

Seasonal Diets of Five Ungulates Grazing the Cold Desert Biome

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Highlight

Fecal material was collected periodically from cattle, sheep, mule deer, antelope and feral horses from May, 1975 through April, 1977. Diet composition by animal species was estimated by examination of microhistological characteristics of plant parts present in the feces. Cattle and sheep grazed the range from April through October annually with some variation. Deer used the area primarily as winter and early spring range. Antelope, a few deer and feral horses were present at all times. Cattle and feral horses consumed mostly grass in all seasons, as did sheep in the spring and summer months. Juniper, sagebrush and bitterbrush were major dietary constituents for deer and antelope during the summer, fall and winter months. Forbs, principally blue mustard, were important only to antelope, particularly in the summer period. Similarity indexes revealed that appreciable dietary overlap existed among cattle, sheep and feral horses. Diets of antelope and deer were similar in summer and winter. Little overlap existed between cattle, sheep, feral horses as a group and deer and antelope. Deer and antelope diets overlapped most in the winter.

Many rangelands in the western United States are public lands administered under the concept of multiple use. These lands are usually grazed in common by wild and domestic herbivores. Policy dictates that no single animal will graze to the extent that it is a detriment to the others or to the perpetuity of the range resource. Therefore, research is needed to document the plant species consumed by each herbivore and the season of use. The forage resource can then be allocated to the various herbivores present and control on their numbers can be exerted to maintain correct stocking rates.

The impact of feral horses (*Equus caballus*) on the range and other herbivores present has received considerable interest in recent years. Hubbard and Hansen (1976), Hansen *et al.* (1977), and Olsen and Hansen (1977) have studied feral horses and their association with other herbivores present.

This study reports on feral horse, cattle (*Bos taurus*), sheep (*Ovis aries*), mule deer (*Odocoileus hemionus*) and antelope (*Antilocapra americana*) diets and how they overlap during various seasons of the year on an area representing a cold desert biome. The study area is an important deer winter range, so data generated could aid in management plans to enhance deer forage or prevent depletion of the deer forage resource. Fecal analysis by the microhistological technique (Sparks and Malechek 1968) was chosen as the best method to quantify diets, even though biases are known to exist (McInnis 1977 and Vavra *et al.* 1977).

Description of Study Area

The study area, located 40 km from Burns, Oregon, is a 166 km² unit of a larger area wintering approximately 5-7,000 mule deer. Most

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deer use occurs from December to May, but some deer are resident to the area year-long. About 30 wild horses and 2-300 antelope are year-long residents. Cattle and sheep graze portions of the area each year under Bureau of Land Management permit from April 1 to January 1, according to allotment management plans.

The study area is a typical desert-forest fringe area of the cold desert. It lies approximately 1,370 m above sea level with local elevation variations of 60 to 90 m. The vegetation is a complex mosaic dominated by an overstory of juniper (*Juniperus occidentalis*), big and low sagebrush (*Artemisia tridentata* and *A. arbuscula*) and an understory of bluebunch wheatgrass (*Agropyron spicatum*) and Idaho fescue (*Festuca idahoensis*). Associated species include antelope bitterbrush (*Purshia tridentata*), Thurber's needlegrass (*Stipa thurberiana*), Junegrass (*Koeleria cristata*) and Sandberg bluegrass (*Poa secunda*). Broadleaf succulents are many, but comprise less than 15% of the total herbaceous production. Blue mustard (*Streptanthus cordatus*) was a forb important to the study.

Average annual precipitation is 29.21 cm, with the majority occurring as snow in the winter or as spring and fall rains. Summers are characteristically dry. Changes from the normal climate occurred in August of 1976 when 5 cm of rain fell and in the winter and spring of 1977 which was abnormally dry.

Methods

Fecal material was collected periodically from cattle, sheep, mule deer, antelope, and feral horses from May 1975 to April 1977. Only fresh fecal samples were taken. Animals were observed in the field and then the area of observation was searched for fresh pellets. Six pellet groups were collected per species per collection period. At least two groups of each ungulate were sampled per period, with the exception of sheep as only one band grazed the area.

Samples were frozen following collection and stored until analysis. Sample preparation and analysis followed the procedure of Sparks and Malechek (1968). Twenty microscope fields were observed on each of three slides for each sample. For data interpretation, samples were pooled by apparent diet changes and occurrences of changing forage availability. Summer diets refer to samples collected in May and June; fall — August and September; winter — January and February; spring — March and April.

Kulczynski's similarity index (Oosting 1956), which has been applied to herbivore diet analyses by Olsen and Hansen (1977), was used to identify the extent of dietary overlap. The similarity index represents the percentages of two diets that are identical (Olsen and Hansen 1977).

Results

Diets

Horse diets contained nearly 100% grass (Table 1) throughout the study. Cattle similarly preferred grass but diets in the summer period of Year 1 contained 11% sagebrush and bitterbrush constituted 12% of the diet in the fall period. Sheep also relied heavily on the grass component, as their diets contained 88% or more grass during the spring and summer period. Only during the summer season did sheep browse and this was confined principally to sagebrush.

Table 1. Grass composition (percent dry weight) in diets of cattle, horses, sheep, deer and antelope in 1975-76(1) and 1976-77(2).

Season	Cattle		Horse		Sheep		Deer		Antelope	
	1	2	1	2	1	2	1	2	1	2
Spring	99	100	99	95	98	a	51	19	71	28
Summer	94	88	98	100	88	88	17	24	23	37
Fall	89	100	99	100	a	a	1	a	0	9
Winter	100	a	100	97	a	a	20	9	0	18

a = animals absent from sample area.

Idaho fescue was the main grass selected by cattle and comprised 75, 32, 41, and 10% of the diet for the spring, fall, summer, and winter period, respectively. Needlegrasses were the next most important grass in cattle diets, with bluebunch wheatgrass comprising up to 27% of the diet in Year 2, but less than 12% in Year 1. Horses similarly chose Idaho fescue and the needlegrasses, but in the winter period approximately 40 to 50% of their diet consisted of squirreltail (*Sitanion hystrix*) and bluebunch wheatgrass. Sixty-three percent of sheep diets in the spring was Columbia needlegrass (*Stipa columbiana*).

In a nearly normal spring, grass constituted 51% of the deer diet, but in the subsequent dry spring this was reduced to 19%. Sandberg bluegrass was the principal species selected during the spring. Grass continued to be a component of the deer diet in the summer period, diminished during the fall period, and increased to summer levels in the winter. During these periods Columbia needlegrass and Idaho fescue were the primary grasses in their diet. Forb composition in the diets of deer was less than 4%.

Seventy-one percent of the antelope diet in the spring was grass in Year 1 but was only 28% in Year 2. Like deer, antelope selected strongly for Sandberg bluegrass. Grass composition in the diet during Year 1 was extremely low for the summer, fall and winter periods but in Year 2 during those periods, diets contained from 9 to 37% grass. Other than Sandberg's bluegrass, Thurber's needlegrass and bluebunch wheatgrass were selected by antelope.

Browse species strongly dominated the diets of deer and, surprisingly, juniper was an important component in all but the fall period (Table 2) when bitterbrush was the preferred species (96%). Year effect strongly influenced the intake of juniper with nearly twice the amount in the diet in Year 2. Only small use of bitterbrush occurred in the spring and winter periods (11%) but the plant was found to be an

Table 2. Browse composition (percent dry weight) in deer diets in 1975-76(1) and 1976-77(2).

Season	Bitterbrush		Sagebrush		Juniper	
	1	2	1	2	1	2
Spring	<1	11	13	12	33	55
Summer	41	0	14	3	26	45
Fall	96	a	2	a	1	a
Winter	0	3	26	38	56	49

a = animals absent from sample area.

Table 4. Diet similarity indexes presented by paired animal species for each season and year of study.

Season	Year	C-A ^a	C-D	C-S	C-H	A-D	A-S	A-H	D-S	D-H	S-H
Spring	1 ^b	.05	.18	.30	.62	.57	.12	.06	.23	.11	.29
	2	.22	.15	—	.72	.40	—	.20	—	.21	—
Summer	1	.14	.37	.86	.54	.59	.17	.07	.26	.18	.85
	2	.40	.14	.78	.73	.19	.42	.37	.15	.09	.71
	1	.12	.12	—	.70	.68	—	.01	—	<.01	—
	2	.05	—	—	.80	—	—	.03	—	—	—
Winter	1	<.01	.13	—	.72	.63	—	.01	—	.16	—
	2	—	—	—	—	.62	—	.20	—	.18	—

^a C = cattle, A = antelope, D = deer, S = sheep, H = horse.

^b Year 1 = 1975-1976; Year 2 = 1976-1977.

important dietary constituent in the summer period of Year 1. Heaviest use of sagebrush by deer occurred in the winter period when diets contained from 26 to 38% sagebrush. Only light use of sagebrush occurred in the fall, but the sagebrush contribution to the diet was 3 to 14% during the spring and summer period.

A single forb, a mustard, was selected by antelope during the summer period and constituted 38% of their diet in Year 1 (Table 3). This forb was also consumed throughout the year, but did not exceed 13% of the diet. This forb fragmented severely upon sample preparation, but identification of even the smallest particle was possible. Therefore, it is thought that the percentage of mustard in the diet is an overestimation. Bitterbrush comprised 44 to 68% of the antelope diet in the summer and fall period of Year 1 but was less than 11% of the diet in Year 2. In Year 2, this reduced consumption of bitterbrush resulted in increased consumption of grasses and of sagebrush in the summer and fall periods, respectively. Juniper was selected by antelope in all seasons but the heaviest use (37% and 20% for Year 1 and 2, respectively) occurred in the winter period.

Table 3. Browse and forb composition (percent dry weight) in antelope diets in 1975-76(1) and 1976-77(2).

Season	Bitterbrush		Sagebrush		Juniper		Forb ^a	
	1	2	1	2	1	2	1	2
Spring	0	0	23	45	5	13	0	9
Summer	44	11	10	10	<1	5	38	20
Fall	68	0	11	56	19	5	1	13
Winter	5	<1	52	53	37	20	0	5

^a Principally blue mustard.

Overlap

Similarity indexes comparing each herbivore with the others for each season and year studied are presented in Table 4. The most consistent dietary overlap occurred between cattle and horses. An index of 0.54 or greater occurred during all seasons of both years. Cattle vs. sheep and sheep vs. horses exhibited extreme overlap during the summer of both years but in spring when forage availability should be highest, much overlap was not evident. Antelope and deer diets overlapped more during spring, summer and fall of Year 1 than Year 2. Similarity indexes of 0.62 and 0.63 were recorded for the winters of both years, indicating a moderate amount of overlap in the winter.

Discussion

Herbivores in this study may be divided into two distinct groups: (1) grass consumers (cattle, sheep and feral horses) and (2) shrub consumers (deer and antelope). Although grass consumers in the spring, sheep did not prefer the same species of grass as did cattle and horses, as is indicated by the relatively low similarity values (cattle vs. sheep, 0.30; horses vs. sheep, 0.29). Similarity values between cattle and sheep, and horses and sheep increased considerably in the summer, perhaps due to the decreased availability or palatability of forage.

Shrub consumers did not seek out grasses during any season of the year except spring. Sandberg bluegrass was actively sought and was a major dietary constituent during Year 1 of the study. Year 2 was an exceptionally dry year and production of Sandberg bluegrass was nil; dietary consumption was likewise. It can be assumed, though, that Sandberg bluegrass is an important dietary constituent to deer and antelope during years of adequate production.

Antelope were the only herbivores in the study to consume significant amounts of forbs. Possible bias due to sample preparation has already been stated. Mustard was an important antelope dietary constituent in summer and was recorded in the diets during the other seasons sampled. Fleabane (*Erigeron* spp.) was also consumed by antelope. Other forbs were taken by antelope and other herbivores but sporadically and in amounts of less than five percent. Quantification of forb-containing diets by fecal analysis has been questioned (McInnis 1977). However, if forbs occurred in the diets in rather large amounts, fecal samples should reveal more than the amounts recorded in this study. Vavra *et al.* (1977) reported significant differences in the percentage of forbs in esophageal fistula vs. fecal samples of cattle diets. However, forbs found in fistular material were also present in the feces.

Generally, grass consumers varied their diets less than did shrub consumers. Horses were the least selective, followed by cattle and then sheep. Shrub consumers (deer and antelope) tended to be more opportunistic grazers, varying their diets with season and availability. Olsen and Hansen (1977) reported similar findings on the Red Desert of Wyoming.

Drought conditions occurring during the latter part of the study

caused greater dietary shifts with browse consumers. Deer and antelope shifted their spring diets more to shrubs (common in other seasons) and away from grasses, probably due to the lack of production of Sandberg bluegrass.

From the data generated, management guidelines of the herbivores studied can be formulated relative to plant community and production information. Population levels of cattle, feral horses and sheep should be regulated to that adverse use on perennial grass species could be avoided.

Antelope and deer populations could influence the production of shrub species. If the presented dietary information is due to preference more than availability, deer and antelope grazing has a positive effect by putting grazing pressure on juniper and sagebrush, two species generally considered undesirable. However, the grazing impact on bitterbrush would have to be monitored to prevent overuse of this desirable species.

Literature Cited

- Hansen, R. M., R. C. Clark, and W. Lawhorn. 1977. Foods of wild horses, deer, and cattle in the Douglas Mountain area, Colorado. *Journal of Range Management* 30:116-118.
- Hubbard, R. E., and R. M. Hansen. 1976. Diets of wild horses, cattle, and mule deer in the Piceance Basin, Colorado. *Journal of Range Management* 29:389-392.
- McInnis, M. L. 1977. A comparison of four methods used in determining the diets of large herbivores. Master's Thesis. Oregon State University, Corvallis, OR.
- Olsen, F. W., and R. M. Hansen. 1977. Food relations of wild free-roaming horses to livestock and big game, Red Desert, Wyoming. *Journal of Range Management* 30:17-20.
- Oosting, H. J. 1956. *The study of plant communities*. W. H. Freeman and Co., San Francisco. 440 p.
- Sparks, D. R., and J. C. Malechek. 1968. Estimating percentage dry weight in diets using a microscopic technique. *Journal of Range Management* 21:264.
- Vavra, M., R. W. Rice, and R. M. Hansen. 1977. A comparison of esophageal fistula and fecal material to determine steer diets. *Journal of Range Management* 31:11-13.