

Influence of Cattle and Big Game Grazing on Understory Structure of a Douglasfir-Ponderosa Pine-Kentucky Bluegrass Community

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Highlight: *A Douglasfir-ponderosa pine-Kentucky bluegrass community was studied 14 years after grazing by cattle and big game, by big game, and no cattle or big game grazing. Heavy season-long use by cattle and big game resulted in apparent retrogression. The herbaceous component of the community was substantially changed by cattle and big game grazing but not by big game grazing alone. Grazing by cattle and big game and big game only had similar effects on the browse components of the community.*

Use of plant communities by different animal species has long been known to influence development of vegetation aggregates. The influence of any particular animal species on plant community structure is in part a function of time, season, and intensity of use. This study was designed to measure the relative impact of grazing by cattle (*Bos taurus*), and mule deer (*Odocoileus hemionus hemionus*) and Rocky Mountain elk (*Cervus canadensis nelsoni*) on a Douglasfir-ponderosa pine-Kentucky bluegrass (*Pseudotsuga menziesii*-*Pinus ponderosa*-*Poa pratensis*) community in northeastern Oregon.

Study Area

The study was conducted in the foothills of the Wallowa Mountains on the Hall Ranch portion of the Eastern Oregon Experiment Station. The 2,000 acre Hall Ranch has been grazed by livestock for over 100 years. A range survey in 1956 indicated much of the ranch was in poor condition. Since then the ranch has been grazed only by cattle and wildlife.

The entire Hall Ranch has been logged at various times since the 1870's. According to ring counts of stumps present in the Douglasfir-ponderosa pine-Kentucky bluegrass community studied, the most recent logging in this stand occurred in the 1930's.

The Douglasfir-ponderosa pine-Kentucky bluegrass stand studied is representative of large acreages in the foothills of mountain ranges in eastern Oregon and Washington and much of northern Idaho. The study area was located on a 5-8% southwest facing slope at an elevation of 3,950 ft. Records for 1963-1971 indicated annual precipitation varied from 19-32 inches coming principally as snow and rain in the cold winter months and rain in spring and fall. The soil type was Hall Ranch loam and has been described in detail by Walton

(1962). According to the key in Daubenmire and Daubenmire (1968), this site was a *Pseudotsuga menziesii*-*Physocarpus malvaceus* habitat type.

Observations¹ of big game use since 1956 indicated the area received continuous, light mule deer use from early May into December, at which time snow depth forced the deer to move onto winter ranges. Rocky Mountain elk used the site from early April to early May and then moved to summer range. Both species of big game occasionally used the study site in mild winters.

Since 1956, cattle have grazed the Hall Ranch from late May until late October or mid-November depending on occurrence of autumn snows. The Douglasfir-ponderosa pine-Kentucky bluegrass community was grazed by cows and calves as needed. In some years the community received as little as 2 months' use and in others was used throughout the grazing season but use was heavy in all years.

Utilization records¹ from 1961-1967 classified grazing by cattle, elk, and deer collectively into five classes: no use—no evidence of utilization or sign of livestock during the current season; light—less than 50% utilization on Kentucky bluegrass; moderate—about 50% utilization on Kentucky bluegrass; heavy—more than 50% utilization on Kentucky bluegrass and some palatable herbage left; very heavy—almost all vegetation grazed off that can be utilized by the animals. The observations indicated use had been heavy to very heavy over the 7 years of examination.

Methods

In 1958 a game and cattle exclosure and a cattle exclosure each 1 acre in size were constructed in the Douglasfir-ponderosa pine-Kentucky bluegrass community (Fig. 1). Sampling was conducted in 1972 following 14 years of grazing treatment. The grazing treatments were: no grazing, big game grazing, and cattle and big game grazing.

Changes in plant community structure were estimated using frequency measurements for all plant species present in each treatment. Presence of plants in 10 plots 1 X 2 ft was recorded at 10-ft intervals along each of four 100-ft transects in each treatment. Frequency of rodent mounds was also recorded for each transect. Each transect began at a randomly selected point and ran perpendicular to the slope.

Canopy cover of shrubs was measured by line intercept of six 100-ft transects. Canopy cover of trees was measured with a model C forest densiometer.

Differences in both frequency and cover were statistically

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The report was submitted as Technical Paper No. 3754, Oregon Agricultural Experiment Station.

Manuscript received February 1, 1974.

¹ File data, Agricultural Experiment Station Project 429, Rangeland Resources Program, Oregon State University. Data collected by Drs. J. A. B. McArthur and D. W. Hedrick, formerly professors of range management.

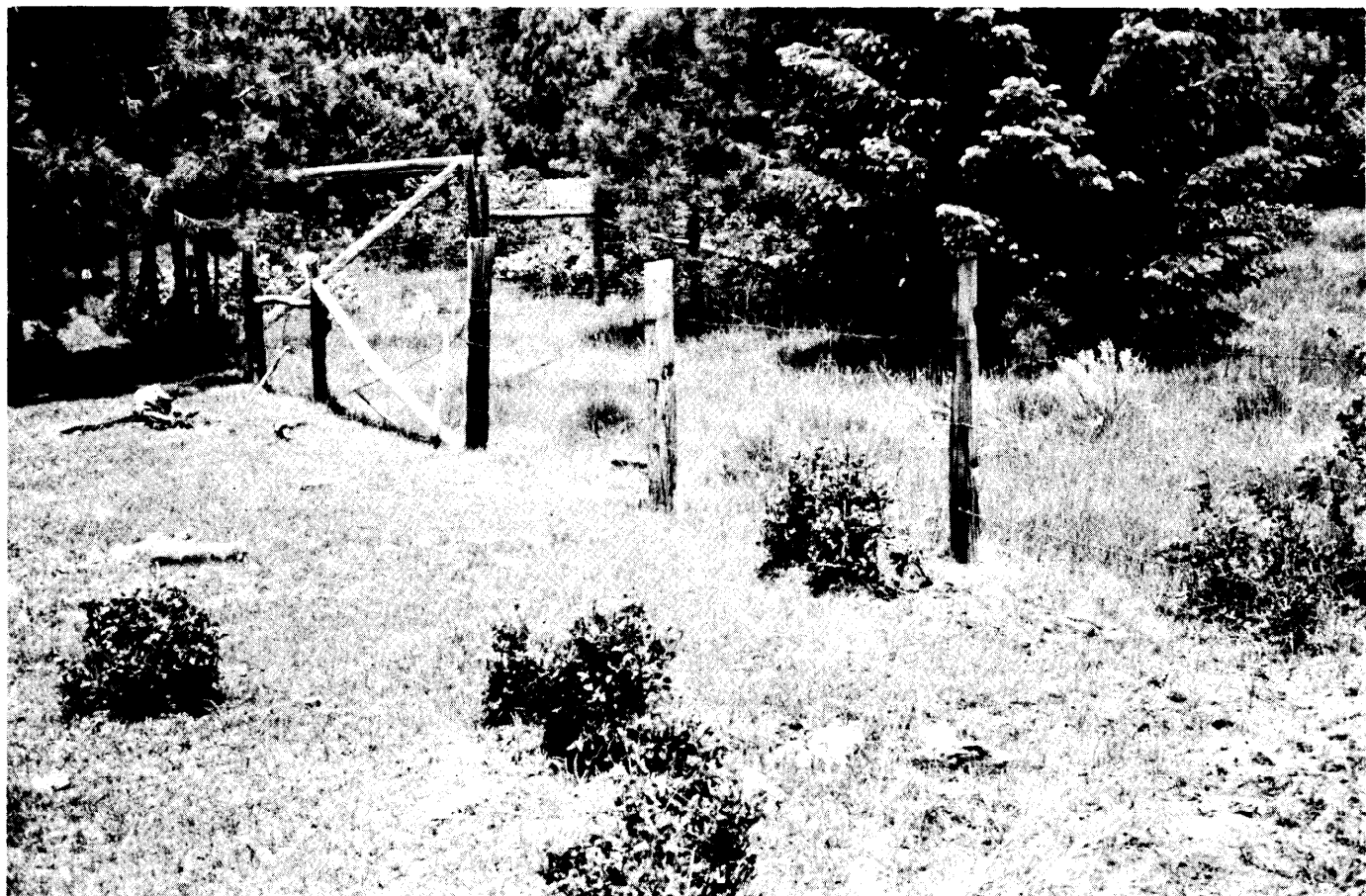


Fig. 1. Enclosures in the Douglasfir-ponderosa pine-Kentucky bluegrass community. Cattle and big game dual grazing is in foreground, cattle enclosure in middle and big game enclosure in upper left.

analyzed with chi-square techniques. Plant species with less than 10% frequency or 1% cover as a maximum value for any of the three treatments were not evaluated. Throughout the paper the term significant refers to $P < 0.05$.

Results

Frequency

Frequency of grasses and sedges indicated that heavy to very heavy season-long use had a significant impact on some species (Table 1). Grazing by big game had no significant influence on frequency of perennial grasses or sedges. Elk sedge (*Carex geyeri*) was significantly lowest in frequency, with a value of 8% in the area grazed in common by big game and cattle as compared to treatments that had no cattle grazing influence. Treatments that excluded cattle grazing resulted in frequency greater than 40% for elk sedge. Junegrass (*Koeleria cristata*) did not occur in transects sampled in the portion of the community grazed in common by cattle and big game. Frequency of Junegrass in the area where cattle grazing was excluded was significantly greater than in the area where cattle grazing was permitted and ranged from 12 to 15%. Kentucky bluegrass and Columbia needlegrass (*Stipa columbiana*) frequencies were not significantly different in the three treatments. However, since Kentucky bluegrass had a frequency near 100% for all treatments, a smaller plot size may have reflected differences in response not identifiable with the sampling procedure used.

Table 1. Average frequency (%) of major plant species after 14 years of grazing by cattle and big game, big game, and no grazing.

Plant species	Grazed by		
	Game and cattle	Game	No grazing
Grasses and sedges			
Columbia needlegrass	10 ^{a1}	15 ^a	5 ^a
Elk sedge	8 ^a	42 ^b	50 ^b
Junegrass	0 ^a	12 ^b	15 ^b
Kentucky bluegrass	98 ^a	100 ^a	100 ^a
Forbs			
Blueleaf strawberry	30 ^a	40 ^a	25 ^a
Dandelion	28 ^a	0 ^b	0 ^b
Fleabane	12 ^a	0 ^b	0 ^b
Heartleaf arnica	0 ^a	0 ^a	12 ^b
Moss	30 ^a	10 ^b	2 ^b
Rose pussytoes	12 ^a	0 ^b	2 ^{ab}
Sheep sorrel	80 ^a	35 ^b	12 ^c
Tortula	28 ^a	15 ^a	2 ^b
Western yarrow	88 ^a	68 ^b	58 ^b
White clover	78 ^{ab}	82 ^a	62 ^b
Woods strawberry	12 ^a	18 ^a	10 ^a
Annuals			
Cheatgrass	0 ^a	2 ^{ab}	12 ^b
Autumn willowweed ²	18 ^a	18 ^a	30 ^a
Bigleaf sandwort	12 ^a	0 ^b	2 ^{ab}
Douglas knotweed	0 ^a	5 ^{ab}	15 ^b
Littleflower collinsia ³	22 ^a	15 ^a	18 ^a
Browse			
Snowberry	15 ^a	20 ^a	40 ^b

¹ Treatment means within species followed by different letters are significantly different at the 0.05 level.

² *Epilobium/paniculatum*.

³ *Collinsia parviflora*.

Table 2. Average cover (%) of major browse species after 14 years of grazing by cattle and big game, big game, and no grazing.

Plant species	Grazed by		
	Game and cattle	Game	No grazing
Ninebark	0.9 ^{ab1}	2.2 ^a	0.6 ^b
Oceanspray	0.6 ^a	0 ^a	3.4 ^b
Snowberry	0 ^a	3.0 ^b	15.7 ^c
Snowbrush	0 ^a	0 ^a	7.3 ^b

¹ Treatment means within species followed by different letters are significantly different at the 0.05 level.

Frequency of most perennial forbs increased under grazing. The relative impact of heavy grazing by cattle and big game was greater than that of lighter utilization by game alone. Western yarrow (*Achillea millefolium*), fleabane (*Erigeron pumilus*), dandelion (*Taraxacum officinale*), and mosses (class: Musci), except tortula (*Tortula ruralis*) were significantly higher in frequency when the stand was open to grazing by cattle and big game than when grazed by big game alone or protected from grazing. Big game grazing alone had no effect on these species when compared to no grazing.

Rose pussytoes (*Antennaria rosea*) did not show a distinct response to grazing but was most frequent under cattle and game grazing and least frequent under treatments that excluded cattle grazing. Frequency of white clover (*Trifolium repens*) was significantly higher on areas grazed by big game alone (82%) than on areas not grazed (62%). Frequency on areas grazed by cattle and big game was intermediate (78%) and not different from either. Sheep sorrel (*Rumex acetosella*) frequency increased markedly on grazed areas, from 12% with no grazing to 35% with big game grazing, and 80% with cattle and big game grazing. All treatments were significantly different from each other. Other perennial forbs, blueleaf strawberry (*Frageria virginiana*) and woods strawberry (*F. vesca*), showed no significant response to grazing.

Annual forbs generally showed no change in frequency under the different grazing treatments. Bigleaf sandwort (*Arenaria macrophylla*) was the only annual forb that increased significantly under cattle and big game grazing compared to lighter grazing by big game alone. There was no significant change in bigleaf sandwort between the cattle and big game grazing treatment. Douglas knotweed (*Polygonum douglasii*) and cheatgrass (*Bromus tectorum*) had significantly different frequencies for the three grazing treatments. Both plants grew on disturbed soil of rodent mounds, and changes in frequency for these species was related directly to rodent activity and only indirectly to grazing treatments.

The only browse species of sufficiently general distribution to examine with the frequency technique was snowberry (*Symphoricarpos albus*). No difference in snowberry frequency was noted for cattle and big game grazing versus no cattle grazing. Under no grazing the frequency doubled to 40%, so it would appear that grazing by either cattle or big game significantly retarded the spread or development of snowberry.

Rodent mound frequency was highest in the area of no grazing at 30%. The area grazed by big game had 20% frequency of rodent activity and the area grazed by cattle and big game showed 8% rodent mound frequency.

Cover

Canopy cover of trees was 9% for Douglasfir and 6% for ponderosa pine.

Because of the low frequency of most browse species, it was felt cover provided a more meaningful measure of relative amounts of these plants in the community (Table 2). Snowbrush (*Ceanothus velutinus*), oceanspray (*Holodiscus discolor*), and ninebark (*Physocarpus malvaceus*) showed no significant differences in cover between the area grazed by cattle and game and that grazed by big game only. Snowbrush and oceanspray were both well represented in the area with no grazing. Cover of ninebark was greatest in the area grazed by big game when compared to cattle and big game grazing or no grazing.

Snowberry cover was significantly different for all grazing treatments ranging from a high of 16% under no grazing to a low of 0% under cattle and big game grazing. Grazing by big game alone resulted in 3% cover of snowberry.

Production

The exclosures were sampled for production of herbaceous and woody vegetation in 1959 the year after construction (Walton, 1962). At this time, Kentucky bluegrass made up most of the yield averaging about 600 lb/acre. Elk sedge produced 160 lb/acre and perennial forbs 60 lb/acre, so it appeared the site had a substantial amount of elk sedge and some perennial forbs at the time the exclosures were established. Perennial forbs were not separated by species in his study.

Discussion

It appeared the 14 years of continuous heavy grazing by cattle and big game resulted in retrogression within the plant community. Frequency of grasses generally decreased and frequency of forbs generally increased under heavy dual grazing, compared to light big-game grazing. Elk sedge appeared to have decreased substantially, but no direct comparison between production in 1959 and frequency in 1972 can be made. However, frequency of elk sedge and Junegrass was different enough between the cattle-grazed area and the areas not grazed by cattle to suggest retrogression had occurred on the site. Daubenmire and Daubenmire (1968) also found Kentucky bluegrass increased in dominance under heavy grazing.

It is possible that protection from cattle grazing since 1958 resulted in secondary succession within both exclosures, which would further emphasize differences between plots grazed heavily by cattle and big game and those grazed lightly by game or not grazed by cattle and big game.

Generally, the impact on herbaceous vegetation was most pronounced when cattle and big game grazed in common. Grazing by big game alone resulted in minor impacts on the herbaceous component of the understory. This does not imply that herbaceous vegetation was not important forage for big game. Big game populations have not been large enough to exert a significant impact on structure of the herbaceous component of this community. Walton (1962) reported annual production on this site was 98% herbaceous material.

Both cattle and big game had similar effects on the browse component of the community. Frequency and cover of browse were significantly reduced either by grazing cattle and big game together or by big game grazing. In 1959-1960 browse made up only 2% of the annual forage production (Walton, 1962). A small portion of forage available for use was browse, and so the relative impact of grazing on these plants would be expected to be greater than for herbaceous vegetation. The

significantly lowered browse frequency and cover on grazed versus ungrazed areas suggested these plants sustained heavy use over the 14 years of study but does not imply that browse was important for production of cattle or big game because of the relatively small amount available.

It seems logical to expect that the herbaceous component of the Douglasfir-ponderosa pine-Kentucky bluegrass community could be maintained by judicious cattle grazing management. The browse component of this community will prob-

ably be suppressed by game regardless of livestock management programs.

Literature Cited

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