Cattle Gains and Vegetal Changes as Influenced by Grazing Treatments on Crested Wheatgrass

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AT BENMORE, Utah, trials are being cooperatively conducted by the Utah State Agricultural College, Soil Conservation Service, and the Intermountain Forest and Range Experiment Station to determine the proper intensity and best method of grazing cattle on crested wheatgrass. Information on this subject is important to the proper management of thousands of acres already seeded to crested wheatgrass and will become increasingly valuable as seeding of semiarid ranges is expanded.

Literature on the subject generally recognizes the importance of grazing crested wheatgrass so as to utilize the forage before it becomes coarse and mature in early summer. Williams and Post (1945) reported that cattle made daily gains of 2 pounds or more per head for a period of 75 days in the spring, but that gains dropped considerably with longer periods of grazing. Barnes and Nelson (1950) concluded that for maximum daily gains, grazing of crested wheatgrass, beginning about April 16, should be sufficiently heavy to make full use of the forage by the forepart of June, after which animals would gain more on some other types of forage. Sarvis (1941) reported that crested wheatgrass became unpalatable to animals after it reached maturity. A general reduction in the consumption of herbage by livestock as it reaches maturity was reported by Graves, Dawson, Kopland, and Moseley (1933); and by Johnstone-Wallace and Kennedy (1944). Williams and Post (1945) reported further that rotation grazing of crested wheatgrass resulted in a 6 percent greater total gain per acre than continuous grazing, but they concluded that this small advantage probably did not justify the extra time and expense involved in a rotation system.

The Benmore experimental area is located in southeastern Tooele County within a belt commonly considered as spring-fall range in the Intermountain region. The elevation is approximately 5,800 feet and average annual precipitation is about 12 inches. Soils are mainly loams derived from the ancient Lake Bonneville sediments with a coarser overburden of alluvial and colluvial outwash material toward the southern boundary. This area, now administered by the Soil Conservation Service, was marginal dry farm land purchased by the Federal Government in 1934 under the National Resources Board. Thirty-two hundred acres were set aside as an experimental area from which twenty-eight 100-acre pastures were fenced. Water was piped to the area in the late 1930's.

Seeding of the pastures was done between 1938 and 1940 by drilling crested wheatgrass with small amounts of several other grasses directly into existing stands of Russian-thistle (*Salsola kali tenuifolia*) Irregular stands resulted in some pastures and it was necessary to seed portions of them twice. Scattered seedlings of big sagebrush (*Artemisia tridentata*) and rubber rabbitbrush (*Chrysothamnus nauseosus*) also obtained a foothold during the period of grass establishment. At present crested wheatgrass, including both the Fairway variety (*Agropyron cristatum*) and the Standard variety (*A. desertorum*), makes up about 95 percent of the forage, with minor amounts of western wheatgrass (*A. smithii*), bulbous bluegrass (*Poa bulbosa*), cheatgrass (*Bromus tectorum*), squirreltail (*Sitanion hystrix*), forbs, and big sagebrush and rubber rabbitbrush.

Experimental Procedure

At the outset twenty-four 100-acre pastures were divided into two blocks of 12 pastures each. Twelve treatments consisting of all combinations of four methods and three intensities of grazing were allotted at random to each of the two blocks of pastures. Methods of grazing include: (1) rotation, with cattle being shifted periodically among three sections of the pasture so as to graze each section twice during the season; (2) continuous; (3) 10-day deferred, where grazing starts 10 days late; and (4) removed 10 days early at the end of the season. Pastures in the first two groups are grazed by cattle for approximately 60 days in the spring, and those in the latter two groups for approximately 50 days.

Planned intensities of utilization are: light, 50 percent; moderate, 65 percent; and heavy, 80 percent of current year's growth. These rates have been achieved rather closely, with averages for the period of study (1948–51) being 51.4, 64.4, and 79.5 percent for the respective intensities. In only 5 instances did utilization on individual pastures deviate more than 5 percent from planned levels and in none more than 7 percent. In the spring of 1947 all pastures were grazed uniformly at a moderate intensity to provide an equalized basis for later comparison. Since then they have been grazed as outlined.

Fall grazing is possible for a period of 40 to 50 days when regrowth is adequate. In the fall all pastures are grazed continuously but at the same relative intensities as in the spring.

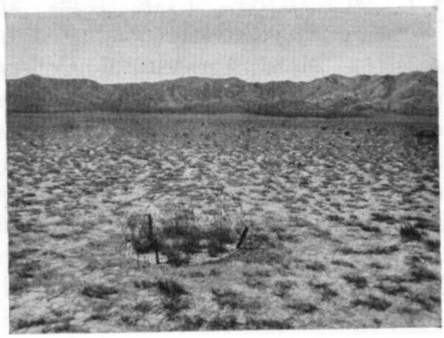

FIGURE 1. Wire cage protection plot covering an area slightly larger than 9.6 square feet in a heavily grazed crested wheatgrass pasture (Benmore, Utah). Note the extremely close utilization in this pasture.

Data are obtained on density, numbers of plants, amount of old growth, stubble height, utilization, and yield of crested wheatgrass on 40 permanent plots located on four random transects within each pasture. Data are also obtained on amount of other species present, including brush. Plots for taking grass data are 9.6 square feet in area so that herbage yields can be obtained directly in pounds per acre, (Frischknecht and Plummer, 1949). Seven to nine cages of heavy wire netting covering areas slightly larger than 9.6 square feet are placed in each pasture as guides for estimating utilization (Fig. 1). Grass beneath cages is clipped and weighed for comparison with yields on nearby grazed plots before estimating utilization on permanent plots.

Cattle for the experiment are furnished

by approximately a dozen cooperators from the nearby town of Vernon. Animals are predominately of Hereford breeding and typical of small herds in the Intermountain region. Approximately one-half the animals either have calves when they enter, or calve in the pastures. The remainder are young stock or dry cows. Cattle are generally very thin when they enter the pastures in the spring.

Grazing usually begins between the 15th and 25th of April at a time when crested wheatgrass averages between 3.5 and 4 inches in height. Cattle are taken to the nearby national forest summer range about 60 days later, generally around the 20th of June. At this time crested wheatgrass is becoming dry and less palatable.

Cattle are allotted at random among the 24 pastures in keeping with predetermined stocking rates and experience of the previous season. Some shifting of animals is necessary during the season to achieve the desired grass utilization. All animals are weighed, individually, in and out of the pastures after an overnight shrink in the corral.

Results

Results reported in this paper cover the first 4 years of the grazing study. Averages for this period show that stocking level of the pastures under light use was 3.1 acres per cow-month, 2.4 acres under moderate use, and 1.8 acres under heavy use when about half the animals were supporting calves. An earlier test showed that 12 to 25 acres of adjacent unseeded sagebrush-grass range were required to carry an animal for 1 month under moderate use. Seeding has therefore increased grazing capacity between 5 and 10 times. The pastures are also ready for grazing 2 to 3 weeks earlier than cheatgrass or native range, at a time when green forage is urgently needed.

Spring Cattle Gains

During the spring period cattle have made excellent gains on crested wheatgrass (Table 1). Although cattle on heavily grazed pastures averaged 2.21 pounds daily gain, this was 0.69 pound less than those on moderately grazed pastures and 0.82 pound less than those on lightly grazed pastures. Thus, from the standpoint of long-term gains per animal, grazing at a heavy intensity was inferior to moderate and light intensities. The slight gain in favor of light over moderate grazing is probably of minor importance.

TABLE 1

*Average daily gains made by adult cattle on crested wheatgrass grazed at three intensities and under four methods during the spring seasons of 1948 to 1951**

METHOD OF GRAZING	INTENSITY OF GRAZING			
	Light	Moderate	Heavy	Average†
	Pounds	*Pounds*	*Pounds*	*Pounds*
Rotation	2.80	2.76	2.02	2.53
Continuous	3.07	2.86	2.17	2.70
10-day deferred	2.97	2.82	2.24	2.68
10-day short	3.28	3.18	2.40	2.95
Average‡	3.03	2.90	2.21	2.71

* In figuring gains, a 70-pound calf weight plus 36 pounds to compensate for weight of membranes and fluid lost in calving was added to final weight of cows that calved in pastures (Morgan and Davis, 1936).

† 0.20 pound is required for statistical significance between method averages, P = .05.

‡ 0.17 pound is required for statistical significance between intensity averages, P = .05.

Method of grazing also influenced daily gains to some extent. Daily gains of cattle removed 10 days early at the end of the grazing season were greater than those of any other method. This indicates that cattle made much lower gains toward the end of the season when crested wheatgrass was stemmy and drying. Cattle in the rotation treatment averaged slightly lower daily gains than for any other method of grazing. McIlvain and Savage (1951) reported similar results on native vegetation on the Great Plains, but found that gains increased when animals were rotated at more frequent intervals during the summer. Similar results might be possible at Benmore by shifting cattle more frequently so as to graze each section three times rather than twice during the season.

TABLE 2

*Average daily gains made by calves during four spring seasons of grazing crested wheatgrass at three intensities and under four methods**

METHOD OF GRAZING	INTENSITY OF GRAZING			
	Light	Moderate	Heavy	Average
	Pounds	*Pounds*	*Pounds*	*Pounds*
Rotation	1.88	1.84	1.65	1.79
Continuous	1.91	1.91	1.78	1.87
10-day deferred	1.84	1.87	1.74	1.82
10-day short	1.85	1.88	1.77	1.83
Average‡	1.87	1.87	1.74	1.83

* In figuring calf gains 70 pounds was subtracted from final weight of calves born in the pastures.

‡ 0.12 pound is required for statistical significance between averages for intensity of grazing, P = .05.

The four methods of grazing had little influence on calf gains and trends did not necessarily follow those of the older animals (Table 2). Intensity of grazing, however, affected calf gains quite markedly, but not so much as it did those of the older cattle. Calves on heavily grazed pastures averaged 0.13 pound less daily gain per head than those on moderately and lightly grazed pastures, the latter two intensities averaging the same. These results are in accord with those of Woolfolk and Knapp (1949) who found that heavy stocking on the Northern Great Plains reduced the weaning weight of calves by as much as 33 pounds compared to moderate and light stocking.

Table 3 shows that for animals over 6 months of age heavy and moderate grazing intensities produced averages of 6 and 7 pounds more gain per acre, respectively, than light grazing. For the first two years heavy grazing produced slightly more gain per acre than moderate grazing, but for the last two years the reverse has been true. This has resulted mainly from having to reduce the stocking rate in heavily grazed pastures. Although the reduction has been relatively minor thus far, it suggests the possibility of a downward trend as a result of continued heavy grazing.

TABLE 3

Average pounds of gain per acre produced by adult cattle during four spring seasons of grazing crested wheatgrass

METHOD OF GRAZING	INTENSITY OF GRAZING			
	Light	Moderate	Heavy	Average
	Pounds	*Pounds*	*Pounds*	*Pounds*
Rotation	30	36	35	34
Continuous	30	35	33	33
10-day deferred	28	36	38	34
10-day short	29	38	33	33
Average*	29	36	35	33

* 2 pounds is required for statistical significance between averages for intensity of grazing, = P .05.

Calf gains have averaged 8, 11, and 14 pounds per acre under light, moderate, and heavy intensities, respectively. These differences in calf gains result from greater calf numbers with increasing intensities of use. Adding calf gains to those of older animals gives total gains of 37, 47, and 49 pounds per acre for the three intensities of grazing.

Fall Cattle Gains

Under conditions at Benmore, crested wheatgrass becomes dry and somewhat dormant during the hot summer months of July and August. However, if moisture is available, green growth begins again in September and continues throughout the fall period. Under such conditions, grazing is possible for a 40- or 50-day period after cattle come off the summer range in October. During this time cattle have made average daily gains from 0.1 to 0.6 pound per head. Cattle are fat when they come off the summer range and under these conditions low gains are to be expected. It would probably pay owners to sell fat cattle when they come off the summer range, and use crested wheatgrass pastures for the breeding herd or for stockers. Satisfactory pasturage is provided until permanent snow comes in the late fall if moderate or light grazing has been practiced in the spring. There is no assurance that fall grazing will be possible on pastures grazed heavily in the spring because, usually, an inadequate amount of spring growth is left to supplement fall regrowth.

Effects on Vegetation

Light grazing permits some plants to go ungrazed each year (Fig. 2). The dry growth of these "wolf" plants is relatively unpalatable to livestock, and because of it such plants are not likely to be grazed in succeeding years. This results in very patchy utilization in lightly grazed pastures, since other plants are grazed heavily, and all gradations exist between these two extremes. Utilization is more uniform under moderate grazing and most uniform under heavy grazing. Although accumulation of old growth varies from year to year, between 1948 and 1951 the numbers of "wolf" plants had increased 180 percent under light, and decreased 20 percent and 90 percent under moderate and heavy grazing respectively.

Considering the light intensity alone, rotation grazing allowed only one-sixth as much old growth to accumulate as the other three methods, because all animals were confined to one-third of a pasture at any given time, thus making for more uniform utilization.

The accumulation of old growth is not

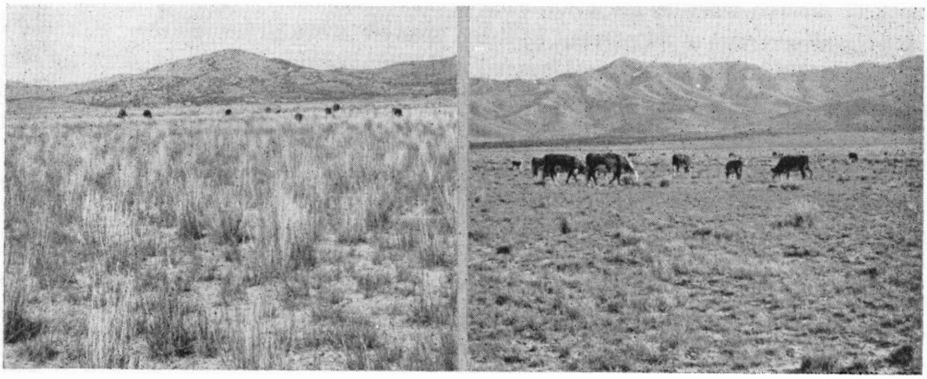

FIGURE 2. CRESTED WHEATGRASS GRAZED AT LIGHT AND MODERATE INTENSITIES
Left—Lightly grazed pasture shows differential grazing and accumulation of old growth. *Right*—Moderately grazed pasture shows fairly uniform utilization.

so much a problem with the Fairway variety of crested wheatgrass as with the Standard variety. Thus far, this has been the most striking difference between the two varieties in response to grazing.

During the 4 years of study, average stubble height, as measured at the end of the spring grazing period, ranged from 3.5 to 5.5 inches on lightly grazed pastures, from 2.6 to 3.9 inches on moderately grazed pastures, and from 1.5 to 2.2 inches on those heavily grazed.

There has been a general increase in density of crested wheatgrass amounting to an over-all average of 54 percent in the last 4 years. This is partly because crested wheatgrass has filled in "islands" of cheatgrass, but mainly because individual plants have increased in size. Thus far, neither method nor intensity of grazing has had a noticeable influence on increase in density.

Seed production is progressively less under moderate and heavy grazing than under light grazing. Prior to 1950, there had been a 9 percent increase in numbers of crested wheatgrass plants for all pastures, irrespective of grazing treatment. However, from June 1950 to June 1951 the total numbers of plants increased 29, 12, and 5 percent under light, moderate, and heavy grazing, respectively. Of course, many of the new seedlings will not become established, but these differences indicate that number of plants and future density will be better maintained or increased under light and moderate grazing.

During the course of the experiment, big sagebrush and rubber rabbitbrush have nearly doubled in yield in all pastures, principally because of an increase in size of original plants and to a lesser extent because of some increase in numbers of plants of both species. Four years ago rabbitbrush occurred on 14 percent of the permanent plots used for taking data; it is now present on 19 percent of the plots. Sagebrush now occurs on 8 percent of the permanent plots compared to 6 percent 4 years ago. Thus far, there is no evidence that increase in brush differs with grazing treatment. When new rabbitbrush and sagebrush plants are found it is generally where there is less than a full stand of crested wheatgrass or in some very heavily grazed spots where grass vigor has been reduced. In the latter instances, young brush plants are commonly found growing in the dead centers or near the edges of weakened crested wheatgrass plants. Apparently, the microenvironment in or near weakened grass plants is more suitable for brush seedling establishment than the bare spaces between plants.

Several benefits are derived from the crested wheatgrass pastures at Benmore. By using these pastures in the spring, cattle have been held off higher summer range one month later than otherwise. This should result in general range improvement on the higher areas. A higher calf crop has resulted from pasture breeding and is close to 100 percent for cows grazed in the experimental pastures the previous year. Ranchers sell some grass-fat cattle when they come out of the pastures in late June. The price is usually good at this time of year and a source of income is provided in the "off" season.

Summary

An experiment at Benmore, Utah, involves grazing of cattle at three intensities and four methods, replicated twice, on twenty-four 100-acre pastures of crested wheatgrass. The pastures are grazed for approximately 60 days in the spring and 40 to 50 days in the fall when regrowth is adequate. Results of the first 4 years of study (1948–51) are as follows:

1. In pastures grazed lightly in the spring (50 percent utilization), an average

of 3.1 acres has been required to carry a cow for one month when about half the animals are supporting calves; averages for moderate (65 percent utilization) and heavy grazing (80 percent utilization) have been 2.4 and 1.8 acres, respectively. In contrast, 12 to 25 acres of adjacent unseeded sagebrush-grass range are required per cow-month under moderate use.

2. Adult cattle made average daily gains of 3.03, 2.90, and 2.21 pounds per head under light, moderate, and heavy grazing, respectively. Daily gains were highest when animals were removed 10 days before the end of the grazing season. Calves averaged 1.87 pounds per head daily gain under both light and moderate intensities of grazing and 1.74 pounds under heavy grazing. Method of grazing had little influence on daily calf gains.

3. Spring gains per acre for adult animals averaged 29, 36, and 35 pounds under light, moderate, and heavy grazing, respectively. During the first 2 years, heavy grazing produced slightly more gain than moderate grazing, but this was reversed in the next 2 years, due mainly to a reduction in stocking rate on heavily grazed pastures. Calf gains amounted to 8, 11, and 14 pounds per acre under the respective intensities of grazing, differences resulting from greater calf numbers with the increasing intensities of use.

4. During the fall, most pastures furnish enough forage to maintain cattle weights. Grazing has not been possible every fall, however, because of insufficient forage in the heavily grazed pastures.

5. Light grazing allows considerable old growth to accumulate in ungrazed crested wheatgrass plants; animals avoid these plants each year and overgraze others. Use is more uniform under moderate grazing and old growth does not accumulate. Heavy grazing tends to remove any old growth that may be present.

6. The average density of crested wheatgrass has increased 54 percent in the Benmore pastures. Thus far, few or no differences are discernible as a result of grazing treatment. However, fewer young plants are now being produced under heavy grazing than the other two intensities, indicating that differences in density between grazing treatments may become more pronounced.

7. Rabbitbrush and sagebrush are increasing slightly in the experimental pastures. When new plants of these species are found, it is generally where there is less than a full stand of crested wheatgrass or in spots where grass vigor has declined as a result of too heavy grazing.

8. Aside from experimental results, several benefits are derived from the crested wheatgrass pastures at Benmore: cattle have been held off the summer range one month longer than otherwise, thus contributing to range improvement on the higher areas. The calf crop approaches 100 percent as a result of pasture breeding. Some grass-fat cattle can be sold when taken out of the pastures in June, thereby providing a source of income to ranchers in the "off" season.

Acknowledgment

The authors gratefully acknowledge the supervision of early phases of the study by Dr. George Stewart formerly of the Intermountain Forest and Range Experiment Station; and the active participation of Professor James A. Bennett and Farris E. Hubbert and Harold R. Beeman, graduate assistants, Animal Husbandry Department, Utah State Agricultural College.

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DISTRIBUTION OF *LARREA TRIDENTATA* IN THE TUCSON AREA AS DETERMINED BY CERTAIN PHYSICAL AND CHEMICAL FACTORS OF THE HABITAT

(*Abstract of thesis submitted in partial fulfillment for an M.S. degree, University of Arizona, Department of Botany and Range Ecology, 1950.*)

Creosote-bush (*Larrea tridentata*) is the most characteristic and widespread shrub of the Lower Sonoran Zone in Arizona. Some of the physical and chemical soil characteristics underlying the distribution of creosote-bush were studied on six typical creosote-bush communities located within a radius of 40 miles from Tucson, Arizona, together with six adjoining communities containing little or no creosote-bush to serve as checks.

A 2500 square-foot quadrat was located in each creosote-bush and each check community. Within each quadrat soil samples were taken at six-inch intervals to a depth of three feet in a trench roughly 7 feet long, excavated to a depth of 3 feet and 1.5 feet wide. Special note was taken of the occurrence of caliche along the soil profile thus exposed. Each of the 144 soil samples was then analyzed to determine mechanical analysis, moisture equivalent, total nitrogen, organic carbon, total soluble salts, and pH.

Caliche was only found in two of the six creosote-bush communities studied, indicating that creosote-bush may occur typically on caliche-free soils.

Mechanical analyses and moisture equivalent tests indicated soils of creosote-bush communities were more porous and had better internal drainage and aeration than the check areas. Surface soils of creosote-bush communities strongly tended to have a lower moisture-retaining capacity than the checks, this tendency gradually becoming less pronounced with increasing depth.

Analyses revealed a lower soil nitrogen content in the creosote-bush association than in the check. Organic carbon, total soluble salts, and pH analyses disclosed no correlation with presence or absence of creosote-bush.

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