

# Fall grazing affects big game forage on rough fescue grasslands

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## Abstract

Prescribed cattle grazing is often used to purposely enhance wildlife habitat. This study investigated the effects of fall cattle (*Bos taurus*) grazing intensity on elk (*Cervus elaphus*) and deer (*Odocoileus* spp.) forage in the following spring and summer. These effects were examined on rough fescue (*Festuca scabrella* Torr.) range on the Blackfoot Clearwater Wildlife Management Area in west central Montana. Cattle were grazed in enclosures during the fall of 1997 and 1998. A randomized complete block design with 5 replications of enclosures per year was used. Grazing levels were 0% removal (control), 50% removal, 70% removal, and 90% removal of herbaceous standing crop. To evaluate elk and deer forage, measurements were obtained in spring and summer on green grass standing crop, green forb standing crop, percent green vegetation, species richness, and plant species composition. There were no differences among grazing levels for plant species composition based on canopy coverage, species richness, and green forb standing crop variables ( $P > 0.10$ ). The 50% and 90% treatments reduced green standing crop in spring ( $P = 0.07$ ) but not in summer ( $P > 0.10$ ). Grazing treatments increased percent green vegetation ( $P < 0.01$ ). Fall cattle grazing can be used as a wildlife habitat improvement tool to reduce unpalatable standing dead material. The 70% removal treatment was the most favorable for habitat improvement without degrading the range.

**Key Words:** *Cervus elaphus*, *Festuca scabrella*, *Odocoileus* spp., livestock-wildlife relations, prescribed livestock grazing

The compatibility of livestock and wildlife on western ranges has been discussed often (Anderson and Scherzinger 1975). Managers traditionally considered livestock activities in wildlife habitat to be detrimental, which led to removal of domestic livestock from many lands managed for wildlife (Jourdonnais and Bedunah 1985). Competition between cattle (*Bos taurus*) and deer (*Odocoileus* spp.) or elk (*Cervus elaphus*) is less than once thought (Kingery et al. 1996, Vavra and Sheehy 1996). Previous research has revealed that wild cervids, such as deer and elk, are more selective herbivores than cattle (McMahan 1964, Collins et al. 1978, Kingery et al. 1996). Positive aspects of livestock grazing on wildlife habitat should be addressed. Livestock producers and wildlife managers benefit from this information.

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## Resumen

El apacentamiento prescrito del ganado a menudo es usado con el propósito de mejorar el hábitat de la fauna silvestre. En este estudio se investigaron los efectos de la intensidad de apacentamiento en otoño del ganado (*Bos taurus*) en el forraje disponible para alces (*Cervus elaphus*) y venados (*Odocoileus* spp.) en la siguiente primavera y verano. Estos efectos se examinaron en un pastizal de "Rough fescue" (*Festuca scabrella* Torr.) en el área de Manejo de Fauna Silvestre "Blackfoot Clearwater" localizado en la región central oeste de Montana. El ganado apacentó en exclusiones durante el otoño de 1997 y 1998. Se usó un diseño de bloques completos al azar con 5 repeticiones de exclusión por año. Los niveles de apacentamiento fueron 0% (control), 50%, 70%, y 90% de remoción de la biomasa en pie. Para evaluar el forraje para el alce y el venado se obtuvieron mediciones en primavera y verano de la biomasa verde en pie de zacates y hierbas, porcentaje de vegetación verde, riqueza de especies y composición de especies vegetales. Los niveles de apacentamiento no mostraron diferencias en la composición de especies de plantas, basado en la cobertura de copa, en la riqueza de especies de plantas y biomasa verde en pie de hierbas ( $P > 0.10$ ). Los tratamientos de 50% y 90% redujeron la biomasa verde en pie en primavera ( $P = 0.07$ ), pero no en verano ( $P > 0.10$ ). Los tratamientos de apacentamiento incrementaron el porcentaje de vegetación verde ( $P < 0.01$ ). El apacentamiento del ganado en otoño puede ser usado como una herramienta de mejoramiento del hábitat de la fauna silvestre para reducir la biomasa muerta no apetecible. El tratamiento de 70% de remoción fue el más favorable para mejorar hábitat sin degradar el pastizal.

Several studies have examined the effects of cattle grazing on winter forage for deer and elk (Anderson and Scherzinger 1975, Neal 1982, Urness 1982, Vavra and Sheehy 1996, Wambolt et al. 1997, Clark et al. 1998). However, there has been little research on how cattle grazing affects spring and summer forage. Spring and summer range is very important for deer and elk production (Collins et al. 1978).

Deer and elk select green grass during spring (Jourdonnais and Bedunah 1985, Lyon 1985). In summer, deer and elk diets consist largely of forbs (McMahan 1964, Stevens 1966, Collins et al. 1978, Kasworm et al. 1984, Jourdonnais and Bedunah 1985, Lyon 1985, Canon et al. 1987, Kingery et al. 1996). Collins et al. (1978) stated that species diversity is an important aspect of wildlife forage. Unpalatable standing dead material is considered a barrier to grazing in bunchgrasses (Willms and McLean 1978, Willms et al. 1979, 1980, 1981, Ruyle et al. 1987, Provenza and

**Table 1. Mean relative utilization and stubble height ( $\pm$ SD) of herbaceous standing crop in treated plots. Utilization expressed as percent removed of current standing crop.**

Year	Target Treatment	Actual Utilization	Stubble Height
		(%)	(cm)
1997	50%	48.9 $\pm$ 2.5	22.2 $\pm$ 3.3
	70%	70.6 $\pm$ 3.4	11.0 $\pm$ 2.2
	90%	88.0 $\pm$ 1.4	5.2 $\pm$ 1.6
1998	50%	49.4 $\pm$ 2.6	21.5 $\pm$ 3.1
	70%	69.3 $\pm$ 1.0	12.6 $\pm$ 2.1
	90%	89.2 $\pm$ 1.4	4.0 $\pm$ 1.9
Average	50%	49.2 $\pm$ 2.4	21.9 $\pm$ 3.2
	70%	70.0 $\pm$ 2.4	11.8 $\pm$ 2.3
	90%	88.6 $\pm$ 1.5	4.6 $\pm$ 2.0

Balphy 1990). When managing spring and summer range, it is important to consider that deer and elk select green grass during spring, forbs during summer, and avoid plants with standing dead material present.

Fall cattle grazing has increased elk use the following spring (Jourdonnais and Bedunah 1990, Frisina 1991). Jourdonnais and Bedunah (1990) recommended that fall cattle grazing be used to make spring forage more attractive for elk. Willms et al. (1979) found that mule deer choose to use fall-grazed areas in the spring. One theory to explain deer and elk preference for areas grazed by cattle in fall by is that fall grazing reduces standing dead material (Willms et al. 1981, Jourdonnais and Bedunah 1985, 1990, Alt et al. 1992). Ungrazed areas accumulate standing dead plant material and stagnant, rank vegetation (Anderson and Scherzinger 1975,

Jourdonnais and Bedunah 1985, 1990). Another theory is that fall cattle grazing increases forb abundance (Stevens 1966). Livestock grazing can increase the amount of forbs for wildlife use (Stevens 1966, Willms et al. 1979). Willms et al. (1979) found that larger amounts of green growth were present in spring in areas that had been grazed by cattle. However, the effects of fall cattle grazing on deer and elk forage have not been examined in detail. Information on prescribed levels of fall grazing to achieve desired spring and summer forage characteristics is not available. There is a complication of deer and elk preference for areas grazed by livestock in fall. If fall livestock grazing occurs in a rest-rotation grazing system and the fall grazed pasture is rested during the following period of increased deer or elk use, is this increased use due to a change in forage or to the absence of

domestic livestock and the associated human presence in that pasture?

We hypothesized that larger amounts of green growth, higher forb levels, reduced standing dead material, and/or higher plant diversity are attracting deer and elk to sites previously grazed by cattle. In this study, we describe the impact of fall cattle grazing on spring and summer deer and elk forage. The objectives were to determine if fall cattle grazing improves spring and summer forage for deer and elk, and if so, what grazing intensity is optimum.

## Methods

### Study Site

This study was conducted on the Blackfoot Clearwater Wildlife Management Area (BCWMA), 70 km northeast of Missoula in west-central Montana (47.0510°N, 113.2726°W). The Montana Department of Fish, Wildlife, and Parks manages the area for wildlife. Most of the area has been excluded from domestic livestock grazing since 1948 (Baty 1995). Recently, the Montana Department of Fish, Wildlife, and Parks became interested in using cattle grazing as a management tool. Permit grazing was started on portions of the wildlife management area in 1995. Study sites were located on the old Boyd Ranch on the east side of the area. The sites were used by deer and/or elk dur-

**Table 2. Effects of forage utilization level in fall on various forage characteristics the following spring and summer.**

Season	Forage Variable	ANOVA P-value	Treatment Level			
			0%	50%	70%	90%
Spring	Green herbaceous standing crop (g/m <sup>2</sup> )	P = 0.07	88.4a	75.6b	78.8ab	73.2b
	Green grass standing crop (g/m <sup>2</sup> )	P = 0.12	76.0	64.0	65.6	62.4
	Percent green vegetation	P < 0.01	49.4a1	82.7b	92.7c	97.7c
Summer	Green herbaceous standing crop (g/m <sup>2</sup> )	P = 0.21	172.4	156.4	160.4	178.8
	Green forb standing crop (g/m <sup>2</sup> )	P = 0.83	23.2	24.8	26.0	22.8
	Percent green vegetation	19982 P < 0.01	56.1a	93.7b	95.1bc	98.2c
		19992 P < 0.01	71.2a	94.2b	99.0c	99.9c
	Relative abundance of rough fescue <sup>3</sup>	P = 0.97	59.5	59.9	61.6	59.3
	Plant species richness <sup>4</sup>	P=0.57	17.5	17.5	18.5	19.4

<sup>1</sup>Means in the same row followed by different letters are significantly different ( $P \leq 0.10$ )

<sup>2</sup>Years are reported separately due to a significant year  $\times$  treatment interaction ( $P \leq 0.10$ ).

<sup>3</sup>Relative abundance of rough fescue based on canopy cover.

<sup>4</sup>Mean number of species present.

ing spring and summer but not in winter.

Climate of the study area is typical of mountainous regions. Annual precipitation varies from 30 to 75 cm with a mean of 45 cm (Steele 1981). Winter snow accumulations on summer ranges commonly exceed 100 cm (Baty 1995). Summers are warm and dry; over 66% of precipitation falls from December to June. Monthly mean temperatures range from  $-8.4^{\circ}\text{C}$  in January to  $16.8^{\circ}\text{C}$  in July (Steele 1981).

Weather was variable over the 2 years of the study. Total monthly precipitation and average daily temperatures were noticeably different between the 2 years of the study. The second year had a warmer, wetter winter and a cooler, drier spring than year 1. The cool, dry spring made year 2 a less productive year for vegetation growth.

The study area consists of a mixture of grasslands and forest on gentle mountainous topography. Elevations range from 1,200 to 1,800 m. Grasslands on the study site are dominated by rough fescue (*Festuca scabrella* Torr.). Additional common species include Idaho fescue (*Festuca idahoensis* Elmer), Columbian needlegrass (*Stipa columbiana* Macoun), Richardson's needlegrass (*Stipa richardsonii* Link), blue-bunch wheatgrass (*Agropyron spicatum* (Pursh) Gould), timber oatgrass (*Danthonia intermedia* Vasey), prairie junegrass (*Koeleria macrantha* Ledeb.), threadleaf sedge (*Carex filifolia* Nutt.), western yarrow (*Achillea millefolium* L.), sticky geranium (*Geranium viscosissimum* F. and M.), and lupine (*Lupinus* spp. Pursh). Several wildlife management areas across western Montana have similar rough fescue dominated range types (Jourdonnais and Bedunah 1985). Rough fescue is considered excellent forage for deer and elk but accumulates dead plant material when grazing is absent (Jourdonnais and Bedunah 1990).

## Study Design

To study the effects of fall cattle grazing on deer and elk forage, we applied different levels of grazing intensity inside enclosures. The experimental unit was a single 20-m x 20-m plot (0.04 ha). Each plot was fenced individually as a separate enclosure for cattle grazing. In 1997 a total of 20 enclosures were constructed in 5 blocks on the east side of the study area. In 1998 the enclosures were torn down and reconstructed on new ground in the same areas. All 10 blocks were constructed on homogeneous sites within the same range site. Blocks were constructed of 3-strand barbed-wire perimeters and divided into individual enclosures with electric fence. Each block contained 1 control enclosure along with 3

**Table 3. Botanical composition (%  $\pm$ SD) of grazing enclosures based on canopy cover.**

Name	Treatment Level			
	0%	50%	70%	90%
<b>Graminoids</b>	----- (% $\pm$ SD) -----			
<i>Festuca scabrella</i> Torr.	59.5 $\pm$ 18.9	59.9 $\pm$ 15.4	61.6 $\pm$ 13.9	59.3 $\pm$ 13.4
<i>Festuca idahoensis</i> Elmer	6.3 $\pm$ 8.1	4.5 $\pm$ 6.4	3.8 $\pm$ 5.4	4.2 $\pm$ 6.9
<i>Stipa columbiana</i> Trin.	1.4 $\pm$ 2.6	3.8 $\pm$ 7.1	2.7 $\pm$ 4.7	0.8 $\pm$ 1.1
<i>Stipa richardsonii</i> Link	1.5 $\pm$ 3.2	1.4 $\pm$ 2.9	2.4 $\pm$ 4.6	1.2 $\pm$ 1.6
<i>Pseudoroegneria spicata</i> (Pursh) A. Love	1.1 $\pm$ 2.5	0.6 $\pm$ 1.4	0.1 $\pm$ 0.1	0.8 $\pm$ 2.1
<i>Phleum pratense</i> L.	0.5 $\pm$ 1.4	0.1 $\pm$ 0.4	0.3 $\pm$ 0.9	0.9 $\pm$ 1.6
<i>Danthonia intermedia</i> Vasey	0.6 $\pm$ 0.7	3.4 $\pm$ 3.6	0.9 $\pm$ 1.9	1.2 $\pm$ 1.2
<i>Koeleria pyramidata</i> Lam. Beauv.	0.2 $\pm$ 0.3	0.5 $\pm$ 0.6	0.7 $\pm$ 0.7	1.1 $\pm$ 1.4
<i>Pascopyrum smithii</i> (Rydb.) A. Love	0.0 $\pm$ 0.0	0.1 $\pm$ 0.3	0.0 $\pm$ 0.1	0.0 $\pm$ 0.0
<i>Carex</i> spp.	4.0 $\pm$ 6.5	5.1 $\pm$ 7.8	5.5 $\pm$ 10.7	5.2 $\pm$ 7.9
Total graminoids	75.2 $\pm$ 11.6	79.4 $\pm$ 9.5	78.1 $\pm$ 12.0	74.8 $\pm$ 11.7
<b>Forbs</b>				
<i>Lupinus</i> spp.	7.5 $\pm$ 5.9	3.8 $\pm$ 4.1	5.0 $\pm$ 5.7	2.8 $\pm$ 4.2
<i>Achillea millefolium</i> L.	2.3 $\pm$ 1.9	3.5 $\pm$ 2.0	3.1 $\pm$ 2.6	3.9 $\pm$ 3.1
<i>Geranium viscosissimum</i> Fisch & Meyer	2.7 $\pm$ 5.4	1.0 $\pm$ 1.5	3.0 $\pm$ 5.8	1.9 $\pm$ 3.0
<i>Antennaria alpina</i> (L.) Gaertn.	2.9 $\pm$ 3.8	1.9 $\pm$ 3.0	2.0 $\pm$ 2.6	1.6 $\pm$ 2.5
<i>Eriogon</i> spp.	1.2 $\pm$ 1.3	1.0 $\pm$ 1.6	1.2 $\pm$ 1.1	1.5 $\pm$ 2.0
<i>Potentilla gracilis</i> Dougl. ex Hook	1.1 $\pm$ 1.3	0.6 $\pm$ 0.6	0.4 $\pm$ 0.4	1.3 $\pm$ 1.2
<i>Hieracium</i> spp.	0.9 $\pm$ 1.1	0.5 $\pm$ 0.7	0.7 $\pm$ 0.8	0.4 $\pm$ 0.6
<i>Fragaria</i> spp.	0.9 $\pm$ 1.0	0.4 $\pm$ 0.3	0.6 $\pm$ 0.6	0.8 $\pm$ 1.0
<i>Eriogonum</i> spp.	0.5 $\pm$ 0.5	1.2 $\pm$ 2.3	0.6 $\pm$ 1.0	0.4 $\pm$ 0.6
<i>Ambrosia artemisiifolia</i> L.	0.3 $\pm$ 0.6	0.4 $\pm$ 0.8	0.6 $\pm$ 0.7	0.5 $\pm$ 0.7
<i>Galium</i> spp.	0.9 $\pm$ 1.5	0.7 $\pm$ 1.5	0.2 $\pm$ 0.5	0.9 $\pm$ 1.4
<i>Geum triflorum</i> Pursh	0.1 $\pm$ 0.3	0.1 $\pm$ 0.3	0.2 $\pm$ 0.4	0.4 $\pm$ 0.7
<i>Tragopogon dubius</i> Scop.	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.1 $\pm$ 0.3	0.2 $\pm$ 0.6
<i>Haplopappus armerioides</i> (Nutt.) Gray	0.3 $\pm$ 1.0	0.3 $\pm$ 0.4	0.1 $\pm$ 0.2	0.2 $\pm$ 0.5
<i>Penstemon procerus</i> Dougl. ex Grah.	0.6 $\pm$ 0.7	0.5 $\pm$ 0.8	0.5 $\pm$ 0.8	1.0 $\pm$ 1.3
<i>Linaria vulgaris</i> Miller	0.1 $\pm$ 0.2	0.9 $\pm$ 2.7	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0
<i>Arenaria</i> spp.	0.1 $\pm$ 0.1	0.4 $\pm$ 0.7	0.3 $\pm$ 0.9	0.7 $\pm$ 2.1
<i>Zygadenus</i> spp.	0.0 $\pm$ 0.1	0.1 $\pm$ 0.1	0.1 $\pm$ 0.2	0.1 $\pm$ 0.1
<i>Artemisia cana</i> Pursh	0.0 $\pm$ 0.1	0.2 $\pm$ 0.4	0.5 $\pm$ 1.0	0.5 $\pm$ 0.9
<i>Campanula rotundifolia</i> L.	0.0 $\pm$ 0.0	0.1 $\pm$ 0.2	0.2 $\pm$ 0.2	0.2 $\pm$ 0.2
<i>Silene</i> spp.	0.0 $\pm$ 0.1	0.0 $\pm$ 0.0	0.1 $\pm$ 0.2	0.0 $\pm$ 0.0
<i>Antennaria pulcherrima</i> (Hook.) Greene	0.0 $\pm$ 0.0	0.2 $\pm$ 0.5	0.0 $\pm$ 0.0	0.1 $\pm$ 0.2
<i>Chrysopsis villosa</i> (Pursh) Shinners	0.0 $\pm$ 0.1	0.1 $\pm$ 0.2	0.0 $\pm$ 0.0	0.4 $\pm$ 1.2
<i>Descurainia</i> spp.	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.1 $\pm$ 0.3
<i>Centaurea maculosa</i> Lam.	0.1 $\pm$ 0.1	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0	0.0 $\pm$ 0.0
Annual forbs	0.6 $\pm$ 0.6	1.2 $\pm$ 1.3	1.1 $\pm$ 0.9	3.8 $\pm$ 4.0
Other forbs	1.8 $\pm$ 2.4	1.6 $\pm$ 2.3	1.1 $\pm$ 1.4	1.6 $\pm$ 2.5
Total forbs	24.8 $\pm$ 11.6	20.6 $\pm$ 9.5	21.9 $\pm$ 12.0	25.2 $\pm$ 11.7
<b>Other</b>				
Bare ground	1.5 $\pm$ 2.1	3.2 $\pm$ 3.6	4.3 $\pm$ 4.3	4.6 $\pm$ 5.2
Litter	26.7 $\pm$ 10.1	31.9 $\pm$ 15.0	33.5 $\pm$ 17.1	27.8 $\pm$ 16.3
Standing dead	31.7 $\pm$ 11.2a1	2.4 $\pm$ 2.7b	0.2 $\pm$ 0.4b	0.0 $\pm$ 0.0b

<sup>1</sup>Means in the same row followed by different letters are significantly different ( $P \leq 0.10$ ).

treatment enclosures. Treatments were randomly assigned within blocks.

## Treatments

During mid September in 1997 and 1998, short duration cattle grazing was implemented on the enclosures in the grazing treatment groups. Eight cow/calf pairs were used for each block. When 1 treatment was completed, cattle were moved to the next treatment within that block. Grazing treatments were monitored so grazing could be terminated when grazing target levels were achieved.

In each block, cattle grazed each of 4 enclosures to 50% relative utilization, 70%, 90%, or 0% (control). Relative utilization is defined as percent removal of

current standing crop as opposed to utilization, which is defined as percent removal of current year's growth. These treatments were equivalent to moderate, heavy, severe, and no grazing (Table 1). A pilot study on the Wildlife Management Area conducted in 1995 and 1996 indicated that relative utilization higher than 50% was needed to prompt any noticeable change in forage. Relative utilization (Frost et al. 1994) in treatment enclosures was measured by the grazed class method (Kingerly et al. 1992). Stubble height measurements were taken along with relative utilization measurements (Table 1). Treatments were all applied within a 2-week period. Control enclosures were not grazed by domestic ungulates.

## Vegetation Sampling

Vegetation data was collected during the spring and summer of 1998 and 1999, according to plant phenology. Spring sampling started 3 weeks after initial green up of rough fescue, which occurred in mid-May in 1998 and 5 days later in 1999. Summer vegetation measurements were taken at the seed ripening for the majority of herbaceous species, which occurred in late June in 1998 and 10 days later in 1999.

A double sampling procedure was used to estimate weight of standing crop for spring and summer. Weights of green grass, green forbs, and standing dead material were estimated on a dry matter basis for 15, 0.25-m<sup>2</sup> quadrats in each enclosure. Quadrats were placed every 1 meter along 2 transects. Every fifth quadrat estimated was clipped, bagged, oven dried, and weighed on a dry matter basis for calibration of the estimates. Summer standing crop measurements were taken from the opposite side of transects used for spring collection. Linear regression equations were developed from estimated and actual dry weights of clipped plots with R<sup>2</sup> values ranging from 0.72 to 0.97 and averaging 0.84. The equations were used to calibrate estimated dry weights for green forbs, green grass, and standing dead vegetation.

We used the canopy-coverage method (Daubenmire 1959) to measure plant species composition and relative abundance. Species richness was determined by the average number of species found in enclosures during canopy-coverage sampling. Cover measurements were taken during the summer at seed ripening to facilitate plant identification. Each enclosure had 2 additional 10-m transects for cover sampling. A 20 x 50-cm Daubenmire frame was placed every 0.5 meter on alternating sides along the transects to estimate vegetation canopy cover, totaling 40 frames per enclosure.

## Statistical Analysis

Analysis of variance (ANOVA) general linear model was used to test for differences in forage characteristics (SAS 1998). The initial ANOVA model included year, block, treatment, year\*treatment interaction, and block\*treatment interaction. Non-significant interactions ( $P > 0.10$ ) were dropped from the final model, however, all main effects were kept in the final model. Least significant difference (LSD) multiple comparison tests ( $P \leq 0.10$ ) were used to identify statistical differences among treatment levels if the ANOVA was significant.

## Results

### Spring Forage

Total green herbaceous standing crop in spring was affected by treatment level ( $P = 0.07$ ). The 50 and 90% treatments resulted in a reduced amount of green standing crop compared to the control and 70% treatments (Table 2). Green grass standing crop in spring did not differ among treatment groups ( $P = 0.12$ ). Percent green vegetation in spring was affected by treatment ( $P < 0.01$ ). Percent green vegetation increased as grazing intensity increased (Table 2).

### Summer Forage

Total green herbaceous standing crop in summer (Table 2) did not differ among treatment groups ( $P = 0.21$ ). Summer forb standing crop also did not differ ( $P = 0.83$ ) among treatments. A year\*treatment interaction ( $P < 0.01$ ) existed for percent green vegetation in summer. In 1998, percent green vegetation differed among treatments ( $P < 0.01$ ). The control treatment averaged 56% green vegetation and average percent green vegetation increased with increased grazing intensity (Table 2). In 1999, percent green vegetation also differed among treatments ( $P < 0.01$ ). The control treatment averaged 71% green vegetation, and average percent green vegetation increased with increased grazing intensity (Table 2).

### Species Composition

Relative abundance did not differ among treatments for rough fescue ( $P = 0.97$ ) or for any other species (Table 3). Relative abundance of rough fescue averaged between 59.3% and 61.6% (Table 2). Species richness did not differ among treatments ( $P = 0.52$ ). The average number of species present in each treatment ranged from 17.5 to 19.4 (Table 2). Standing dead material was the only composition variable that differed among treatments ( $P < 0.01$ ). The control treatment contained a substantially greater canopy-coverage of standing dead material than did the grazed treatments (Table 3).

## Discussion

Lower green herbaceous standing crop in the spring as a result of 50 and 90% treatments is unexplained. The difference was of low significance ( $P = 0.07$ ) and likely does not make a large biological difference. There was no effect of treatment level on green grass standing crop in the

spring. Since deer and elk select for green grass during spring, treatment levels had no effect on the production of preferred deer and elk forage. It appears that earlier warming of soil in grazed areas was not beneficial enough to increase spring green herbaceous standing crop. Moisture held by residual plant material could have made up for earlier warming of soil. Our study did not, however, measure timing of spring green-up. It is possible that grazed treatments greened-up earlier, due to quicker soil warming, which would be attractive to deer and elk.

The cause of differences in spring standing crop due to grazing intensity apparently did not affect summer production. McLean and Wikeem (1985) and Willms et al. (1986) also found that fall defoliation did not reduce herbage production the following year.

Higher grazing intensities created higher levels of green vegetation in relation to standing dead material. Our findings agree with those of Willms et al. (1979), in which availability of spring forage was related to degree of prior fall grazing by cattle. Willms et al. (1981) reported that deer did not use areas in spring until new growth extended above standing dead material. When standing dead material is removed, preferred green growth is accessible by deer and elk. In a study of spring forage selection by deer, Willms and McLean (1978) found that forage was only utilized from plants where mature stalks had been removed prior to spring growth.

Our findings on green forb standing crop in summer did not support the theory that deer and elk are attracted to sites grazed by cattle the previous fall due to increased forb levels. To increase forb levels with cattle grazing may take several years of treatments, treatments during the growing season and possibly reduction of rough fescue. Since forbs are the preferred forage for deer and elk in the summer (McMahan 1964, Stevens 1966, Collins et al. 1978, Kasworm et al. 1984, Jourdonnais and Bedunah 1985, Lyon 1985, Canon et al. 1987, Kingery et al. 1996), treatment level did not effect the production of preferred deer and elk forage.

During summer, as in spring, the more intense the utilization treatment the higher the percentage of green vegetation. Deer and elk select for forbs in the summer, but the amount of standing dead material present affects whether forbs are available for consumption by a selective forager. The production of forbs and their availability are both important. Through maintaining forb production and increasing their availability, grazing treatments improved summer forage for deer and elk.

The lack of differences in the number of plant species present and in the relative abundance of plant species present indicates that we did not alter already healthy range sites. The sites meet goals of providing livestock forage in the fall and preferred deer and elk forage in the spring. A change in the number of plant species present or the relative abundance of plant species present may have reduced the site's ability to meet these goals.

## Management Implications

We improved spring and summer forage for deer and elk on our study site. The reduction of unpalatable standing dead material without compromising forage production is possible with fall cattle grazing. The 70% utilization treatment would be best for improving forage availability. An average 70% treatment goal on a landscape level would allow ranges in utilization from 50 to 90%. This would increase percent green biomass in both spring and summer, not reduce green grass standing crop in spring, not reduce green forbs standing crop in summer, not alter species richness of the sites, and not alter relative abundance of plant species present. By grazing cattle in the fall, managers can utilize the current year's growth for livestock production and deer and elk forage can be more easily accessed.

Treatment areas should be assessed for use by deer and elk in the winter before treatment. It would be inadvisable to apply fall grazing treatments to an area that is valuable winter range.

McLean and Wikeem (1985) found that heavy fall defoliation of rough fescue did not damage plants. Studies in British Columbia and Alberta found that annual yields of rough fescue were not affected after fall defoliation (McLean and Wikeem 1985, Willms et al. 1986). This suggests that high levels of fall cattle grazing may improve availability of elk and deer forage without damaging or reducing yield of rough fescue plants. However, it is important to monitor the status of rough fescue stands due to their high value for wildlife. McLean and Wikeem (1985) indicated that fall use followed by heavy spring use could damage rough fescue plants. High deer and elk use in the spring could degrade the range and require a change in management. Treated areas should be monitored to determine if the range is being degraded. It is possible that over time, treatments could reduce rough fescue proportional abundance.

Information from this study could be incorporated into rest-rotation or deferred-

rotation grazing systems. Pastures recognized as spring and summer range for elk and deer and not winter range, could be grazed to an average of 70% relative utilization during their fall rotation. This would improve availability of forage in those pastures for deer and elk during the year following treatment.

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