The Effects of Fall Defoliation on the Utilization of Bluebunch Wheatgrass and Its Influence on the Distribution of Deer in Spring

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Abstract

Deer and cattle grazing in spring preferred bluebunch wheatgrass plants that had been defoliated the previous fall to those that had not. Deer selected burned plants in greater proportion than grazed plants. Fall grazing by cattle affected the distribution of deer. Deer displayed preference for the fall grazed field after green growth exceeded the height of stubble.

The increasing costs of cultural energy and the loss of arable land to urban development will put greater pressure on rangeland to meet future demands for food. The response of rangeland managers can be to increase the efficiency of converting forage into products for human consumption.

Studies have shown that utilization of spring forage can be increased by removing litter prior to grazing (Willms et al. 1979) thus shifting the optimum grazing pressure to a higher level. Observations were made on tame deer and cattle in small enclosures. They demonstrated increasing preference for forage from the control, to the clip, to the burn treatment. In order to examine the treatment effects on free-ranging animals, three studies were made. The objectives were: to determine the effects of fall grazing or burning on selection of bluebunch wheatgrass by free-ranging deer or cattle in spring and to determine the influence of fall grazing on the distribution of deer in spring.

Methods

The studies were made about 24 km northwest of Kamloops, British Columbia, in an area encompassing the big sagebrush *(Artemisia tridentata)*[1]-bluebunch wheatgrass *(Agropyron spicatum)* and Douglas fir *(Pseudotsuga menziesii)*-bluebunch wheatgrass communities. The south side was bounded by Kamloops Lake at 335 m above sea level (masl). The land rose rapidly to level off in a series of knolls, at 580 masl, and flat field created by several alluvial fans. The ecotone of the big sagebrush and Douglas fir communities was situated at 600 masl. The Douglas fir community extended to an upper altitude of 1,350 masl (McLean 1970).

The south slope and knolls were dominated by big sagebrush and bluebunch wheatgrass; however, needleandthread *(Stipa comata)* dominated the crests of knolls while Sandberg's bluegrass *(Poa sandbergii)* was abundant throughout. The flat field was seeded to crested wheatgrass *(Agropyron desertorum)*. The understory of the Douglas fir community was dominated by bluebunch wheatgrass. The communities have been described in detail by McLean (1970) and Tisdale and McLean (1957). The study area represents the spring range of mule deer and spring and fall range of cattle.

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Three independent studies were made in the vicinity of two fields, each with an area of about 150 ha Both fields had 41% Douglas fir community and 59% big sagebrush community. Only one field was grazed by cattle in the fall.

Two small burns were made in winter (1976–77): one in the fall-grazed field (.25 ha) and the other in the fall-ungrazed field (.5 ha). These burns were restricted to areas of high grass litter accumulation in the Douglas fir community.

Forage Selection by Cattle

Selection by cattle was determined using permanently marked plants and estimating dry matter utilization. Observations were made in May at five sites (A-E) (Table 1). At each site 100 or more individual bluebunch wheatgrass plants (>15 cm basal circumference) were randomly selected, within a 1-m wide belt, and their dimensions recorded. The selected plants were identified by paint sprayed on the ground at their base.

Available forage and utilization estimates were made for each plant. Available forage was estimated from relationships of volume to weight. Plant volume was determined from measurements of basal circumference and height. Utilization was estimated by the proportions of plant volume removed and modified by the dry matter distribution in the plant. These estimates were transformed into percentage of total weight per plant. Utilization was estimated weekly, beginning in early May, during the grazing period.

Utilization estimates were transformed to percent of total available forage on a per plant basis. Treatment differences were examined at each site using analysis of variance and Duncan's multiple range test where necessary.

Forage Selection by Deer

Treatment selection by deer was determined as the proportion of plants utilized from each treatment. Observations were made, in April, in both the big sagebrush and the Douglas fir communities. The design was an unbalanced, randomized complete block with 3 rows of 6 plots each. The plots represented 1 control, 1 burn, and 4 graze treatments. Dimensions of the perimeter were 82 × 82 m. Each experimental unit was enclosed by a 3-strand barbed wire fence which was permeable to deer. The treatments were imposed in the fall by first burning and then grazing with cattle. The plants were sampled with 10 belt transects established parallel to the rows and across the plots. A single survey was made at each site near the time of maximum deer use.

The data (proportion of plants selected of the total number available) was transformed with the arc sine square root transformation prior to statistical analysis. Since the values for the control were all zero, the response to the burned and grazed treatments were analyzed using the *t* test.

Immigration and Distribution of Deer on Spring Range

An estimate of the relative seasonal distribution of deer on

Table 1. Site descriptions for the study of treatment effect on bluebunch wheatgrass utilization by free-ranging cattle.

Site	Community description	Proportion: plants grazed†/ plants ungrazed	Stubble ht. of grazed plants (cm ± 1 SEm)	Available spring forage (gm/plant ± 1SEm) Control	Grazed	Burned
A	Big sagebrush-bluebunch wheatgrass (knoll)	1.2:1	7.1±0.4	5.3a±.4	5.7a±.5	
B	Douglas fir-big sagebrush ecotone	4.0:1	7.6±0.5	4.5a±.8	4.3a±.6	
C	Douglas fir-bluebunch wheatgrass (near ecotone)	1.0:1	7.6±0.3	6.2b±.3	3.9a±.2	
D	Douglas fir-bluebunch wheatgrass	0.5:1	5.3±2.9	5.9b±.5	2.2a±.2	6.0b±.4
E	Douglas fir-bluebunch wheatgrass	0.0:1		3.5b±.3		2.5a±.2

† Grazed by cattle in fall.
a-b Averages in row with same letter do not differ significantly ($P<0.05$).

spring range was made with night-time surveys encompassing the two fields. Deer counts were made by an observer, using a 300,000 candle-power spotlight, standing at the back of a slow moving pick-up truck. Counts were made on 18 occasions from February 18 to April 11 (1977), along the same 17-km transect. The counts were partitioned according to field to show changes in distribution. Approximately 58 ha were surveyed in the grazed field and 110 ha in the ungrazed field.

Results

Forage Selection by Cattle

Free-ranging cattle utilized bluebunch wheatgrass from the treated plants significantly more ($P<0.05$) than from the control plants (Table 2). At the only site (D) where both burned and grazed treatments were present, plants of the grazed treatment were utilized more than plants of the burned treatment. This difference was significant only during the first week of grazing.

Utilization of plants from the grazed treatment was similar at each survey and did not appear to be affected by site. However, utilization of fall-ungrazed plants decreased from the big sagebrush community, to the big sagebrush-Douglas fir ecotone, to the Douglas fir community (Table 2). It may be noteworthy that the proportion of fall grazed plants decreased in a similar manner (Table 1).

Forage Selection by Deer

No control plants were found that were utilized by free-ranging deer (Table 3). In the Douglas fir community, deer selected about twice the proportion of plants from the burned treatment as from the grazed treatment. Selection in the big sagebrush community favoured the burned treatment as well but the difference was not significant ($P<0.05$).

Immigration and Distribution of Free-ranging Deer

Two hundred and sixty eight animals were observed on two fields from February 18 to April 11 (Fig. 1). From February 18 to March 29, 147 sightings were made, which were distributed in ratio of 1:4.2 between the fall grazed and fall ungrazed fields. During the remaining time, 121 sightings were distributed in a ratio of 1:1.1 among the fields. If the sightings were weighted according to the area surveyed in each field, the first ratio becomes 1:2.2 and the second 1:0.6.

Discussion

Forage Selection by Cattle

Free-ranging cattle utilized the defoliated plants significantly

Table 3. The proportion of bluebunch wheatgrass grazed by free-ranging deer in areas of control, fall grazed or fall burned treatments in the big sagebrush and Douglas fir communities in late April.

Community	Control n	Control Proportion grazed	Grazed n	Grazed Proportion grazed	Burned n	Burned Proportion grazed
Big sagebrush	159	0.00a	576	0.33b	146	0.44b
Douglas fir	436	0.00a	1700	0.14b	383	0.30c

a-c Proportions in a row with the same letter do not differ significantly ($P<0.05$).

Table 2. Estimates of utilization (%) by cattle of bluebunch wheatgrass plants from two or three treatments at five sites.†

Site	Survey 1 Control	Survey 1 Graze	Survey 1 Burn	Survey 2 Control	Survey 2 Graze	Survey 2 Burn	Survey 3 Control	Survey 3 Graze	Survey 3 Burn
A $\bar{x}$: (n=138 to 162)	4.5a	25.9b	—	13.9a	35.5b	—	24.3a	49.2b	—
B $\bar{x}$: (n=63 to 117)	4.9a	27.94b	—	13.9a	43.9b	—	22.8a	52.5b	—
C $\bar{x}$: (n=300)	1.4a	26.3b	—	5.2a	41.4b	—	14.8a	50.7b	—
D $\bar{x}$: (n=66 to 134)	0.2a	24.0c	5.4b	2.4a	46.7b	39.2b	5.6a	59.0b	49.2b
E $\bar{x}$: (=200)	1.9a	—	42.1b	2.0a	—	56.8b	4.1a	—	59.0b

† Described in Table 1.
a-c Average within subset of each survey, with same letter do not differ significantly ($P<0.05$).
n Number plants per treatment.

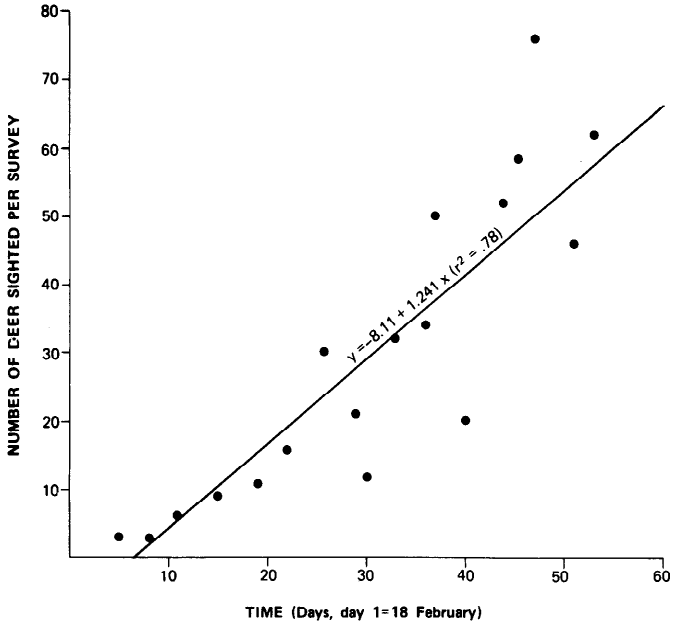

Fig. 1. *Linear regression describing the plotted observations of deer (night sightings per survey) from February 18 to April 11, 1977.*

($P<0.05$) more than the control. These results were similar to those derived for confined cattle (Willms et al. 1979). However, contrary to that study, information from site D indicated greater utilization of plants grazed in the fall than of plants burned in the fall. The reason for this is not clear. An explanation may be in the size and shape of area burned. The burn at site D was small and irregular, perhaps making selection for plants of that treatment unprofitable.

It is noteworthy that minor use was made of control plants in both communities. Although average utilization over the entire range approached the recommended levels, uneven distribution led to inefficient use of the forage resource.

Forage Selection by Deer

Evidence from this study indicates that free-ranging deer will not select forage from among standing litter of bluebunch wheatgrass when alternate sources are available (Table 3). Furthermore, burning in the fall increased the number of plants that were selected. Willms et al. (1979) report that deer preferred plants burned in the fall to plants grazed in the fall.

The method of determining selection, by estimating the proportion of plants grazed from each treatment, describes more accurately the olfactory and tactile preferences. The relatively small plots available to free-ranging deer permitted ready access to all choices and encouraged greater use. Lack of control on the stocking rate of deer makes the importance of absolute values irrelevant.

Deer Distribution

Observations on the local distribution of deer indicated a switch, in April, to the fall-grazed field. This phenomenon was related to the influence of standing litter on the utilization of spring production. Wheatgrass tillers appeared at the ground surface in early March and the grazing effect should have reflected on the animal distribution soon after if stubble height were zero. In fact, no shift to the grazed field was apparent until spring growth extended above the stubble in early April. The relatively little use made of the fall-grazed field prior to April is not understood. Food, however, did not seem to be a factor since the same forage types were present in both fields. In other work, Leckenby (1968) found a 3-fold increase in crested wheatgrass utilization by deer where the standing litter had previously been removed.

Immigration by deer onto spring range did not follow a fixed schedule (Fig. 1). Movement from their fall and winter range to the lower spring range appeared to be in response to two pressures. One was a positive response to spring production of grass while the other was a negative response to deep snow at higher elevations. The effect was similar but spaced in time.

The spring range is important to deer in providing the earliest available, high quality forage. Willms and McLean (1978) found that deer utilized mostly grass in early April; the greatest proportion being Sandberg's bluegrass. This shallow rooted species produces forage earliest and mature stalks do not persist through the winter. Cattle do not utilize this species in fall, hence do not directly affect its palatability and vigor. The effect of fall burning on the palatability of Sandberg's bluegrass is not known; however, Wright and Klemmedson (1965) report no effect on plant vigor. The productivity of Sandberg's bluegrass is highly variable and it loses palatability early in spring. These characteristics reduce the importance of this species, particularly since its long-term benefit is determined by minimum production, and focuses attention on the deeper rooted perennials.

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