Spring Livestock Grazing Affects Crested Wheatgrass Regrowth and Winter Use by Mule Deer

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Abstracts

Areas grazed and ungrazed by cattle in spring were compared for regrowth of crested wheatgrass on a big sagebrush-grass range. Overwinter utilization of crested wheatgrass by tame mule deer and their grazing area preferences were assessed under 3 snow cover conditions—snow free, partial, and complete. Results showed regrowth production was usually higher on areas previously ungrazed by livestock. Overwinter utilization of crested wheatgrass by deer was determined to be greater on ungrazed areas in both percentage of available grass used and weight per unit area consumed. Thus, interference from cured growth limiting green grass availability was more than compensated by increased production. The percentage of grass in the diet was generally higher on areas ungrazed by cattle, and deer preferred these areas under snow free and partial snow cover conditions; no preference was exhibited during complete snow cover. Recommendations for livestock grazing of seeded, foothill ranges where deer use is critical are discussed.

Few winter rangelands are used exclusively by either domestic or wild ungulates, rather, use is usually sympatric, but not necessarily simultaneous. Critical foothill ranges used by mule deer *(Odocoileus hemionus)* in the winter are typically grazed by livestock during spring, fall or both. As demands for and values of wildlife recreation increase, managing these critical ranges primarily for wildlife habitat becomes monetarily and socially justifiable (Hendee 1974, Wennergren et al. 1977). The purpose of this study was to determine the influence of spring livestock grazing on a big sagebrush *(Artemisia tridentata)*- crested wheatgrass *(Agropyon desertorum)* range on overwinter forage utilization and area choice by mule deer.

Study Area

The study site was located near Henefer in northern Utah. The rolling foothill topography, most slopes 5–15%, had a mean elevation of 1,700 m and well-drained loam and sandy-clay-loam soils. Following a 1965 wildfire on the native big sagebrush-grass community, that portion of the area was seeded to crested wheatgrass. During this study, crested wheatgrass dominated forage production with lesser amounts of big sagebrush and other browse and forb species. The land was purchased in 1975 by the Utah Division of Wildlife Resources. Since then, livestock grazing has been limited to spring (May-June) to provide fall regrowth of crested wheatgrass and increased browse forage for wintering deer.

Methods

Summer growth production, spring cattle utilization, and fall regrowth production of crested wheatgrass were determined for the 3-year period 1975 through 1977. At each of 6 sites having a common exposure, 7 paired, 1-m^2 plots were established. These 42 pairs of circular plots were replicated on 4 exposures—flat, ridge, south, and northwest aspects for a total of 168 paired plots. One of each pair was protected with circular (diameter=1.7 m) mesh-wire cages for grazed-ungrazed comparisons. Plots were systematically established prior to cattle grazing and baskets were randomly assigned within pairs. Two pairs were clipped at each site in midsummer to determine summer production and utilization. Five pairs were clipped at each site in late fall to determine regrowth production, with samples separated into green and cured portions. All samples were oven-dried at 105°C for 24 hours prior to weighing.

In spring, 1979, prior to livestock use, 5, 1.0-2.0-ha sampling areas were established. Half of each area, selected by coin toss, was fenced to exclude cattle. Five paired 1-m^2 plots were established in each grazed unit prior to cattle use to determine summer production and percent utilization. One of each pair was protected from use by a mesh-wire cage. Following grazing these plots were clipped. After clipping, 4 of the sampling areas were entirely fenced to a height of 2.5 m, as enclosures for overwinter grazing trials using tame mule deer. The fence on the fifth area was removed to allow unimpeded access in winter by wild deer. Five paired plots (1 m^2) were then established in both the livestock-grazed half and ungrazed portion in each of the sampling areas to determine regrowth production and deer utilization of crested wheatgrass. This second series of plots was clipped soon after snow melt in the spring. Materials were treated as above.

To characterize the vegetal community within each sampling area, fall forage production of species other than crested wheatgrass was determined using the weight-estimate technique. On each of the 5 areas, 30 microplots (20 × 50 cm) were read along each of 6 belt transects established between opposite fence posts. Estimates were converted to an oven-dry basis via clipped samples.

Tame, female mule deer (1 fawn, 1 yearling, and 1 mature) were used to determine diet and treatment selection within the 4 enclosures. All 3 deer were observed in 4 enclosures during each trial period on a rotational basis. Deer were kept in a 0.4-ha holding enclosure between sampling periods throughout the winter, and during the 8-day acclimatization period prior to the first trial. Deer were fed alfalfa hay ad libitum only within the holding enclosure. Diet was determined using the bite count method (Wallmo and Neff 1970), and bites were converted to oven-dry weight via hand plucked, simulated bites. Each trial consisted of sampling individual deer for 5, 30-minute foraging periods within each enclosure. If weather and snow conditions significantly changed during a trial, the data were disregarded. Single trials were completed under snow free, partial, and complete snow cover conditions, during early spring, late fall, and mid-winter, respectively. Selection of grazed and ungrazed treatments for feeding was determined by scan sampling (Altmann 1974) at 4-minute intervals for a minimum of 2-½

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Table 1. Mean summer production (kg/ha) and cattle utilization (%) of crested wheatgrass on 4 aspects, and fall regrowth production (kg/ha), 1975-77.

	Summer production			% Utilization				Regrowth production		
Aspect	1975	1976	1977	1975	1976	1977	Treatment	1975	1976	1977
Flat	1187	1115	915	93	94	77	Grazed	32.7	11.7	65.8
							Protected	26.8	16.3	92.6
Ridge	1064	841	849	63	85	76	Grazed	34.3	15.8	114.5
							Protected	21.9	15.3	150.9
South slope	758	623	534	68	88	63	Grazed	32.0	10.6	60.5
							Protected	19.0	10.2	88.5
Northwest slope	764	725	481	60	75	61	Grazed	9.0	6.4	56.6
							Protected	7.4	3.5	58.9
Mean	943	826	694	71	86	69	Grazed	27.0	11.1	74.4
							Protected	18.8*[1]	11.3	97.7*[1]

[1]*Significantly different at $P \leq .05$.

hours per deer per enclosure per trial. Grazing activity was recorded only during those instances when the observed deer was selecting forage.

Results

The production of fall regrowth of crested wheatgrass was determined to be highly variable (Table 1). In 1975, under moderately droughty, fall conditions, regrowth was significantly greater ($P<.05$) on grazed plots. During fall 1976, drought was severe and regrowth was about the same on grazed and protected plots. Amounts of regrowth were low in both 1975 and 1976. Precipitation in fall of 1977 was above average and regrowth production was high and significantly greater ($P<.05$) on protected plots. With normal precipitation, overwinter regrowth production in 1979-80 was again significantly higher ($P<.05$) in areas protected from cattle grazing (Table 3, Columns 3, 5).

Although the 5 enclosures were located in the same general habitat and none were separated by more than 1 km, important differences existed (Table 2). Enclosure #1 contained considerable bushy birdbeak *(Cordylanthus ramosus),* a warm-season forb often found in association with big sagebrush. In enclosure #2 all browse species above 15 cm height were removed in 1977 to reduce their potential influence on treatment selection by deer. Enclosure #3, on a slightly southern exposure, had the highest production of Douglas rabbitbrush *(Chrysothamnus viscidiflorus).* The holding pen was constructed along one edge of the grazed portion of enclosure #4. Enclosure #5 was used only by wild deer.

The overwinter (1979-80) crested wheatgrass regrowth production, consumption by deer and standing cured growth were all generally higher in the ungrazed areas (Table 3). The areas grazed by cattle had significantly less regrowth remaining than areas ungrazed on plots protected from deer use ($P<.01$) and those unprotected ($P<.06$). More importantly, deer consumed a significant 2.3 times more green grass on the ungrazed areas ($P<.05$). Cured growth was avoided. However, the percentage of available grass consumed was close between grazed and ungrazed areas with means of 27 and 31%, respectively. Cured growth, as would be expected under heavy spring grazing, was substantially greater on areas ungrazed by livestock ($P<.05$). Ratios ranged from about 3-11 times mores cured material on protected areas and deer encountered considerable interference when selecting for green regrowth at plant bases. No differences were determined between those enclosures used by tame deer and that used by wild deer.

During late winter an opportunity to observe wild and tame fawns feeding together occurred when a wild fawn entered enclosure #3 with the tame fawn. During the second day of containment the wild fawn showed no visual signs of nervousness or stress. The deer were observed from an on-site blind, elevated 2.5 m above ground level, using a 20X spotting scope at maximum distance of 30 m for 7 consecutive hours. Snow cover was 69% and mean depth was 10 cm. Diets for both deer were determined simultaneously by alternating observations while they grazed. Observations of the deer would shift when the deer observed lifted its head from the forage being consumed. Activity was recorded at 2-minute intervals (Altmann 1974) and included grazing, standing, walking, lying, ruminating, and other. Diet and activities were highly correlated between deer (Table 4).

The proportion of regrowth crested wheatgrass in the diet of mule deer varied with snow cover condition, and whether the area had been grazed the previous spring by cattle (Figure 1). Under partial snow cover conditions, differences in the dietary contribution of crested wheatgrass consumed by deer between areas previously grazed or ungrazed were significant ($P<.01$). During this trial, cured grass had considerable effect on snow melt, acting as a black body (Figure 2). Snow depth ranged from 5–7 cm and snow cover 26–53% on ungrazed areas, and 12–15 cm with 82–92% snow cover on the grazed half. Percentage of grass in the diet under these conditions averaged 69.5 and 17.2% in ungrazed and grazed areas, respectively. The least amount of grass was consumed during mid-winter when snow depths averaged 31 cm and snow cover was 100%. Under these conditions dietary contribution of grass was

Table 2. Summer 1979 vegetal production (kg/ha) and cattle utilization (%) of crested wheatgrass.

	Species								
Enclosure	*Artemisia tridentata*	*Chrysothmanus viscidiflorus*	*Xanthocephalum sarothrae*	*Chrysothamnus nauseosus*	*Cordylanthus ramosus*	*Circium arvense*	Other forbs	*Agropyron desertorum*	Total production
1	215	28	60	55	51	T[1]	T	709 (85)	1118
2	1	8	13	T	0	21	2	1975 (86)	2020
3	187	74	13	T	0	T	1	543 (81)	818
4	211	41	96	56	15	3	T	1111 (83)	1533
5	331	26	102	30	22	9	1	657 (82)	1178
Mean	189	35	57	28	18	7	1	999 (83)	1333

[1]$T<1.0$ kg/ha.

Table 3. Production (kg/ha) and dee consumption (kg/ha) of fall-winter regrowth and standing cured old growth, crested wheatgrass, winter, 1979-80.

		Treatment				Overwinter deer consumption	
	Enclosure Enclosure	Cattle-grazed Deer-unprotected	Cattle-grazed Deer-protected	Cattle-ungrazed Deer-unprotected	Cattle-ungrazed Deer-protected	Cattle-grazed	Cattle-ungrazed
Regrowth	1	43.8	43.0	47.8	67.1	-.8	19.4
	2	122.9	168.3	287.0	341.7	45.4	54.7
	3	33.9	47.5	86.5	160.3	14.6	73.8
	4	50.1	86.2	72.7	104.6	36.1	31.9
	5	40.6	55.3	66.0	140.0	14.7	74.0
	Mean*	58.3[a]	80.1[a]	112.0[ac]	162.8[bc]	22.0[a]	50.8[b]
						Deer trampling loss	
Old growth	1	45.9	61.8	165.6	188.1	15.9	22.5
	2	71.4	80.3	780.3	948.5	8.9	168.2
	3	59.4	75.7	297.6	383.9	16.3	86.3
	4	54.3	120.9	285.4	326.4	66.6	41.0
	5	46.6	67.1	302.3	334.2	20.5	31.9
	Mean*	55.5[a]	81.2[a]	366.2[b]	436.2[b]	25.7[a]	70.0[b]

*Means with differing superscripts different at $P<.05$ level.

higher on ungrazed areas ($P<.01$), but it averaged only 3.9% and less than 1% on the ungrazed and grazed areas, respectively. Under snow-free conditions, the proportion of grass in the diet was high, but means were not statistically different between grazed and ungrazed areas where percentage of grass in the diet averaged 86.1% and 82.4% (Fig. 1).

During partial snow cover conditions, an average of 80.0% of time feeding was spent in ungrazed areas and only 20.0% in grazed areas (Fig. 3). As might be expected under deep snow conditions, deer showed no preference for grazed or ungrazed areas, spending 47.4% and 52.6% of feeding time, respectively. However, under snow-free conditions preference for ungrazed areas was evident with deer averaging 66.6% and 34.4% in ungrazed and grazed areas, but the relationship was not consistent. For unknown reasons, deer preferred the grazed area in enclosure #1.

Discussion

The results from this study showed that under heavy spring utilization of crested wheatgrass by cattle, fall regrowth was variable. Data from Urness (1966) suggested fall regrowth was slightly higher on grazed than ungrazed plots following heavy spring use. Based on our results, greater fall regrowth production would be expected on ungrazed areas during years of normal or above normal precipitation, whereas grazed areas may have some advantage during droughty years. Furthermore, a higher overwinter availability would be obtained on ungrazed areas particularly during winters having long periods of partial snow cover. Also, greater regrowth and new growth production in spring would be expected on ungrazed areas. Sneva (1980) reported standing dead material in spring increased production in *Agropyron inerme.* Other investigators studying bluebunch wheatgrass *(Agropyron*

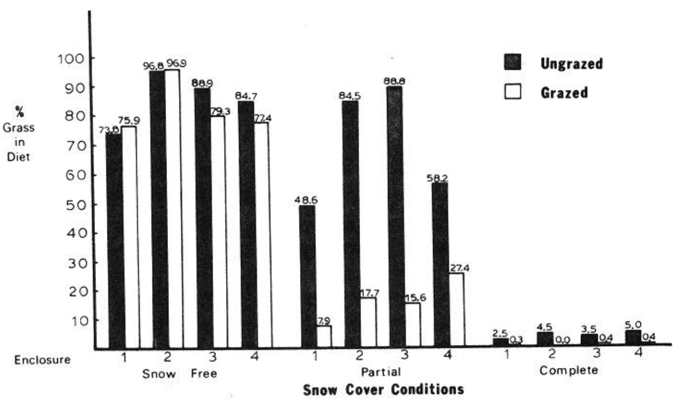

Fig. 1. *Percentage of regrowth crested wheatgrass in the winter diet of mule deer during snow free, partial, and complete snow cover conditions within cattle grazed and ungrazed areas.*

Fig. 2. *Effect of ungrazed cured crested wheatgrass on snow cover.*

Table 4. Diet and activity comparison of wild and tame female fawns.

Plant species	% Diet (Bites) Wild fawn	% Diet (Bites) Tame fawn
Agropyron desertorum	23.2	26.7
Artemisia tridentata (leaves)	25.4	24.2
Chrysothamnus viscidiflorus	51.1	48.6
Artemisia tridentata (seed stalks)	0.3	0.4
Xanthocephalum sarothrae	0.0	0.1
Total bites	1175	819
Activity	**% Time Wild fawn**	**% Time Tame fawn**
Grazing	11.8	14.2
Standing	45.3	41.5
Walking	4.2	1.4
Lying	26.4	27.4
Ruminating	10.8	13.7
Other	1.4	1.9
Total observations	212	212

spicatum) reported decreased production in spring when standing dead material was previously removed (Rickard et al. 1975, Sauer 1978, Willms et al. 1980).

The inhibiting effect of cured grass on the grazing of regrowth by deer is difficult to assess. In this study, such a physical barrier appeared less important than the total amount of regrowth available. Considering the large differences in consumption and preference between grazed and ungrazed areas, the inhibiting effect appeared minor. Contrary to our findings, Lamb (1966) suggested that when the physical barrier imposed by coarse old grass is considered, grazed plots would produce more available growth. Also, Leckenby (1968) reported 40–60% of fall regrowth of crested wheatgrass was removed by deer when summer cattle grazing was allowed, but only 10–20% was consumed when cattle were excluded. Willms et al. (1979) reported heavy fall or spring grazing by cattle made spring forage in fields dominated by bluebunch wheatgrass more attractive to deer than ungrazed fields. However, Willms et al. (1981) determined deer displayed distribution preference for the ungrazed field in early spring until new green growth exceeded stubble height on grazed areas.

Three factors warrant consideration in defining the effects of the barrier formed by standing dead material: (1) coarseness and amount of old growth; plants not grazed heavily by livestock for several years would have more coarse material than those grazed periodically and the inhibiting effect would be increased, (2) effectiveness of the coarse grass in reducing snow cover and inducing increases in growth, and (3) time of use; since the barrier would be lessened due to overwinter decomposition, deer using grass primarily in spring would encounter less cured material than if use occurred during fall or winter. We noted a strong tendency for standing dead crested wheatgrass, ungrazed for 1 year, to be matted down by winter snow making new growth more readily available in spring.

Conclusion and Application

The 3 indices used in this study to compare deer use between grazed and ungrazed habitats—overwinter utilization of grass, percent grass in the diet, proportion of time spent in grazing activity—showed consistent results. Clearly, under partial snow cover conditions, mule deer strongly preferred ungrazed winter range. During snow-free conditions there appeared to be a lesser preference for ungrazed range, while during complete snow cover conditions little selectivity was found.

Under livestock-grazing regimes in late spring and early summer, grasses and forbs constitute the bulk of their diets and only minor amounts of shrubs are consumed (Smith and Doell 1969, Jensen et al. 1972). Thereby shrubs gain a competitive

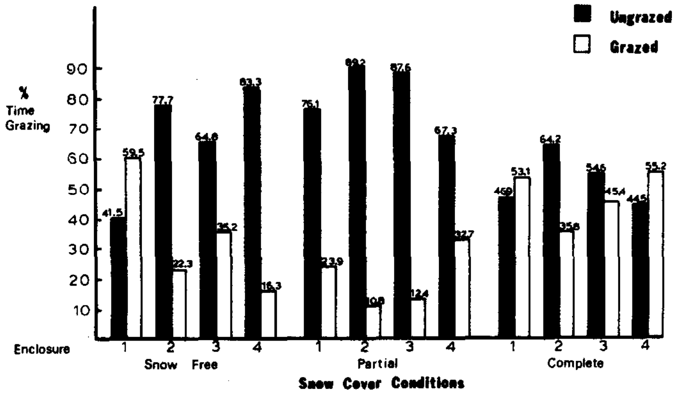

Fig. 3. *Percentage of grazing time spent by mule deer within areas grazed and ungrazed by cattle in spring during snow free, partial, and complete snow cover conditions.*

growth advantage over time and the proportion of shrub production increases. Conversely, where growing-season livestock grazing has been eliminated and winter use of shrubs continues, the growth advantage is shifted to the grasses (Scotter 1980). The question then becomes how to manage big sagebrush-grass, and particularly seeded, ranges where mule deer are an important consideration.

In general, rest-rotation management of crested wheatgrass ranges is seldom warranted, but foothill areas, having a diverse mix of native and seeded types and receiving significant deer use, appear to be an exception. Although grass is important in deer diets, browse species become critically important as snow depth increases (Austin and Urness, in press). Consequently, the amount of winter range which should be protected from livestock grazing would be inversely related to snow depth and duration. Our recommendation, assuming adequate stands of big sagebrush and other shrubs presently exist to sustain the current or desirable number of deer, is to determine the percentage of a harsh wintering period that would have 100% snow cover or snow depths exceeding 20 cm, and use that percentage as the proportion of range to be grazed by livestock in late spring and early summer on a yearly basis. Grazed areas should be rotated with those ungrazed, and several small, scattered areas would be preferable to a few large units. For example, in our study area winter deer use continues about 5-½ months and during a harsh winter about 3-½ months may be expected to have deep snow. Thus about 2/3 of the area should be grazed yearly with 1/3 rested. Anderson and Scherzinger (1975) reported similar recommendations.

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