluebunch wheatgrass and bulbous bluegrass occur as secondary components in the pastures. By 1948, the third year of grazing, many bluebunch wheatgrass plants had died in the heavily-grazed pastures, and by 1951, the seventh year, very little of this grass was left. This high mortality resulted despite the fact that bluebunch wheatgrass was utilized to an average of only 67 percent in the heavily-grazed pasture compared to an average of 88 percent for crested wheatgrass. Because of its upright habit and lack of basal leaves 67-percent use removed practically all the foliage of this grass. Under light and moderate grazing, where

FIGURE 1. Lightly-grazed clumps of bluebunch wheatgrass containing dry stems from former years in contrast to moderately-used plants of crested wheatgrass.

Table 2. Number of plants and yield of Russian thistle in 1951 under three intensities of sheep use

Intensity	Number	Production
	Per sq. ft.	*Lbs. per acre, dry weight*
Light	0.8	80
Moderate	0.5	67
Heavy	5.3	364

crested wheatgrass was utilized to an average of 59 and 71 percent, bluebunch wheatgrass was utilized only 14 and 16 percent. Under this use it is maintaining itself and many plants are becoming large, ungrazed "wolf plants" (Fig. 1).

There is no evidence that grazing bulbous bluegrass to an average of 61 percent in the heavily-grazed pasture has materially affected its production or vigor. A much lighter average utilization of this grass, 30 and 34 percent, was obtained in the lightly- and moderately-grazed pastures. Bulbous bluegrass shows a fluctuating production under all intensities of use. It has a proliferating bulb with a shallow, temporary root system. Former studies (Plummer, 1943) have shown that the roots of this grass dry up and deteriorate with the onset of high temperatures, and when moisture and temperatures are suitable in the fall new roots grow out from the bulb. Consequently its main growth is made before the middle of May, and since the foliage was usually drying at this time sheep ceased to graze it. However the bulblets produced on the seed stalk in place of seed are avidly eaten.

This study has furnished some information on the seeding of bluebunch wheatgrass and bulbous bluegrass in mixture with crested wheatgrass. Because of the low preference of sheep for bluebunch wheatgrass when growing with crested wheatgrass under light and moderate grazing, its use in mixture with crested wheatgrass is not recommended. If bluebunch wheatgrass is used these results suggest that it should be planted alone in separate units and used in rotation with crested wheatgrass.

Considerable conjecture exists as to the value of bulbous bluegrass in mixture with crested wheatgrass. Bulbous bluegrass does serve a useful pupose by producing highly palatable forage soon after the snow melts in spring. Even in dry years there is enough moisture for this grass to make fair growth. Biggest fluctuations in yield are caused by periods of low temperature after spring growth begins, rather than by lack of moisture. Whether one should use it in a mixture is a matter of personal choice and need. Some feel the presence of bulbous bluegrass with crested wheatgrass results in less total yield because of less efficient use of moisture by bulbous bluegrass. However, this aspect must be determined by future research.

Sheep Days

During the first three years of treatment the heavily-grazed pastures furnished materially more sheep-days per acre in the spring than the moderately- and lightly-grazed pastures (Fig. 2). During the last four years of treatment the moderately- and heavily-grazed pastures each furnished about the same number of sheep days. In two of these years, 1948 and 1951, sheep days' use from moderate grazing was greater than from heavy

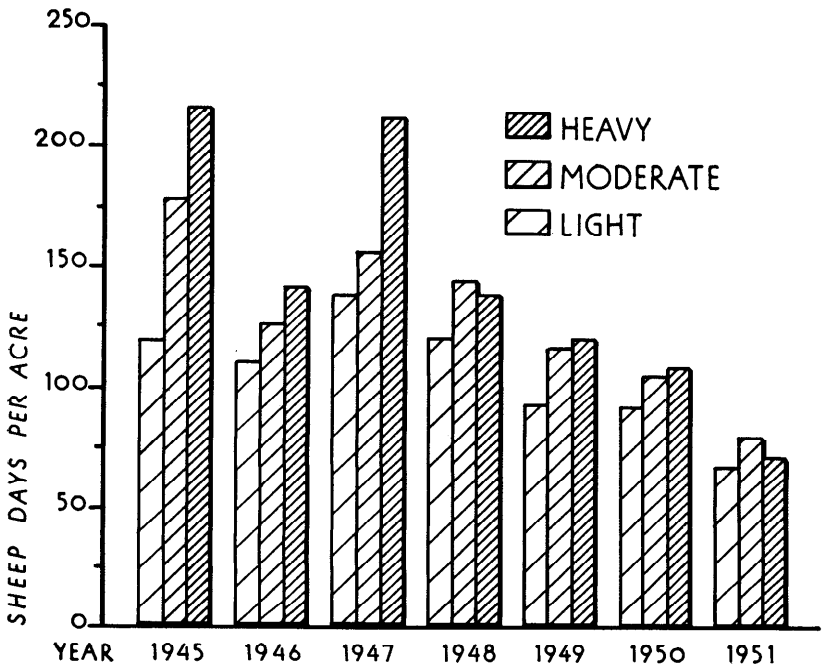

FIGURE 2. Sheep days per acre under three intensities of spring grazing during a 7-year period.

grazing, and in 1951, the seventh year, light grazing produced very nearly the same number of sheep days as heavy grazing. The relative difference in sheep days furnished by moderate and light grazing remained fairly constant during the study period.

Sheep days provided by the pastures varied widely in different years. The fluctuations between 1945 and 1948 are presumably attributable to more favorable conditions for plant growth in 1945 and 1947 than in 1946 and 1948. The decline in sheep days in 1949, a year in which early production was fairly high as Table 1 shows, may possibly be due to the fact that the ewes were in very poor condition because of the shortage of feed they had suffered on their winter range in a winter of exceptionally deep snow, so that they ate more green grass than in other years. The pronounced decreases in 1950 and 1951 are to a large extent attributable to decreased forage production in two very dry years. Part of the decline between 1947 and 1951 is attributable to decadence in the seeded stand already described.

Sheep Gains

Lamb gains per acre under the three intensities of use followed a pattern like that for sheep days. As shown in Table 3, average lamb gains per acre were greatest under the heavy intensity in 1946 and 1947, the first two years in which weights were taken. During the last 4 years, average gain per acre was greatest under the moderate intensity. This convergence of lamb gains between the heavy intensity and the moderate and light intensities parallels the similar convergence noted for sheep days. Although the heavily-grazed pastures produced slightly more lamb per acre for the six years in which weights were taken, the pronounced decline in lamb gains reflects deterioration of the grass stand under heavy use.

Average lamb gains for all intensities averaged 0.60 pound per day per head and ranged from 0.51 in 1947 to 0.70 pound per day in 1951. Lambs in the moderately- and heavily-grazed pastures made the same average gain per day, 0.58 pound, while lambs in the lightly-grazed pastures made a slightly greater gain, 0.64 pound. The difference between light and heavy is statistically significant, but that between light and moderate is not. Although the gain in favor of light grazing appears small, over a 6-weeks' grazing period it means a difference of 2½ pounds per lamb.

Gain by mother ewes for the 6-year period averaged 0.18, 0.30, and 0.08 pound per day and 8.2, 15.7, and 5.6 pounds per acre in the lightly-, moderately-, and heavily-grazed pastures. However these gains are so variable between years that it is not possible to say that they represent a real difference between treatments.

Table 3. Average lamb gain per acre under three intensities of use

Year	Intensity		
	Light	Moderate	Heavy
	Pounds		
1946	21.3	27.3	35.0
1947	30.3	33.0	50.3
1948	31.3	44.7	35.0
1949	29.7	28.3	31.7
1950	32.0	32.3	37.7
1951	24.3	26.3	22.7
Average	28.2	32.0	35.4

Fall Grazing

In two years, 1950 and 1951, there was not enough regrowth to permit fall grazing in the heavily-grazed pastures. For this reason no fall grazing use was allowed in the other pastures. During the five years that the pastures were grazed in the fall, the average number of sheep days' use for light, moderate and heavy averaged 51, 42 and 27, respectively. Greater production from lightly- and moderately-grazed pastures resulted from greater availability of old growth.

In three years, 1945, 1948 and 1949, sheep weights were taken

during the fall grazing period. In general sheep evidenced an ability to gain or maintain weight in the fall, particularly if their teeth were good. Average gain per day for all intensities was 0.23, 0.35 and 0.15 pound (Table 4). In 1949 sheep in the heavily-grazed pastures merely maintained their weights. This is attributed to the fact that snow covered the low regrowth, and since there was very little old growth above the snow the sheep couldn't get enough to fill up.

In 1948 and 1949, light and moderate grazing in the fall produced more gain per acre than heavy grazing because of the greater number of sheep days available and the higher gain per day. When fall gains are added to spring gains of ewes and lambs, the total gains per acre in 1948 were 53.3, 73.4, and 52.7, and in 1949, 55.0, 60.6, and 41.0 pounds for the lightly-, moderately- and heavily-grazed pastures, respectively. Thus sheep gains from moderate grazing are substantially greater than from heavy grazing when spring and fall grazing periods are considered together.

Early Versus Deferred Grazing

During the 7-year study, the deferred pastures furnished 20 more sheep-days per acre per year than the early pastures. Nevertheless lambs in the early pastures made about 0.08 pound more gain per day, a difference that is statistically significant. This advantage tends to make gains per acre in the early and deferred pastures about equal.

Since ewes and lambs in the early pastures made better gains per acre with fewer sheep days, it would appear that sheep starting to graze early actually consumed a greater volume of grass per head than sheep starting to graze about 2 weeks later. This is largely attributable to greater succulence of grass in the early period. The question arises as to which would be the best date to start grazing crested wheatgrass. From the standpoint of the vegetation it evidently makes no difference so long as the grass is not too heavily used at the close of the grazing season. If the primary concern is getting the lambs to gain as fast as possible, grazing early is to be preferred.

Table 4. Sheep gains in the fall grazing period in three years of record

Year	Gain per day				Gain per acre			
	Light	Moderate	Heavy	Average	Light	Moderate	Heavy	Average
	Pounds				*Pounds*			
1945	—	—	—	0.23	—	—	—	11.9
1948	0.39	0.33	0.32	0.35	14.3	9.7	4.7	9.6
1949	0.25	0.19	0.00	0.15	7.0	5.3	0.0	4.1

Summary and Conclusions

A grazing study with sheep was conducted on six 1½-acre dryland pastures in typical spring-fall range in Utah with crested wheatgrass as the dominant species. Beardless bluebunch wheatgrass and bulbous bluegrass occurred as secondary components. Three intensities of use were applied (light, moderate and heavy) with grazing starting when crested wheatgrass was 2 to 3 inches high (early) and 4 to 5 inches high (deferred). After seven years of grazing, injurious effects are obvious where crested wheatgrass has been heavily utilized (88 percent use). Under heavy grazing, production has decreased, most grass clumps have died in the middle, plants are small, and there is a marked growth of Russian thistle generally over the pastures. Although production has declined with aging of the seeded stands, crested wheatgrass appears to have maintained equally good production under light (59 percent) and moderate (71 percent) use during this first seven years.

Because of the low preference of sheep for beardless bluebunch wheatgrass under light and moderate grazing as compared to crested wheatgrass, its use in mixtures with crested wheatgrass is not recommended. Bulbous bluegrass has maintained itself well in stands of crested wheatgrass. Its use in mixtures with crested wheatgrass depends on the need for early forage and on personal preference. If grazing is deferred until late spring, inclusion of bulbous bluegrass in mixtures with crested wheatgrass is of questionable value.

Sheep days' use declined sharply in the heavily-grazed pastures as compared with the lightly- and moderately-grazed pastures after three years of treatment. During the following four years, the moderately- and heavily-grazed pastures each furnished about the same number of sheep days.

The trend in lamb production per acre was similar to the trend in sheep days. Lamb gains were slightly greater in lightly-grazed pastures than in moderately- and heavily-grazed pastures. Average lamb gain for all intensities varied from 0.51 to 0.70 pound per day.

With fall grazing, the lightly- and moderately-grazed pastures produced markedly more sheep days' grazing than the heavily-grazed pastures, chiefly because of the unconsumed spring growth still available. When sheep gains per acre for fall are included total gains for the lightly- and moderately-grazed pastures are greater than those for the heavily-grazed pastures.

No permanent differences in vegetation were apparent between pastures where spring grazing started when crested wheatgrass

was 2 to 3 inches high and those where grazing started approximately 13 days later when crested wheatgrass was 4 to 5 inches high. During the 7- year period, the deferred pastures furnished an average of 20 more sheep-days per acre per year than the early pastures. Nevertheless, in the early pastures, lambs made 0.08 pound greater gain per day.

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