Plant Response and Livestock Weight Changes on Big Bluegrass Range Grazed during Late Fall, Winter, and Early Spring

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Highlight: *Yearling heifers grazing Sherman big bluegrass ranges in Colorado during the cold winter period gained weight during late fall with or without a protein supplement, but they gained less than animals that grazed native range and received ½-lb protein/day. During winter and early spring, animals lost weight in most pastures. Exposure as well as kind and quantity of forage and feed available evidently influenced livestock weights. Grazing was not detrimental to Sherman big bluegrass during any period from late fall to early spring, and stands improved during the study. For most effective use, big bluegrass should replace native range for fall grazing in a management system. More animals could be carried over winter, or a set number of animals could be overwintered on fewer acres.*

Sherman big bluegrass, a selected strain of *Poa ampla* Merr., indigenous to the Pacific Northwest, is highly productive in certain areas of the Rocky Mountain Region. Generally, it is best adapted to elevations above 7,000 ft and where average annual precipitation approaches or exceeds 14 inches (McGinnies et al., 1963). Although it is often difficult to establish, Sherman big bluegrass usually remains green in late fall and winter, resumes growth very early in spring, and responds exceptionally well to grazing. It has a tendency to "pull up" when grazed, however (Hyder and Sneva, 1963; Haferkamp and Currie, 1973).

Beef production from Sherman big bluegrass grazed in late spring and summer has been greater than for other seeded species tested at the Manitou Experimental Forest (Currie, 1969a). Also, where incorporated into a yearlong management plan, early fall grazing of this grass produced excellent weight gains (Currie, 1969b).

To further evaluate big bluegrass as a source of forage, tests were conducted over a 3-year period to (1) determine cattle responses to grazing seeded stands of this species during late fall, winter, and early spring, and compare responses with those of animals grazing on nearby native ponderosa pine-bunchgrass ranges, (2) evaluate effects of grazing during these periods on stand characteristics, and (3) compare minimum level of protein supplement necessary for maintenance or satisfactory weight gains of animals grazing big bluegrass.

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Climatic conditions during the study were often very cold at the 7,800 ft elevation of the experimental forest. January minimum temperature ranged from -12°F in 1967 to -30°F in 1971. Snow, although not usually deep, is present at different times throughout the fall through spring season in this area of Colorado.

Experimental Procedure

Study Areas

Two 45-acre tracts were planted to Sherman big bluegrass at the Manitou Experimental Forest near Woodland Park, Colorado, during the summer of 1965 (Currie, 1967). One tract, the Nursery Field, has a westerly exposure. The other, designated the Sinclair Field, has an easterly exposure. The land was plowed and tilled (Currie and Smith, 1970) to kill existing vegetation prior to seeding.

A randomized block design was used for evaluating treatment responses. The Nursery and Sinclair blocks were fenced to provide nine 5-acre pastures at each location. In addition, two 30-acre native ranges, one adjacent to each area, served as controls for comparing livestock gains. Native ranges were included for comparison because they are the usual forage source in this area for keeping animals through the winter.

In the Nursery block, the control pasture is situated along a stream bottom that produces mainly meadow grasses and legumes. It also contains willow thickets, which provide some protection for cattle. The native range control treatment in the Sinclair block is more exposed. It is on an upland site which supports excellent stands of Arizona fescue (*Festuca arizonica* Vasey) and mountain muhly (*Muhlenbergia montana* (Nutt.) Hitchc.) among scattered stands of ponderosa pine (*Pinus ponderosa* Laws.).

Pasture and Livestock Treatments

Experimental grazing began in the fall of 1967 and was concluded in the spring of 1971. Grazing seasons and forage sources and protein supplement rates tested on the 5-acre pastures and native range were as follows:

Combinations of Forage Source and Supplement Rate

(1)	NR ½	Native Range + ½ lb protein/animal/day
(2)	S_O	Seeded Sherman big bluegrass - 0 protein
(3)	S ¼	Seeded Sherman big bluegrass + ¼ lb protein/animal/day
(4)	S ½	Seeded Sherman big bluegrass + ½ lb protein/animal/day

Grazing Seasons and Approximate Dates

Seeded Sherman big bluegrass
(1) Late fall–December 1 to January 10
(2) Winter–January 10 to February 20
(3) Late spring–February 20 to April 1

Native Ranges
(1) Same pasture fall through spring–December 1 to April 1

Weaner Hereford calves, kept for replacement heifers, were used to graze the pastures. All animals were kept from fall through spring, and the same heifers were kept on the same protein level through the series of the three seasonal treatments. Thus, animals randomly selected for treatment S_0 received no protein supplement for the entire fall-through-spring period, while animals in the other treatments received specified amounts of protein for the entire period. Grazing periods on big bluegrass pastures were approximately 40 days. Heifers were weighed at the beginning and the end of each treatment period. Animals on native range also were weighed at 40-day intervals, but were returned to the same pasture. These heifers were fed ½ lb protein per animal per day throughout the 120-day fall-through-spring seasons.

The protein ration was the same for all treatments, a locally available commercial mix. It contained approximately 12–13% crude protein, 2–3% crude fat, and 5–7% crude fiber, with 20,000 units each of vitamins A and D. The supplement was fed free choice into feed bunkers in each pasture unit.

Put-and-take stocking was used to obtain the desired stubble height and degree of use. The number of heifers in each 5-acre big bluegrass pasture ranged from a low of 7 in 1 year to a high of 13, depending upon the amount of forage available. Vegetative yield on native ranges was lower and less variable; and 3 to 5 heifers per pasture provided proper stocking.

Sherman big bluegrass was grazed to a 3-inch stubble height, about 65% by weight. Previous intensity-of-grazing studies at Manitou showed that grazing to a 2-inch stubble height, or about 72% use, was too heavy for stand maintenance. Grazing to a 4-inch stubble height, or about 61% use, was too light and resulted in uneven utilization (Currie, 1969a).

Native, meadow-grass hay was fed in uniform amounts to all animals when grazable forage was snow-covered. Sheds were placed in the bluegrass pastures to provide shelter for the animals. Animals had continuous access to water, which was kept free of ice with stock tank heaters.

Plant Measurements

Standing crop was estimated on the big bluegrass pastures during mid-August each year with a Neal Electronics[1] Model 18-612 herbage meter (Neal and Neal, 1973). In 1967, herbage was estimated on plots randomly located in each pasture by a double sampling technique (Currie et al., 1973). Thereafter, estimates were made on 180 plots per pasture. Big bluegrass was separated from other herbage and standing dead organic matter, except in 1967. Each year all material harvested was oven dried at 105°C for 24 hours prior to weighing.

Density of invading species and changes in stand characteristics of Sherman big bluegrass were evaluated on permanently located 1- by 10-ft plots placed perpendicular to drill rows. Twenty-five of these plots were systematically established throughout each pasture.

Densities of plant species other than big bluegrass were estimated by counting individual plants within the plot frame.

[1] Trade and company names are used for the benefit of the reader; such use does not constitute an official endorsement or approval of any service or product by the U.S. Department of Agriculture to the exclusion of others that may be suitable.

Fig. 1. *Heifers grazing the open bluegrass pastures were more exposed to the elements than animals grazing native range in and among trees and willow thickets in lower background. Animals shown received ½ lb protein/animal/day. Hay was not fed when this much bluegrass forage was available.*

Because individual plants of big bluegrass growing in rows cannot easily be distinguished, a different procedure was used to evaluate plant numbers and aggregation or dispersal of that species. For this measurement, an engineer's rule, graduated 10 divisions to the inch, was placed parallel and adjacent to drill rows within the plot frame. A continuous segment of big bluegrass crown was counted as one plant. Plant intercepts were recorded to the nearest 0.1 inch. Thus a continuous, 12-inch row of bluegrass within the frame was counted as one plant, and its intercept recorded as 120 units. Wherever breaks in plant crown were evident, distinguishable plants were counted and their intercepts measured. Plants within 10 separate 1-ft drill rows were counted and measured in each of 25 plots in each pasture. Changes in intercept and numbers of bluegrass plants were evaluated by covariance analyses.

Results

Livestock Performance

The heifers made small but significant ($P < .05$) weight gains on all pastures during late fall (Table 1), but usually lost weight during winter and spring. They consistently gained significantly ($P < .05$) more weight on native range at the Nursery location than from other treatments. At the Sinclair location, heifers lost weight during winter and spring under all treatments. Losses on native range, which averaged 6 lb/animal in winter and 8 lb/animal in spring, were about half those on big bluegrass pastures where the animals received ¼ or ½ lb protein/day.

Differences in weight changes on the two native ranges evidently were associated with differences in forage quality and exposure of cattle to adverse weather conditions. Along the stream bottom in the Nursery block, a variety of meadow plants comparable to those on the native meadow winter range described by Malechek (1966) apparently provided higher quality forage than did plants within the upland pine-bunchgrass pasture at the Sinclair location. In addition, native range at the Nursery location is more protected from the cold and wind than either the Sinclair native pasture or the

Table 1. Average seasonal changes in weight (lb/animal) of heifer calves on Sherman big bluegrass pastures and native ranges for a 3-year period.

Forage source and protein supplement (lb/animal/day)	Season		
	Fall (Dec. 1-Jan. 10)	Winter (Jan. 10-Feb. 20)	Spring (Feb. 20-Apr. 1)
Nursery			
Big bluegrass			
0	6	-21	2
¼	19	-15	- 3
½	18	- 6	- 5
Native range			
½	35	16	-26
Sinclair			
Big bluegrass			
0	5	-14	-22
¼	5	-10	-16
½	2	-10	-17
Native range			
½	22	- 6	- 8

bluegrass pastures at either location.

Although sheds were provided to protect the heifers in all bluegrass pastures, exposure to the elements while grazing made the animals more susceptible to weight loss (Fig. 1). As expected, cattle weight gains varied significantly ($P < .01$) by years on the bluegrass pastures. During 1967-68, the heifers gained weight under all treatments in the fall, lost most weight in winter, and a lesser amount in spring. They ended the entire fall through spring seasons with a net gain of 14 lb/animal. In 1969-70, heifers lost an average of 2.1 lb/animal in the fall on the ½ lb protein/day treatment and gained only 2.5 and 0.1 lb on the ¼ lb protein supplement and no protein treatments, respectively. The heifers on these latter two treatments lost less weight in the winter season than they did in the 1967-68 treatment year, but weight losses during the spring season were larger than previous losses. Thus the heifers ended with a net weight loss of a 8 lb/animal for the 1969-70 treatment year. In 1970-71, the weight gain and loss pattern by season was similar to that for 1967-68 with gains in the fall, followed by winter losses which averaged more than in the spring. Net loss averaged 5.5 lb/animal for the season. In all years the differences in gain between seasons were associated with the onset of cold weather, particularly if accompanied by wind.

Although heifers generally gained consistently during all seasons only on native ranges, it is advantageous to have Sherman big bluegrass pastures for fall use. Even without a protein supplement, heifers gained some weight in all years. These gains were made by a total of 27 heifers over a 3-year period in each 5-acre pasture, while only 12 heifers made the larger gains on 30 acres of native range. Evaluated on a per acre basis, gains from big bluegrass without supplement nearly equaled those for native range. With either the ¼ or ½ lb protein per day supplement, the gains produced per acre were double those for native range. More important, however, is that using bluegrass pastures in the fall permits saving native range areas for grazing during the more severe winter and early spring period. Thus, a larger number of animals could be maintained in good condition on the same total amount of grazable acreage, or the same number maintained on fewer acres. In addition, costs could be reduced by not feeding protein, or feeding at the ¼-lb/day rate compared with the ½-lb/day used to supplement native range.

Table 2. Crown intercepts (inches) and numbers of Sherman big bluegrass plants per foot of drill row in 1971 following 4 years of grazing treatment. Values are adjusted means for 3 pastures with 25 plots per pasture analyzed by covariance.

Location	Season	Crown intercept	Plant numbers
Nursery	Fall	7.7	1.8
	Winter	8.3	1.6
	Spring	8.0	1.7
Sinclair	Fall	7.0	1.6
	Winter	7.0	1.7
	Spring	7.4	1.6

Plant Responses

Grazing during any of the dormant periods was not detrimental to Sherman big bluegrass. Neither plant crown intercept nor number of plants differed significantly among grazing periods at the end of the study in 1971 (Table 2). The largest difference in average intercept for seasons was only 0.6 inch between fall and winter use at the Nursery location. These same two treatments also had the most difference in plant numbers, but again the difference was very small.

From 1968 to 1971, plant intercept increased while the number of plants decreased under all treatments at both locations. These changes were not large. The increase in intercept averaged 0.6 inch, and the average number of plants per foot of row decreased 0.3. The changes indicated, however, that plants were aggregating, thus the net effect was pasture improvement under all dormant-period grazing. In contrast, grazing during the growing season damaged the stands from "pull up." Dormant season use of big bluegrass therefore provides an alternative management method (the first several years following establishment) and late fall would be the best use period for animal weight gain.

Because of uniformity in numbers and crown cover of big bluegrass in the pastures, there were no large differences in herbage yields between seasonal treatments (Table 3). Yields in 1967 were considerably higher than for other years because accumulated organic matter from time of planting in 1965 was included in this year's standing crop estimate. In subsequent years, standing dead organic matter was separated from current live plants and not included in the yield figure.

Yields were uniform between the seasonal treatments, and fluctuated in relation to growing season precipitation. From 1968 to 1969, average yields increased approximately 500 lb/acre on all treatments. These higher yields were in response to an increase of 6.42 inches of moisture received during the growing season. Yields then decreased roughly 50% in 1971 when precipitation also decreased about 50%. The influence of precipitation on yield has been documented for longer periods of time and several seeded species (Currie and Peterson, 1966; Currie, 1969; Currie and Smith, 1970).

Table 3. Herbage yields (lb/acre) from big bluegrass pastures in relation to seasonal precipitation (inches) and period of grazing. Records of oven-dry plant material produced on three pastures at each of two locations were averaged by grazing period.

Year	Precipitation (Apr. 1-Aug. 31)	Season of grazing		
		Fall	Winter	Spring
1967[1]	13.13	4,238	4,242	4,237
1968	9.93	952	906	954
1969	16.35	1,448	1,413	1,570
1971	8.54	744	730	740

[1] Yield for 1967 includes standing dead organic matter.

Table 4. Plant density[1] of invading species in 1967 and 1970 on Sherman big bluegrass pastures in relation to season of grazing. Values averaged for three pastures per season at each location.

	Season of grazing					
	Fall		Winter		Spring	
Species	1967	1970	1967	1970	1967	1970
Nursery						
Seeded species	0.75	1.89	0.39	0.77	0.23	0.43
Fringed sagebrush	0.54	1.56	0.30	1.10	0.56	1.84
Trailing fleabane	2.14	9.33	0.34	5.86	2.39	14.79
Evening primrose	0.31	0.63	0.18	0.90	0.37	0.79
Cinquefoil	0.07	0.22	0.02	0.03	0.03	0.04
Misc. grasses	0.13	0.17	0.03	0.41	0.09	0.40
Misc. forbs	0.17	2.19	0.22	0.33	0.19	2.22
Total	4.11	15.99	1.48	9.40	3.86	20.51
Sinclair						
Seeded species	0.55	1.50	0.54	1.32	0.30	0.62
Fringed sagebrush	0.29	1.63	0.58	1.97	0.47	1.57
Trailing fleabane	0.55	4.74	1.62	11.91	1.13	10.65
Evening primrose	0.26	1.49	0.58	1.62	0.28	1.38
Cinquefoil	0.02	0.05	0.01	0.02	0.03	0.01
Misc. grasses	0.01	0.37	0.03	0.44	0.01	0.78
Misc. forbs	0.18	0.63	0.17	0.42	0.25	0.36
Total	1.86	10.41	3.53	17.70	2.47	15.37

[1] Plants per square foot.

Invading species changed most on seasonally grazed Sherman big bluegrass pastures (Table 4). Trailing fleabane (*Erigeron flagellaris*) initially was one of the more abundant species in most pastures in 1967. When remeasured in 1970, it was by far the most abundant plant. Densities ranged from 4.74 plants/ft^2 in the fall-grazed Sinclair pasture to 14.79 in the spring-grazed Nursery pastures. There was no particular trend in relation to treatment, however.

Although fleabane contributed substantially to plant density, it remained relatively unimportant in terms of pasture yields or livestock forage. The "mother" plant often sends out a large number of runners which form new plants at the nodes. These juvenile plants seldom become very large, and often die. Also, both the mother and juvenile plants are dormant and have shattered prior to grazing, and those few that do remain viable have a prostrate growth form which limits their availability to livestock.

Fringed sagebrush (*Artemisia frigida*), evening primrose (*Oenothera coronopifolia*), volunteer plants of big bluegrass growing outside the drill rows, and other seeded species not killed from tillage prior to planting, also invaded the stands. All increased between 1967 and 1970, but none of the increases were associated with a particular seasonal treatment. The number of fringed sagebrush plants per square foot increased three- to six-fold under the seasonal treatments. Evening primrose and seeded species generally increased a smaller amount, with only a doubling or tripling in plant numbers. However, these species contributed approximately 20% to the standing crop of herbage available to livestock.

Conclusions

Dormant-season grazing of Sherman big bluegrass was effective in reducing "pull up." As evidenced by aggregation of big bluegrass and minor invasion by native species, there was very little detrimental effect from late fall, winter, or early spring grazing. Big bluegrass usually provided abundant forage for overwintering weaner heifer calves. The animals gained weight in late fall with or without a protein supplement. Weight losses during winter and spring were relatively small, usually averaging less than 20 lb per animal. Feeding a protein supplement to prevent or reduce such a small weight loss probably is not justified.

Cattle fed ½ lb protein per animal per day on native range usually gained weight during winter months, particularly if the native forage consisted of meadow grasses and legumes. However, Sherman big bluegrass pastures carried 2 to 3 times more animals than did native ranges of comparable acreage. Big bluegrass forage grazed in late fall produced almost as many pounds of beef per acre as did native forage supplemented with ½ lb of protein. Big bluegrass supplemented with ¼ or ½ lb of protein produced nearly twice as many pounds of beef per acre as did native range.

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