

Forage Selection Comparisons for Mule Deer and Cattle under Managed Ponderosa Pine

P. O. CURRIE, D. W. REICHERT, J. C. MALECHEK, AND O. C. WALLMO

Highlight: Cattle and mule deer competed very little for forage on a central Colorado ponderosa pine-bunchgrass range during the spring-summer-fall grazing season. Species they selected for the bulk of their diets were quite different. Diets overlapped most for fringed sagebrush and sunsedge. Fringed sagebrush was used heavily by both deer and cattle in April-May. Sunsedge was consumed in small amounts by both animals throughout most of the grazing season. Management of the timber stand increased forage for both types of animals. Also, timber stand improvement practices resulted in short-term availability of dried pine needles, a preferred deer food.

From spring through fall, mule deer (*Odocoileus hemionus*) frequently occupy the same rangelands as cattle throughout the ponderosa pine (*Pinus ponderosa*) type of the central Rocky Mountains. These summer ranges provide a wide diversity of plants available as forage for both species of animals. There are questions, however, as to whether or not the two animals prefer the same plant species, and which plants comprise the bulk of the diet for each. In addition, commercial logging of ponderosa pine, a common practice on many of these lands, may affect the foraging habits of the mule deer.

The objectives of this study were to compare diet selections of deer and cattle on pine-bunchgrass ranges on an area that had been commercially logged and received post harvest timber stand improvement. Observations were made at intervals from spring through fall, when there was joint use of these ranges. Some deer also used these ranges at other times of the year but not in direct competition with cattle.

Several studies have indicated that competition for forage between cattle and deer is minimal on properly stocked, moderately grazed ranges (McMahan 1964; Skovlin et al. 1968; McKean 1971; and Dusek 1975). On ponderosa pine-bunchgrass ranges in Oregon, Skovlin et al. (1968) found that moderate cattle grazing provided for full use of the forage with little or no effect on deer use. They also found deer preferred

pastures managed under a deferred-rotation system over those grazed seasonlong, and showed a high preference for forested habitat. They concluded that "there was no evidence of direct competition between big game and cattle for any particular food plant on the study areas." In Arizona, Neff (1974) determined that mule deer ate almost 100 taxa in the ponderosa pine type, but in each season of the year, only 10 taxa provided from 67 to 95% of the total forage consumed. Chemical analyses of the simulated monthly diets from late spring through early summer showed forage quality declined as the seasons advanced, but dietary nutrients were usually adequate for growth and production of mule deer (Urness et al. 1975a; 1975b). Deer and cattle diets were not compared in these studies, but the results provided insight into the adequacy of ponderosa pine-bunchgrass ranges to support mule deer.

Methods

Study Areas

The research was carried out at the Manitou Experimental Forest, 28 miles (45 km) northwest of Colorado Springs, Colorado, at an elevation of approximately 7,800 ft (2,375 m). In this area, seasonal growth of native plants usually becomes evident in late March or early April, with the growing season ending in late September or early October. Plant growth is slow in early spring and late fall, however, with frost in all months except July and August. Daytime temperatures are cool and seldom exceed 90°F (32°C). Winters are open but cold and temperatures occasionally dip below -40°F (-40°C).

Precipitation at Forest Headquarters has averaged 15.8 inches (40.1 cm) annually for the 35 years, 1941-1975. About three-fourths of the annual precipitation is received during the April through August growing season. July is normally the wettest month with rainfall averaging approximately 3.5 inches (8.9 cm).

Vegetation of the pine-bunchgrass type of the central Rocky Mountains is a complex of plant communities characterized by open grassland parks interspersed among the ponderosa pine. The understory contains a large number of grass and forb species, with a rather limited number of shrub species.

Silvicultural Treatment

The study was conducted at a number of locations throughout 1,200 acres (485 ha) of the type which has been brought under multipurpose silviculture management (Myers 1974). These prescriptions provide for several uses and products from the Forest but scenic and recreation values predominate with additional uses for grazing and wildlife. The total area was cut to "growing stock level 80," which means that basal area of the trees is to be 80 ft²/acre (18.4 m²/ha) when average dbh

Currie and Reichert are range scientist and range research technician, Rocky Mountain Forest and Range Experiment Station, U.S. Department of Agriculture, Forest Service, with central headquarters maintained at Fort Collins in cooperation with Colorado State University. Malecek is assistant professor, College of Natural Resources, Utah State University, Logan. Wallmo is wildlife biologist, Forestry Sciences Laboratory, Juneau, Alaska, Pacific Northwest Forest and Range Experiment Station with central headquarters in Portland, Oregon.

Manuscript received January 15, 1977.



Fig. 1. Rumen collections provided material for analysis of cattle diets. Sub-samples from the collections were microscopically analyzed to quantitatively determine species composition.

after cutting is 10 or more inches (25.4 cm). Improvement cuttings were made for dwarf mistletoe control and timber stand improvement. Slash was removed primarily for small posts and firewood; material smaller than 2 inches (5 cm) in diameter was lopped and scattered. Comprehensive and detailed prescriptions for the silvicultural practices are described by Myers (1974). The net result was groups of managed irregular stands of ponderosa pine with good growth of the understory vegetation.

Cattle Evaluations

Cattle were grazed on a pasture basis in a separate study of weight gains. The area was fenced into 12 pastures of 100 acres (40.5 ha) each, with cattle use from mid-June to mid-October each year. Chemical analyses of species grazed and plant preferences by cattle were determined for native ranges in an earlier study (Malechek 1966). This work was done on range used or immediately adjacent to that used in the present study. Patterns of grazing use for cattle were the same throughout the cattle and deer studies and both animals were on the ranges at the same seasons. Forage species available were similar on all of the native ranges.

For the early work on cattle, rumen samples were collected from fistulated steers (Fig. 1) following the "rumen evacuation" techniques of Lesperance et al. (1960). Samples were collected at approximately 1-month intervals with more frequent collections during periods of rapid plant growth. A detailed description of methodology used for determining contents of the sample is given by Malechek (1966).

The samples were oven-dried and ground through a Wiley mill equipped with a 1-m screen. Small subsamples were taken from the ground material and mounted on microscope slides. Relative botanical composition was determined by counting the number of epidermal fragments of each species recognized in 100 microscope fields at 125x. Reference slides of known species were used to learn diagnostic features of the species.

Mule Deer Evaluation

Tame, trained deer¹ were used to determine forage selections considered representative of mule deer diets. Procedures were similar to those described by Wallmo et al. (1972) except only 1 deer and 1 observer were used to collect individual samples. On a number of

occasions, wild deer were observed in the same or an adjacent pasture. Available information (Wallmo and Neff 1970; Regelin et al. 1976) indicates diets for the two types of deer are similar, although the degree has not been definitely established. We assumed that plants selected by the tame deer represented preferences comparable to those for wild deer present on the study area.

Forage selection samples were taken during June, July, August, and October of 1974 and April and May of 1975. Samples were taken during several consecutive days in each month. Four deer were usually used at each sampling period. One deer would be taken out for 1 to 2 hours or as long as the deer was productively grazing. Then it would be returned to a holding barn and another deer would be taken out. The forage selected and bites taken by each deer during the 1 to 2 hours were considered a forage sample unit. In all, 137 forage sample units were collected during 158 hours of grazing observation throughout the six seasonal sampling periods.

Grazing trials throughout the pastures started from a number of pre-determined points readily accessible by the truck used to haul deer. The observer then released the deer and followed its meanderings as it foraged. The species ingested and number of bites taken were recorded on a portable tape recorder. A record was made of grazing in relation to tree overstory by estimating the basal area of the ponderosa pine. A 10-factor prism for cruising timber was used to make estimates of basal area. Four stand densities were used to categorize the overstory: (1) open grassland parks or a tree density less than 10 ft²/acre (0.9 m²/0.4 ha), (2) 10–30 ft²/acre, (0.9–2.7 m²/0.4 ha), (3) 40–60 ft²/acre (3.7–5.6 m²/0.4 ha), and (4) greater than 70 ft²/acre (6.5 m²/0.4 ha).

Results

Forage Preference of Cattle

Cattle selected a predominance of grass or grasslike species from July to early November (Table 1). During June, about equal amounts of grass and forbs were taken; in May the cattle

Table 1. Botanical composition (%) of forage samples from fistulated cattle grazing ponderosa pine-bunchgrass ranges. (Adapted from Malechek 1966.)¹

Species	Total ²	May	June	July	Aug.	Sept.	Nov.
Grass and grasslike	15.4	.0	<0.1	50.2	0.6	11.7	29.7
<i>Agropyron smithii</i>	<0.1	.0	.0	0.3	0.1	.0	.0
<i>Blepharoneuron tricholepis</i>	4.3	.0	.0	0.1	13.0	10.3	2.4
<i>Bouteloua gracilis</i>	0.9	.0	.0	.0	.0	.0	5.5
<i>Calamagrostis inexplansia</i>	2.8	<0.1	1.0	.0	2.6	1.9	11.4
<i>Carex heliophila</i>	0.7	.0	.0	.0	0.7	3.3	0.0
<i>Danthonia parryi</i>	7.3	4.3	1.5	0.6	16.5	20.8	0.0
<i>Festuca arizonica</i>	2.8	3.6	<0.1	0.0	4.8	6.4	2.2
<i>Koeleria cristata</i>	10.5	1.8	14.6	5.3	22.1	16.0	3.3
<i>Muhlenbergia montana</i>	3.5	2.7	0.0	0.8	3.9	3.0	10.5
<i>Poa pratensis</i>	1.7	<0.1	5.0	0.0	2.0	2.2	0.8
<i>Stipa comata</i>	2.2	3.9	3.7	<0.1	0.1	.0	5.1
<i>Stipa robusta</i>	16.0	25.0	23.3	11.0	20.3	7.0	9.4
Unidentifiable grasses	68.2	41.5	49.3	68.3	86.7	82.6	80.3
Total							
Forbs							
<i>Arenaria fendleri</i>	0.7	.0	.0	1.0	1.8	1.2	.0
<i>Artemisia frigida</i>	10.9	19.8	23.3	.0	4.0	9.2	9.0
<i>Chenopodium album</i>	<0.1	.0	.0	<0.1	.0	.0	.0
<i>Erigeron flagellaris</i>	0.1	.0	.0	.0	.0	.0	0.8
<i>Geranium parryi</i>	<0.1	.0	<0.1	.0	.0	.0	.0
<i>Melilotus officinalis</i>	0.1	<0.1	.0	<0.1	.0	.6	.0
<i>Polygonum aviculare</i>	<0.1	.0	.0	5.4	.0	.0	.0
<i>Potentilla pennsylvanica</i>	8.0	32.4	12.4	1.6	.0	.0	1.5
Unidentifiable forbs	11.3	5.9	15.1	24.0	8.0	6.3	8.5
Total	31.4	58.2	50.9	32.2	13.8	17.3	19.7
Shrubs							
<i>Chrysothamnus viscidiflorus</i>	<0.1	.0	.0	.0	.0	<0.1	.0
Total	<0.1	.0	.0	.0	.0	<0.1	.0

¹ Samples from different fistulated animals and consecutive sample days within a month were averaged to obtain a single value for comparisons with mule deer data.

² Total use value for each species is an average of monthly values.

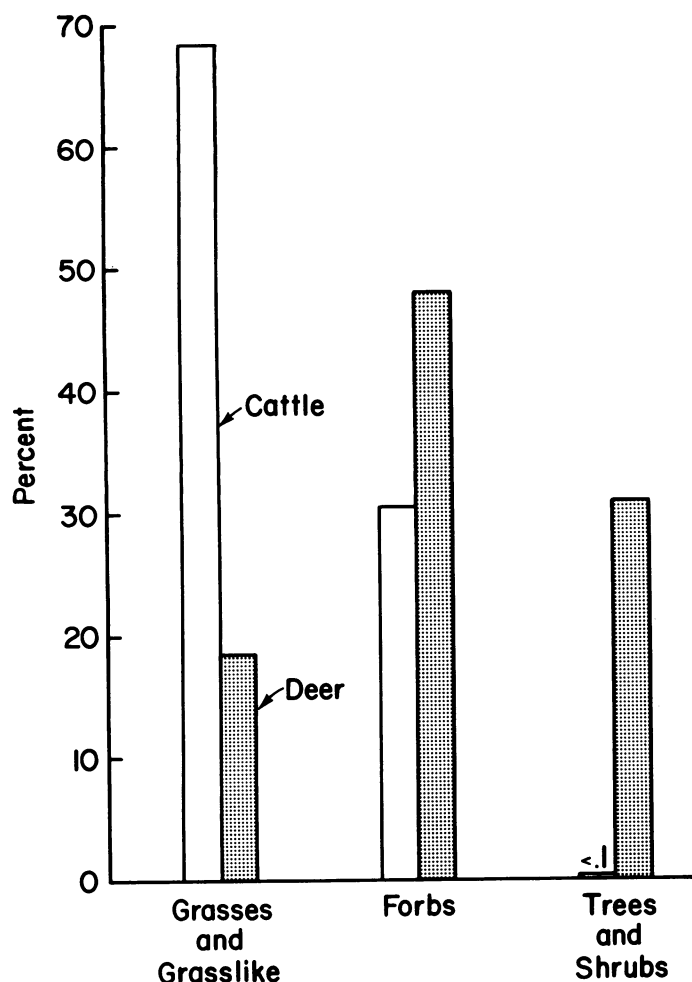


Fig. 2. Relative use of plant groups by cattle and mule deer on ponderosa pine-bunchgrass ranges.

consumed mostly forbs. Shrubs were unimportant in cattle diets throughout the growing season (Fig. 2).

Some difficulty was experienced in identifying all species of grasses in cattle diets, particularly during the period of early growth in May and June and in August when regrowth occurred. Thus, unidentifiable grasses made up an average of 16% of the diet. Three species, western wheatgrass (*Agropyron smithii*), mountain muhly (*Muhlenbergia montana*), and Arizona fescue (*Festuca arizonica*) made up an additional 33% of the diets and were the most preferred grasses. These species were generally grazed throughout or during the mid to late part of the season. Blue grama (*Bouteloua gracilis*) and Kentucky bluegrass (*Poa pratensis*) became important in cattle diets late in the season, from August into November. Sunseed (*Carex heliophila*) was grazed lightly in all months except November when it made up 1.4% of the diet.

Only two forbs were consistently selected by livestock throughout most of the growing season. Fringed sagebrush (*Artemisia frigida*) was utilized during every month but July, and made up 19.8 and 23.3% of the diet in May and June (Table 1). This use was of interest because fringed sagebrush is generally considered unimportant or an undesirable livestock forage.

The other forb of singular importance was Pennsylvania cinquefoil (*Potentilla pennsylvanica*), which contributed more than 32% to the composition of cattle diets in May and over 12% in June. The only other forb contributing substantially was knotweed (*Polygonum aviculare*), which made up 5.4% of the diet in July but was not present in any other month. Fendler sandwort (*Arenaria fendleri*) contributed less than 2% to the diets in August and approximately 1% in both July and September. Difficulty was again experienced in identifying all forbs to the species level; in July 24% of the diet was made up of a combination of unidentifiable forbs. This problem was less pronounced in the other months.

Mule Deer Diets

Tame mule deer showed a preference for ponderosa pine (*Pinus ponderosa*), followed by Arkansas rose (*Rosa arkan-*



Fig. 3. Mule deer consumed ponderosa pine needles throughout the grazing season. They relished green needles from live trees (left) but also ate quantities of dry needles from downed trees or slash (right).

Table 2. Botanical composition of diets for tame mule deer grazing ponderosa pine-bunchgrass ranges. Ranking based on average consumption for the growing season and for species making up 1% or more of the total diets.

Species	Total	April	May	June	July	August	October
Sampling size (total bites)	61,838	7,301	6,694	10,097	10,203	15,214	12,329
Species grazed (number)	129	43	47	68	72	74	57
Species preference (%) ¹							
<i>Pinus ponderosa</i>	12.7	25.2	8.6	6.2	8.0	8.2	20.2
<i>Rosa arkansana</i>	8.3	0.9	1.0	16.9	18.1	8.0	5.1
<i>Poa</i> spp.	8.0	14.0	17.9	4.3	.3	.1	11.1
<i>Geranium fremontii</i>	6.2	9.2	2.8	3.8	5.2	8.6	7.6
<i>Cercocarpus montanus</i>	5.4	2.7	.2	9.6	7.0	8.4	4.6
<i>Potentilla hippiana</i>	4.3	1.2	2.9	3.2	8.3	4.9	5.4
<i>Pulsatilla ludoviciana</i>	4.3	6.9	11.4	2.8	.1	1.8	2.7
<i>Artemisia frigida</i>	3.9	12.5	2.2	6.9	.7	T ³	1.0
<i>Frageria ovalis</i>	3.8	.0	.8	4.0	6.5	6.1	5.5
<i>Bromus inermis</i>	3.4	3.0	7.2	4.5	5.0	.2	.2
<i>Carex heliophila</i>	3.2	2.6	7.6	5.3	.1	.4	2.9
<i>Taraxacum officinale</i>	2.6	.0	5.9	2.5	2.0	4.9	.4
<i>Oenothera</i> spp.	2.3	.4	.9	.1	3.9	6.1	2.5
<i>Populus tremuloides</i>	2.0	1.2	3.3	1.3	3.0	.3	2.9
<i>Chenopodium album</i>	1.8	.1	.8	1.6	3.4	5.1	.1
<i>Agropyron</i> spp.	1.8	2.5	3.2	1.0	3.6	.0	.4
<i>Penstemon virens</i>	1.8	1.7	6.3	1.0	.2	.1	1.2
<i>Convolvulus arvensis</i>	1.7	.0	.0	.8	2.4	4.9	2.1
<i>Eriogonum alatum</i>	1.7	2.0	2.1	.0	.5	2.2	3.3
<i>Campanula rotundifolia</i>	1.6	.1	1.9	.0	.5	4.6	2.7
<i>Arctostaphylos uva-ursi</i>	1.3	1.7	1.3	1.0	2.0	.3	1.7
<i>Potentilla pennsylvanica</i>	1.2	1.7	2.9	.1	1.0	.7	1.0
<i>Sitanion hystrix</i>	1.2	.7	.3	4.7	1.2	.1	.4
Additional species ²							
<i>Arcanthobium vaginatum</i>		2.5					
<i>Elymus junceus</i>		1.1		1.7			
<i>Antennaria parvifolia</i>			1.3				
<i>Sedum stenopetalum</i>			1.1				
<i>Ribes cereum</i>				1.8	2.0		
<i>Andropogon scoparius</i>				1.3			
<i>Stipa robusta</i>				1.2			
<i>Koeleria cristata</i>				1.1	2.1		
<i>Tragopogon parvifolius</i>					1.2	3.3	
<i>Polygonum aviculare</i>					1.0	1.4	1.8
<i>Allium cernuum</i>						4.0	
Fungi (mushroom)						5.2	
<i>Sysimbrium altissimum</i>						1.2	
<i>Agrostis alba</i>							2.9
<i>Solanum triflorum</i>							1.6
<i>Melilotus officinalis</i>							1.0
Percent of diet composed of:							
Trees and shrubs	31.6	31.8	14.9	45.3	41.3	26.6	35.4
Forbs	48.1	40.2	46.9	26.5	43.7	66.5	45.2
Grass	18.4	25.5	37.7	28.2	15.0	1.6	19.0
Other	1.9	2.5	.5	.0	.0	5.3	.4

¹ Total use value for each species is an average of monthly values.

² All other species which contributed 1% or more to the diet during specific months.

³ Trace.

sana) and species of bluegrass (*Poa* spp.) (Table 2). Ponderosa pine contributed substantially to the diets in all months, with the highest preference of 20 to 25% in October and April, respectively. In all other months the percentage of pine needles in the diet averaged between 6 and 9%.

Rose was used lightly in April and May before active leaf growth. By June and July, however, it made up about 17 to 18% of the diet, then decreased during late fall. The bluegrass species used by the deer was primarily mutton bluegrass (*Poa fendleri*-ana) rather than Kentucky bluegrass grazed by the cattle. The mutton bluegrass made up about 14 to 18% of the deer diets in April and May, decreased in importance during the summer, but contributed over 11% to the diets in October.

Pennsylvania cinquefoil, one of the forbs utilized heavily by cattle, was not grazed much by deer. Another cinquefoil (*Potentilla hippiana*) however, rated quite high in the diets of the tame deer throughout the entire grazing season.

Fringed sagebrush made up 12.5% of the diet for deer during May and 6.9% in July. During other months it ranged from a trace to 2.2%. Thus diet overlap for this species was substantial early in the growing season and some competition might occur with high densities of cattle or deer. However, competition was probably not severe because of moderate cattle stocking, rather low deer densities, and the availability and abundance of this species. By July, cattle quit using fringed sagebrush. Sunseed was the only other species for which competition was particularly noted. The tame deer ate small amounts ranging from 0.1 to 7.6% throughout the season. Sunseed also appeared in cattle diets in all months except July.

The tame deer grazed 129 species during the 7-month season. The fewest species were grazed in April and May because not all plants are available at this time. Maximum numbers were taken in July and August when maximum numbers were available. During such periods, mushrooms were actively sought out by

the deer. They would paw through needles and duff to find preferred fungi, which made up more than 5% of their diet (Table 2).

Silvicultural Treatment and Deer Use

The use of ponderosa pine was affected by the silvicultural practice and post-harvest treatment. The deer readily grazed needles from the lower branches of actively growing trees (Fig. 3-left). They also demonstrated a taste for dry needles on trees that had been felled for control of dwarf mistletoe (Fig. 3-right). The deer were very selective as to which branches or needles were grazed on live trees, felled trees, or needles picked up from the ground. The dry needles from downed trees or those picked up from the ground were semidried, and generally somewhat crisp, but still retained a yellow-brown color, perhaps with some green. The deer did not eat old grey-brown needles which had been on the ground 2 or more years. The forage value of needles is not known, but Neff (1974) also found them to be used abundantly by mule deer in Arizona.

In addition to the needles, the deer grazed a number of pine seedlings when they happened upon them in the pastures. Usually the terminal bud plus a number of upper needles were nipped off and eaten.

Some dwarf mistletoe (*Arceuthobium vaginatum*) was gathered from the ground after it had fallen from live trees. Most of it, however, was selected from downed trees specifically felled to control spread of the organism. Dwarf mistletoe made up 2.5% of the tame deer's diet in April, coming from trees felled during the prior winter or early spring (Table 2).

Cutting of timber to growing stock level 80 resulted in a residual stand of trees with basal areas ranging from 10 ft²/acre (0.9 m²/0.4 ha) to more than 70 ft²/acre (6.5 m²/0.4 ha). Intermingled with these tree stands are open grassland parks characteristic of the pine type. The tame deer spent about equal amounts of time grazing in the open parks, low-density stands, and high-density stands (Table 3). The least time was spent in areas with basal areas between 40–60 ft²/acre (3.7–5.6 m²/0.4 ha). The average percentage of forage use in this intermediate basal area class was about half that for the other areas occupied by trees. This difference, however, was probably a result of forage supply rather than some well-defined preference. Trees, shrubs and other species were grazed more heavily on the areas which had a tree basal area greater than 70 ft²/acre. The category "other" was composed largely of fungi or dwarf mistletoe in areas which were heavily infected.

Conclusions

Earlier studies at the Manitou Experimental Forest have shown that grazing by cattle is concentrated in the openings or low-density timber areas (Smith 1967). Tame deer spent more than 50% of their time grazing in comparable areas. Dietary competition between the two kinds of animals was not of consequence, however, because of limited overlap in the species consumed. Fringed sagebrush and sunsedge are exceptions, but neither species comprises a sufficient percentage in the overall diet of cattle or deer to be of much consequence.

Table 3. Diet composition (%) by forage class and amount of time (%) spent grazing by tame mule deer in relation to basal area of ponderosa pine (ft²/acre).

Item	Basal area (ft ² /acre)			
	0	10–30	40–60	>70
Forage source (%)				
Trees and shrubs	18.8	31.0	15.4	34.8
Forbs	28.7	31.0	12.3	28.0
Grasses	36.9	36.5	13.3	13.3
Other	5.2	23.1	23.0	48.7
Average	22.4	30.4	16.0	31.2
Grazing time (%)	24	29	16	31

Also, both species are sufficiently abundant so that competition is minimal.

Commercial timber harvesting activities resulted in almost a two-fold increase in understory herbage yields, which has been beneficial to both deer and cattle. By harvesting timber to leave a density of stocking level 80, sufficient trees are available to provide the distribution and density of ponderosa pine needed to maintain the preferred forage of mule deer. Sanitation treatments and thinnings removed undesirable trees and provided a short-term preferred food source for mule deer.

Literature Cited

- Duresk, G. L. 1975. Range relations of mule deer and cattle in prairie habitat. J. Wildl. Manage. 39:605-616.
- Lesperance, A. L., V. R. Bohman, and D. W. Marble. 1960. Development of techniques for evaluating grazed forage. J. Dairy Sci. 43:682-689.
- Malechek, J. C. 1966. Cattle diets on native and seeded ranges in the ponderosa pine zone of Colorado. U.S. Dep. Agr. Forest Serv. Res. Note RM-77. 12 p. Rocky Mtn. Forest and Range Exp. Sta., Fort Collins, Colo.
- McKean, W. T. 1971. Rivalry among the ruminants. Colorado Outdoors Sept.-Oct. 14-18.
- McMahan, C. A. 1964. Comparative food habits of deer and three classes of livestock. J. Wildl. Manage. 28:798-808.
- Myers, C. A. 1974. Multipurpose silviculture in ponderosa pine stands of the montane zone of central Colorado. U.S. Dep. Agr. Forest Serv. Res. Pap. RM-132, 15 p. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, Colo.
- Neff, D. J. 1974. Forage preferences of trained mule deer on the Beaver Creek watersheds. Arizona Game and Fish Dep. Spec. Rep. No. 4. 61 p.
- Regelin, W. L., R. M. Bartman, D. W. Reichert, and P. H. Neil. 1976. The influence of supplemental feed on food habits of tamed deer. U.S. Dep. Agr. Forest Serv. Res. Note RM-316, 4 p. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, Colo.
- Skovlin, J. M., P. J. Edgerton, and R. W. Harris. 1968. The influence of cattle management on deer and elk. Trans. Thirty-third N. Amer. Wildl. and Nat. Resour. Conf., 169-181.
- Smith, D. R. 1967. Effects of cattle grazing on a ponderosa pine-bunchgrass range in Colorado. U.S. Dep. Agr. Tech. Bull. 1371. 60 p.
- Urness, P. J., D. J. Neff, and J. R. Vahle. 1975a. Nutrient content of mule deer diets from ponderosa pine range. J. Wildl. Manage. 39:670-673.
- Urness, P. J., D. J. Neff, and R. K. Watkins. 1975b. Nutritive value of mule deer forages on ponderosa pine summer range in Arizona. U.S. Dep. Agr. Forest Serv. Res. Note RM-304, 6 p. Rocky Mountain Forest and Range Exp. Sta., Fort Collins, Colo.
- Wallmo, O. C., and D. J. Neff. 1970. Direct observations of tamed deer to measure their consumption of natural forage. p. 105-110. In: Range and wildlife habitat evaluation—a research symposium. U.S. Dep. Agr. Misc. Pub. 1147. 220 p.
- Wallmo, O. C., W. L. Regelin, and D. W. Reichert. 1972. Forage use by mule deer relative to logging in Colorado. J. Wildl. Manage. 36:1025-1033.

