Livestock-Deer Relations in the Lodgepole Pine-Pumice Region of Central Oregon

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Utilization by cattle, sheep, and deer on meadow communities and logged and nonlogged lodgepole pine/bitterbrush/western needlegrass communities was studied during the summer grazing season of a dry (1973) and a wet (1974) year in the pumice region of Klamath County, Oregon. Deer had a forb-dominated diet in the meadows while sheep and cattle had a grass-grasslike-dominated diet. Only six forb species of the 34 meadow species utilized were found to constitute any substantial degree of overlap between the diets of deer and livestock. Bitterbrush gradually replaced the maturing forbs in the diets of deer during July. Bitterbrush was the most important forage species in the diets of all three herbivores using the lodgepole pine/bitterbrush/western needlegrass communities. Logged areas received the bulk of utilization from all three herbivores. Sheep and deer utilized 2.5 and 7-10 times more forage, respectively, in logged areas, while cattle used only the fringes of unlogged areas. Fall was the peak consumption period for bitterbrush by cattle and deer, while sheep consumed large quantities throughout the summer grazing season.

The lodgepole pine (Pinus contorta)-pumice region has received limited attention concerning grazing values for domestic livestock and mule deer (Odocoileus hemionus hemionus) which utilize the region for summer range. Improved harvesting and milling technology along with the creation of new markets have contributed to accelerated timber harvest in the last 10 years. Logging has subsequently altered a sizeable portion of the rangeland-animal habitat in the region, and the values of this newly created forage resource have not been assessed. The strong interrelationship between understory production and the wild and domestic animals which depend on this forage and the dynamics of timber stand development suggests that harvesting of lodgepole pine will have far-reaching implications (Volland 1974).

The grazing potential of lodgepole pine types appears to be considerably underutilized as a result of administrative factors such as limited knowledge of grazing management and shifting emphasis of use because of the transitory nature of the forage resource (Basile and Jensen 1971). Both Dealy (1975) and Basilc (1975) have given excellent reviews on forage potentials and grazing management schemes for both livestock and deer in the lodgepole pine types of the western United States.

Determination of the grazing potential and management of any major vegetation type requires an understanding of the food habits and seasonal use patterns of animal species as they relate to available plant communities and the subsequent manipulations of these plant communities. The degree of interaction, in this case between domestic livestock and mule deer, should also be considered.

The purpose of this study was to determine the plant species utilized, season of use, and the degree of interaction between cattle, sheep, and deer as affected by plant communities and timber management practices in the lodgepole pine-pumice region.
Study Area

Lodgepole pine is considered a topo-edaphic climax species in the pumice plateau of south-central Oregon (Franklin and Dymess 1973). The two areas chosen for study were located in the east-central portion of Klamath County, Ore. Elevation averages 4,960 feet. The criteria used in selecting areas for this study were that both livestock (cattle or sheep) and mule deer were utilizing the area and that logged and nonlogged lodgepole pine/bitterbrush (Purshia tridentata)/western needlegrass (Sistia occidentalis) communities were located within a half-mile radius of the interspersed meadows. The meadow communities, although limited in acreage, were determined to be centers of grazing activity (Pickford and Reid 1948). The lodgepole pine/bitterbrush/western needlegrass community was the most extensive community in the region.

Species composition of the meadows in this region are strongly influenced by water table conditions and history of grazing use. The meadows are generally associated with flowing springs, stream bottoms, and internally drained areas. Primary species found on the wetter, more lightly grazed meadows include tufted hairgrass (Deschampsia caespitosa), sedges (Carex spp.), and rushes (Juncus spp.). Cusick bluegrass (Poa cusickii) and slender wheatgrass (Agropyron caninum) generally dominate the lightly grazed, dry meadows. Mat
muhly (Muhlenbergia squarrosa), California oatgrass (Danthonia californica), Kentucky bluegrass (Poa pratensis), and numerous forbs are more prevalent on the heavily grazed meadows (Volland 1974).

**Methods**

The study was conducted on two areas in the summers of 1973 and 1974. One area was representative of a large block-cut pattern (1 mile²) while the other area was representative of a strip-cut pattern (3 chains wide). Cattle and deer grazed the large block-cut area and sheep and deer grazed the strip-cut area. The nonlogged and logged patterns were replicated twice in the two study areas (Fig. 1). Two meadows were also selected for study in each of the two grazing situations (Fig. 2).

The weight estimate method (Pechanec and Pickford 1937) was used to measure utilization of herbaceous species by cattle, sheep, and deer on each area. Forty 2.4-ft² plots were sampled in each meadow site and forty 9.6-ft² plots were sampled in each of the logged and nonlogged lodgepole pine sites. A single 1-acre exclosure was used to separate deer utilization from livestock utilization in each of the 12 study sites. Production by species was obtained by clipping and weighing vegetation within 11 standard production cages per site. Samples of each plant species were collected and oven dried at 60°C for 48 hours, to convert measurements to dry weight. Dietary composition and relative preference indices for the three herbivores were obtained from utilization and production measurements (Van Dyne and Heady 1965).

Bitterbrush production and utilization measurements were stratified according to three leader classes: terminal, lateral, and spurs (Fig. 3). A direct ruler and count measurement was used to calculate utilization of bitterbrush (Stuth 1975). The percent utilization of each leader class was calculated with the following formulas:

\[
\% \text{utilization} = \frac{\text{average uncropped leader length at period sampled}}{\text{average length of the cropped leaders}} \times \% \text{leaders cropped}
\]

\[
\% \text{leaders cropped} = \frac{\text{No. leaders cropped}}{\text{No. leaders + leaders cropped uncropped}} \times 100
\]

Utilization of bitterbrush was converted to a weight basis by the use of a linear regression formula which related leader growth rate to production rate of current year’s growth.

The percentage of each plant species in the diet and relative preference index (RPI) for each species were calculated for mule deer, sheep, and cattle. Diets were determined from measurements of deer, sheep, and cattle utilization as outlined by Laycock et al. (1972):

\[
\% \text{diet} = 100 \times \frac{\% \text{utilization} \times \% \text{composition}}{\Sigma (\% \text{utilization} \times \% \text{composition})}
\]

Animal preference for each plant species was evaluated with a relative preference index (Krueger 1972):

\[
\text{RPI} = \frac{\% \text{diet}}{\% \text{composition}}
\]

This was a ratio between percent composition of a plant in the animal’s diet to percent composition of the plant on the site.

Yearly fluctuations of meadow vegetational components in the diets of cattle, sheep, and deer were examined with analysis of variance (completely random design) and Duncan’s multiple-range test. Student’s t-test was used to evaluate sheep utilization on bitterbrush between logged and nonlogged sites (Steele and Torrie 1960).

**Results and Discussion**

**Meadows**

The diets of cattle, sheep, and deer were found to vary, depending on moisture conditions prior to and during the growing season (Table 1). Precipitation was 18% below average and 42% above average for 1973 and 1974, respectively. Deer maintained a near-pure diet of forbs both years, whereas grasses and grasslikes dominated the diet of cattle and sheep. The composition of forbs in the diet of cattle and sheep fluctuated slightly, varying from 14.2 to 24.0%. Grass remained high in the diet of sheep with a rise in grasslike species in the wet year. Grasses dominated the diet of cattle in the dry year while grasses and grasslikes were equal in composition during the wet year. The shift to grasslikes in the wet year was felt to be related to increased productivity and composition of grasslike plants.

**Deer**

Species that had relative preference index (RPI) values greater than two and which collectively constituted 90% of the diet of deer were as follows: Beauty cinquefoil (Potentilla gracilis), nodding microseris (Microseris nutans), plantain leaf buttercup (Ranunculus alismaefolius), knotweed (Polygonum bistortoides), Oregon checkermallow (Sidalcea oregana), and western yarrow (Achillea millefolium).

Minor dietary species which had RPI values greater than two included: Beardtongue (Penstemon procerus), nineleaf biscuit-root (Lomatium triternatum), alpine lake microseris (Microseris alpestris), western buttercup (Ranunculus occidentalis), and Menzies larkspur (Delphinium menziesii). Grasses and grasslikes were utilized only in the early portion of the grazing season during the wet year and were not utilized in the dry year. Desirable forb species were available over a longer period of time in wet years, thereby, affecting their preference status.

The deer utilized plantain leaf buttercup from early May through mid-June. This species is prevalent on meadows through the spring season. Only the flower heads and stalks were utilized on beauty cinquefoil, Oregon checkermallow, western yarrow, heartroot, nineleaf biscuitroot, and Menzies larkspur. Oregon checkermallow and western yarrow were more heavily utilized in the dry year due to the reduced availability of more preferred species.

Beauty cinquefoil, western yarrow, and Oregon checkermallow were utilized more heavily from mid-June to early July. Again phenological stage played an important role in that flower stalks were at their peak of development on these species at this time. Nodding microseris and knotweed developed later than the previously mentioned species and were utilized from late June to mid-July. Common camas (Camassia quamash) was heavily utilized by the deer in swale areas of drier meadows dominated by Cusick bluegrass.

Observations of deer using a near-climax meadow revealed that they spent much of their grazing time on areas that were in lower successional stages. Most of the deer utilization in these near-climax meadows took place on forbs found growing on disturbed areas such as gopher mounds and on isolated areas where domestic animals had altered the vegetation. Meadows in lower successional stages received the most use. This may have been due to greater variety and abundance of forbs available to the animals on these meadows.
Cattle

Cattle grazed the meadows for approximately 7 days and then moved out of the study area when local watering ponds went dry during the low precipitation year. Cattle distribution remained stable during the wet year and the meadows received use at various times throughout the grazing season (July 1 through September 30). This points to the need for better water distribution in this region in order to utilize available forage in a more efficient manner. The cattle moved off the meadows during seed set and grazed on a limited basis thereafter.

RPI values were generally less than one for most species in the meadows, with only Kentucky bluegrass, western needlegrass (Stipa occidentalis var. minor), singlewinged sedge (Carex microptera), meadow rush (Juncus nevadensis), nodding microseris, beardtongue, and meadow aster (Aster campestris) having values greater than two. All of these preferred species accounted for only 40 to 57% of the cattle's diet. Species which made the greatest contribution to the diet of cattle were as follows: Cusick bluegrass, California oatgrass, Junegrass (Koeleria cristata), western needlegrass (dry years), Kentucky bluegrass, smallwinged sedge, meadow rush (wet years), nodding microseris (dry years), and meadow aster (wet years). Approximately 87 to 89% of the cattle's diet from the meadow communities could be accounted for by these nine meadow species both years. Of these species, Cusick bluegrass, California oatgrass, and smallwinged sedge comprised 50% of their diet.

During the wet year cattle utilized meadow aster to such an extent that a distinct contrast existed inside and outside the enclosures. Meadow aster appeared to be an increaser species on the drier meadows and was later in development. Since the cattle left the meadow early in the dry year, they did not utilize this late developing forb.

Nodding microseris was a forb highly preferred by cattle especially during the dry year. Most forbs had matured by July 1, while nodding microseris was still actively growing during this period; consequently, it was more heavily utilized by cattle in early July.

Sheep

Relative preference index values for species grazed by sheep were generally low in the meadows with only California oatgrass, smallwinged sedge, slender wheatgrass, plantain leaf buttercup, and nodding microseris having values greater than two.

Species which made the greatest contributions to the diet of sheep were as follows: California oatgrass, Cusick bluegrass, slender wheatgrass, tufted hairgrass. Kentucky bluegrass, smallwinged sedge, plantain leaf buttercup, nodding microseris, and western yarrow. Approximately 87 to 91% of the sheep’s diet from the meadow communities was accounted for by these nine species.

Overlap of Diets on Meadow Species

Thirty-four of the 49 meadow species available for utilization by the three herbivores were utilized during the summer grazing season. Six species which were considered to be important in the diet of deer were found to have RPI values greater than two for sheep and/or cattle (Table 2). However, under existing grazing management programs there is minimal competition for forage between cattle and deer since only limited overlap in seasonal use was indicated and overall utilization values were below 10%. Since the grazing season of sheep in this area begins in June, the period when forbs are high in the diets of deer, a potential for significant dietary overlap in the meadow may exist. Also, the physical presence of large bands of sheep may have an influence on fawning activities of deer in and around the meadows during this period.

Table 2. Meadow species which exhibited the greatest potential for overlap in diets between livestock and deer.

<table>
<thead>
<tr>
<th>Type of interaction</th>
<th>Species</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cattle, sheep, and</td>
<td>Beauty cinquefoil</td>
</tr>
<tr>
<td>deer</td>
<td>Nodding microseris</td>
</tr>
<tr>
<td></td>
<td>Oregon checkerseemall</td>
</tr>
<tr>
<td>Sheep and deer</td>
<td>Plantain leaf buttercup</td>
</tr>
<tr>
<td>Cattle and deer</td>
<td>Western yarrow</td>
</tr>
<tr>
<td></td>
<td>Beardtongue</td>
</tr>
</tbody>
</table>

After July 1 sheep utilizing the meadows had a minimal degree of dietary interaction with deer. The preferred forage species of deer matures during July and resulted in the deer seeking alternative forage sources available in adjacent forest communities.

Production and utilization data revealed an interesting relationship between the influence of livestock grazing on successional stage of the meadow community and availability of deer forage. The variety and abundance of desirable forb species appeared to be directly related to season and intensity of grazing by domestic livestock. All six species considered important in the diets of deer, except nodding microseris, were increaser species. As grazing intensity increased, the abundance of these species increased. However, with high intensity livestock grazing during this season (July 1–October 1) these species potentially could be reduced in composition and become less available to deer. If livestock are allowed to graze earlier in the spring, even judicial stocking rates could potentially cause a decline in desirable forb species. Consequently, the grazing scheme on a given area may also be critical. The land manager is faced with the problem of maintaining a balance in providing a good variety of forbs for deer and at the same time stabilizing or improving the condition of meadows through proper livestock management.

Coordinated grazing programs which take into account forage preferences of all three herbivores, yearly fluctuations in precipitation and the existing conditions of the meadows should include the flexibility necessary for managing these meadows.

Lodgepole Pine/Bitterbrush/Western Needlegrass Community

Deer

Deer began utilizing the actively growing shrubs as forbs in
the meadows and in the logged, wetter lodgepole pine communities reached maturity. The date of transition depended upon the precipitation received prior to and during the growing season.

Bitterbrush was the only species utilized by deer in logged and nonlogged areas of the lodgepole pine/bitterbrush/western needlegrass community. Deer followed similar utilization trends for both years and on both patterns of timber harvest. Utilization was first detected July 1 on bitterbrush in the nonlogged areas during the dry year but was first noted in the logged areas the wet year.

Utilization was minimal in both the nonlogged and logged areas until August 1 (Fig. 4). After August 1 utilization accelerated in the logged sites but remained relatively constant for the remainder of the season in the nonlogged areas. Utilization on leaders reached approximately 10% in the logged areas but never exceeded 3% in the nonlogged areas. By the end of the grazing season, 7 to 10 times more forage was consumed from the logged areas as compared to the nonlogged areas. (This amounts to 40–55 lb/acre versus 4–8 lb/acre removed for logged and nonlogged areas, respectively). Wallmo’s (1969) study in a Colorado lodgepole pine type revealed that the logged strips received three times more use than nonlogged strips. A later study in the same area revealed that 63.3% of the deer’s forage was obtained from the logged areas, 27.4% from uncut strips, and 9.3% from logging roads (Wallmo et al. 1972).

Deer utilized mainly the terminal leaders of bitterbrush until approximately mid-August. Because of differential growth rates of the two developed leader classes and limited quantity of terminal leaders, utilization on lateral leaders increased and exceeded use on terminal leaders in the latter third of the grazing season. The third leader class (spurs) were not eaten by the deer during any portion of the growing season.

In the dry year initial use was first detected when the average leader length was approximately 3 cm. However, in the wet year initial utilization was not evident until leaders had attained an average length of 4 cm. In the dry year forbs had matured earlier, and growth rates of bitterbrush were somewhat depressed. Consequently, deer began to utilize bitterbrush at an earlier phenological stage during the dry year than in the wet year. Leader length at the time bitterbrush was starting to receive heavier use was approximately 4 to 4.5 cm for dry years and 5 to 6 cm for wet years.

Cattle

Inadequate water supplies caused the cattle to move out of the study area to a more stable water source during the dry year. Consequently, no cattle utilization took place on the lodgepole pine/bitterbrush/western needlegrass communities in 1973. There were ample water supplies in 1974; however, cattle utilization could not be found in the nonlogged areas since cattle used only the fringes of the timbered areas for shade and occasional foraging. Therefore, cattle utilization data were obtained only for the logged communities (Table 3).

Cattle diets were dominated by grasses in the early grazing season. Western needlegrass and bottlebrush squirreltail (Sitanion hystrix) from the logged lodgepole pine/bitterbrush/western needlegrass communities comprised 96% of the diet during the first two weeks on the allotment. By mid-August bitterbrush dominated the diet and by the end of the grazing season (September 30) it comprised 75% of their diet. RPI values for bitterbrush were less than one, indicating utilization may be a function of availability rather than preference.

Western needlegrass was utilized until seed set (July 15) and had an RPI value higher than two. However, after maturity its forage contribution to cattle was low. Bottlebrush squirreltail maintained RPI values greater than two and was the most sought after herbaceous species available to cattle. Ross sedge (Carex rossii) was utilized on a limited basis at mid-grazing season when western needlegrass and bottlebrush squirreltail were setting seed.

![Fig. 4. Percent utilization of bitterbrush by deer on logged and nonlogged lodgepole pine/bitterbrush/western needlegrass communities.](image-url)

### Table 3. Summary of percent utilization, percent diet, and relative preference index (RPI) values for cattle on the logged lodgepole pine/bitterbrush/western needlegrass communities.

<table>
<thead>
<tr>
<th>Species</th>
<th>Utilization (%)</th>
<th>Diet (%)</th>
<th>RPI</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>July 15 Aug. 15 Oct. 1</td>
<td>July 15 Aug. 15 Oct. 1</td>
<td>July 15 Aug. 15 Oct. 1</td>
</tr>
<tr>
<td><strong>Grasses</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western needlegrass</td>
<td>1 2 5</td>
<td>21 8 8</td>
<td>3 1 1</td>
</tr>
<tr>
<td>Bottlebrush squirreltail</td>
<td>8 9 20</td>
<td>75 24 17</td>
<td>17 5 4</td>
</tr>
<tr>
<td><strong>Grasslikes</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ross sedge</td>
<td>0 4 4</td>
<td>0 1 t</td>
<td>— 3 1</td>
</tr>
<tr>
<td><strong>Forbs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pink microseris</td>
<td>t t 0</td>
<td>t t 0</td>
<td>— — —</td>
</tr>
<tr>
<td>Nodding microseris</td>
<td>t 0 0</td>
<td>t 0 0</td>
<td>— — —</td>
</tr>
<tr>
<td>Least lupine</td>
<td>6 0 0</td>
<td>4 0 0</td>
<td>12 — —</td>
</tr>
<tr>
<td><strong>Shrubs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bitterbrush</td>
<td>0 1 5</td>
<td>0 67 75</td>
<td>— 1 1</td>
</tr>
</tbody>
</table>
An important factor was observed concerning distribution of grazing on logged areas near meadows. Although bitterbrush comprised approximately three-fourths of the diet by the end of the grazing season, only 4.6% utilization had taken place. A maximum of 5.2% of the total vegetation in the logged sites had been utilized by the end of the grazing season. Methods for improving livestock distribution such as water development, salt placement and fencing are needed in order to more efficiently utilize vegetation in the lodgepole pine-pumice region.

In areas where cattle and deer occupied the same habitat, dual utilization values on bitterbrush approximated 15 to 25% for nonlogged and logged areas, respectively. However, concentration areas such as meadows, water sources, saltating ground or major travel ways would receive greater utilization. In dry years when the number of water sources were reduced grazing became more severe around remaining ponds or springs.

Areas where slash accumulations were heavy were avoided by cattle. This was especially true for the wetter lodgepole pine communities. An effective slash disposal program may be necessary to avoid this problem. The advent of the portable chipper may provide an excellent opportunity for increased revenue from the slash and in turn create more desirable grazing conditions for cattle.

Sheep Unlike cattle, sheep began utilizing bitterbrush within a few hours after arrival on the allotment and continued to consume it throughout the grazing season.

The logged areas offered a greater amount of forage and greater variety of species to sheep than the adjacent nonlogged areas. This was reflected in the dietary composition (Table 4). Grass species growing under tree canopies were smaller and had only three to five leaves per plant, whereas, in logged areas the grasses formed large bunches. Reduced visibility and low productivity of the herbaceous species in conjunction with preference for bitterbrush were felt to be the reasons why bitterbrush was utilized almost exclusively by sheep in the nonlogged lodgepole pine/bitterbrush/western needlegrass communities.

Western needlegrass and bottlebrush squirreltail were the dominant herbaceous species in the diet of sheep on logged areas. There seemed to be a decline in use of these species as they became mature.

Utilization of developed bitterbrush leaders approximated 42 and 33% for logged and nonlogged areas, respectively. This is equivalent to 34 and 20% utilization of total current year’s growth in logged and nonlogged areas, respectively. Approximately 2.5 times more bitterbrush was consumed in the logged areas as compared to nonlogged areas. The sheep preferred the terminal leaders over the lateral leaders and did not eat the spurs of bitterbrush. Stuth (1975) found that approximately 71% of the production of bitterbrush in logged areas was in developed leader growth, while leaders only accounted for 45% of the production in nonlogged areas. Therefore, those bitterbrush plants in logged areas provided a more desirable forage source.

Because of greater control of sheep distribution through herding and hauling water and because they show a high preference for bitterbrush, sheep may be a more desirable domestic animal than cattle for utilizing forage in nonlogged areas.

Conclusions

Diets for all three herbivores were found to vary depending on moisture conditions in the meadow communities prior to and during the growing season. Deer maintained a forb dominated diet both years, whereas, cattle and sheep had a grass- and grasslike-dominated diet. Sheep had well over 60% of their diet represented in grasses both years. Cattle diets were approximately the same as sheep diets during the dry year. However, in the wet year grasslikes and grasses were found equal within the diet of cattle. This increase of grasslikes in the diet of cattle were related primarily to their increased availability in the wet year.

Under existing grazing management programs there is minimal competition for forage between domestic livestock and deer on the meadows since only limited overlap in seasonal use was indicated and overall utilization values were low. It seems likely that sheep would pose the greatest potential for overlap in the diet of deer if allowed to overgraze meadows during June. The physical presence of large bands of sheep in the meadows may also influence occupancy by the deer during the early June fawning period. The intensity and duration of grazing by sheep would also be critical during this period.

Of the 48 meadow species available for utilization by the three herbivores, 34 were utilized and only six of the 34 exhibited a high potential overlap in the diets of livestock and deer. All of these species were forbs. Moderate use of the meadows by livestock, however, may be complementary to deer by providing a greater diversity and abundance of desirable forb species.

July was found to be a period of dietary transition for deer. During this period forbs had reached maturity and were declining in the diet of deer. Bitterbrush was starting active leader development and was increasing in their diet. The timing of this transition from a forb-dominated diet to a shrub-dominated diet was believed to be related to yearly precipitation prior to and during the growing season as it influences the phenology of desirable forage species. Both deer and cattle followed similar utilization trends on bitterbrush throughout the summer season, with consumption peaking in the early fall months. Sheep, however, maintained a higher preference for bitterbrush throughout the entire grazing season.

Forage growing in logged areas was utilized to a greater extent than in nonlogged areas. Deer consumed 7 to 10 times more bitterbrush in the logged areas, while sheep consumed more than double the amount of forage in logged areas. Cattle also had a distinct preference for logged areas especially where slash concentrations were minimal.

Bitterbrush was demonstrated to be the most important forage species to the three herbivores using the lodgepole pine/bitterbrush/western needlegrass community. Under existing grazing management programs, dual use values on bitterbrush would be approximately 25% and 50% utilization of current year’s growth by cattle-deer and sheep-deer, respectively, in
logged areas. Dual use values on bitterbrush growing in adjacent nonlogged areas would approximate 15% and 30% of current year’s growth for cattle-deer and sheep-deer, respectively.

**Literature Cited**


