

Food Relations of Wild Free-Roaming Horses to Livestock and Big Game, Red Desert, Wyoming

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Highlight: The seasonal foods selected by wild horses, cattle, elk, domestic sheep, and antelope on the Red Desert in southwestern Wyoming were determined by microscopic inspection of fecal material. A large percentage of the diets of wild horses, cattle, and elk were the same species of grasses and sedges. Wheatgrass and needlegrass each made up 11 to 46% of the average annual diets of the herbivores studied except antelope. Sagebrush was the major food in antelope diets regardless of season. Saltbush was an important food in each herbivore's seasonal diet and was the major food of domestic sheep each season except summer. Each herbivore species ate a variety of plants each season, but the majority of the diet within a season usually consisted of fewer than six major plant species.

Increased emphasis on managing rangelands for multiple use necessitates determination of the requirements of each proposed use. Populations of the wild horses appear to be increasing on National Resource Lands. It has been speculated that livestock grazing may have to be reduced to make room for horses (Cook 1975). Concern also exists for native big game animals which could eventually be displaced if there is serious food competition between the wild horses and big game.

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To estimate the populations that can be supported on a given range, it is necessary to know the diets of the animals; the kinds, amounts, and distribution of food plants; and the relation of the plants and animals to other environmental and land-use factors. The studies on big game and livestock diets and interrelationships show large variation by year of study, location, and technique of diet determination. The food habits of important herbivores have usually been published in separate reports (Sundstrom et al. 1973; Cook 1954; and Hoover et al. 1959). The only published reports on the botanical compositions of wild horses' diets in North America which were found are by Hansen (1976) and Hubbard and Hansen (1976).

The Rock Springs Bureau of Land Management District is an area where information on the interactive feeding relations of wild free-roaming horses (*Equus caballus*), cattle (*Bos taurus*), elk (*Cervus canadensis*), sheep (*Ovis aires*), and pronghorns (*Antilocarpa americana*) is needed. Much of the same vegetation type is used by the five large herbivores, frequently on the same areas during the same seasons.

The purpose of this study was to determine diet composition and dietary overlaps for wild horses, cattle, elk, sheep, and pronghorns allowed a free choice of range plants on the same area (Fig. 1).

Study Area and Methods

The study area was located in southwestern Wyoming in the eastern portion of the Red Desert. The area, located from approximately 32 km north of Rock Springs, encompassed about 2,500 km². The area



Fig. 1. Photo of elk and wild horses on the Red Desert study area.

was predominantly National Resource Lands managed by the U.S. Bureau of Land Management (BLM) with scattered tracts of State and private lands.

Aerial surveys and ground observations in 1975 indicated that the area supported about 800 wild horses, 850 pronghorn antelope, and 185 elk. Seasonal migration usually increases the winter population of antelope to about 1,400 and the number of elk to about 475. The BLM licenses 679 cattle and 27,100 sheep on this area.

Most of the area is about 2,100 m in elevation with the maximum altitude being 2,600 m on Steamboat Mountain. The area receives 20 cm of precipitation in the lower elevations and 25 cm in the higher areas. The majority of the area is characterized by either sagebrush-grass (*Artemisia* spp.), saltbush (*Atriplex* spp.), or rabbitbrush (*Chrysothamnus* spp.) communities.

The sagebrush-grass type is commonly found on the low, rolling hills with sandy loam soils 46 to 76 cm deep characterized by rocky subsoil. The saltbush type is found in the flats where the soils are silty clays 20 to 30 cm deep with heavy clays being common. The rabbitbrush type is located primarily on stabilized sand dunes with loamy sand deeper than 60 cm. The sagebrush-grass type is characterized by big sagebrush (*Artemisia tridentata*), Douglas rabbitbrush (*Chrysothamnus vicidiflores*), Gardner saltbush (*Atriplex gardnerii*), spiny hopsage (*Grayia spinosa*), bluebunch wheatgrass (*Agropyron spicatum*), thickspike wheatgrass (*Agropyron dasystachyum*), Indian ricegrass (*Oryzopsis hymenoides*), Sandberg bluegrass (*Poa secunda*), needleandthread (*Stipa comata*), buckwheat (*Eriogonum* spp.), and phlox (*Phlox* spp.).

The saltbush type is characterized by Gardner saltbush, big sagebrush, Douglas rabbitbrush, birdfood sage (*Artemisia pedafida*), thickspike wheatgrass, Indian ricegrass, Sandberg bluegrass (*Poa secunda*), lambsquarter goosefood (*Chenopodium album*), and stickseed (*Lapula redowskii*).

The rabbitbrush type is typified by Douglas rabbitbrush, rubber rabbitbrush (*Chrysothamnus nauseosus*), Indian ricegrass, needlegrass (*Stipa* spp.), and scurfpea (*Psoralea* spp.). Greasewood (*Sarcobatus* sp.) types are also scattered throughout the study area but none were encountered in the sampling area.

The botanical compositions of diets were determined by a standard microscopic analysis (Sparks and Malechek 1968) of composite samples of fecal material from wild horses, cattle, elk, sheep, and pronghorns. Fecal samples for the five herbivores were collected randomly during the four seasons. Sample areas varied from 10 to 20 ha. A subsample of fresh feces weighing about 2 g was taken from each defecation of horses, cattle, sheep, antelope, and elk. A minimum of 20 subsamples constituted the seasonal composite. Anthony and Smith (1974) reported that 15 composited subsamples

were adequate to describe the seasonal deer diet in Arizona.

Forage categories can be identified in fecal samples by microscopic analysis of the epidermis and cuticle of plants (Storr 1961; Williams 1969). Microscopic identification of plant fragments in mixtures of species occurring on the study area substantiated composition of fecal samples. Twenty fields were examined on each of 20 slides per sample. Anthony and Smith (1974) and Todd and Hansen (1973) found that quantifications of deer and bighorn sheep diets by microscopic analysis of feces were similar to results from rumen samples. Dearden et al. (1975) reported that discerned fragments in digested and simulated digested residues were not greatly different for reindeer (*Rangifer* sp.), cattle, and bison (*Bison bison*).

Similarity of diets was calculated using Kulczynski's formula (Oosting 1956). The similarity index represented the percentage of two diets that was identical. Hansen et al. (1973) reported that the estimated degree of dietary overlap is approximately the same for microhistological examinations of fecal samples and diet samples from cattle, bison, and sheep.

Common statistical procedures were used to test diet differences within seasons and among species of herbivores. Diets were also compared by the Spearman's rank-order correlation of category percentages in two diets (Snedecor and Cochran 1973).

Unless otherwise noted, means and standard deviations are shown in the text and tables. Statistical differences were accepted at the 5% level of significance. Common and scientific names of plants follow those of Beetle (1970).

Results

Average seasonal diet overlaps were highest between wild horses, cattle, and elk and were lowest for diets of these three herbivores compared to antelope (Tables 1, 2). Domestic sheep diets were most similar to diets of cattle and least similar to those of antelope. There was considerable variation for diet overlaps between seasons and species of herbivores, suggesting that the herbivore species select foods in an independent manner.

Wheatgrass and needlegrass each constituted 11 to 46% of the average annual diets of all herbivores except antelope (Table 3). Wild horse and cattle diets contained higher percentages of grasses and sedges than occurred in the diets of the other animals. Sagebrush provided over 95% of the antelope's diet in winter and spring and 77% in fall but only 42% in the summer. Saltbush was consumed by each species of herbivore and was the major food of domestic sheep each season except in the summer, when it made up less than 1% of their diet. The fall diets of antelope contained 18% saltbush. Saltbush was seasonally important in cattle diets (fall = 16%, winter = 10%, spring = 9%) and elk diets in spring (11%).

The correlation coefficients between the ranked order of percentages of plants in the average annual diets were positively

Table 1. The percentage season diet overlaps for five ungulates on the Red Desert of Wyoming during 1974 and 1975.

Comparisons	Summer	Fall	Winter	Spring
Wild horses and				
Cattle	61	69	21	28
Elk	14	70	52	26
Sheep	21	31	40	15
Antelope	4	10	<1	<1
Cattle and				
Elk	16	53	62	89
Sheep	35	41	46	19
Antelope	6	20	2	3
Elk and				
Sheep	18	24	53	26
Antelope	10	10	3	9
Antelope and				
Sheep	12	21	8	8

Table 2. The average and standard deviation for seasonal dietary overlap for foods of ungulates and Spearman's rank correlation coefficients with the corresponding confidence values in the Red Desert, Wyoming, 1974 and 1975.

Relationship	3Percentage similarity	Spearman's ¹ RHO values	P values
Horses and elk	40 ± 25	+ 0.36	.040
Horses and cattle	45 ± 25	+ 0.64	.001
Horses and sheep	27 ± 11	+ 0.42	.037
Horses and antelope	4 ± 4	- 0.13	.274
Elk and cattle	55 ± 30	+ 0.59	.002
Elk and sheep	30 ± 15	+ 0.61	.002
Elk and antelope	8 ± 3	+ 0.32	.071
Cattle and sheep	35 ± 12	+ 0.60	.003
Cattle and antelope	8 ± 8	- 0.16	.236
Sheep and antelope	21 ± 15	+ 0.21	.159

¹Significantly similar diets will have positive correlation coefficients.

correlated for all herbivore combinations except wild horses vs antelope and cattle vs antelope (Table 2). Significant correlation coefficients occurred in the ranked order for foods selected by all herbivore combinations except for wild horses vs antelope, elk vs antelope, cattle vs antelope, and sheep vs antelope.

Discussion

Efficient biological production could best be obtained through the multiple use of herbivores with contrasting food habits and dietary needs. Although herbage production is relatively low in the Red Desert, the diversity of the resident large herbivores is great enough to stock the range for proper and uniform use of certain range plants.

The optimum diet for all of the herbivores is an abundant supply of plant tissues containing a high proportion of protein and a low proportion of nondigestible fiber. Antelope diet diversity was the highest in summer, when it selected a variety of young growing tissues having thin cell walls and abundant cytoplasm. When certain plants (in summer diets) matured and the cell walls thickened, the diet of the antelope changed to primarily the leaves of sagebrush and saltbush, which had relatively thin walls. The diets of domestic sheep suggested that they shifted their diets more than did the larger-bodied herbi-

vores to optimize for low concentrations of fiber and high protein per unit of food ingested.

Wild horses, cattle, and elk appeared to be more tolerant of feeding on the same plants in different seasons than were antelope or sheep. The problem of extracting protein and energy from plant cells with thick walls may not be as important for the large herbivore species as it is for the small herbivore. The basic intake and digestive strategy of the wild horse and cattle permit them to maintain more similar diets from season to season than the other species.

The cattle feeding strategy is more selective for digestible tissue than is that of wild horses. The wild horse may consume foods high in fiber because they are less limited on the rate of passage of large food fragments through the gut. Cattle, being ruminants, must regurgitate and repeat the cycle of chewing until the particles are small enough to be passed in rumen liquor into the diverticulum. Bell (1971) reported that the material passes twice as fast through the gut of a horse as it does through the gut of the cow.

The relative maintenance requirement is higher for a small herbivore than for a large one, but the reverse is observed for the absolute maintenance requirement. Based on average body size and intake rates, a pronghorn may consume daily about 7% of the amount of food that a wild horse would require. If we assume that the antelope is more selective than the horse in obtaining a more digestible diet, the antelope can use more energy in searching for food in a day than can a wild horse. The characteristic differences in diets suggest that the five ungulates studied on the Red Desert may be stimulated physiologically to seek certain tissues of range plants. Changes in the availability of certain species of plants due to a combined preference by these herbivores might cause certain species to be reduced or eliminated.

Sagebrush, greasewood, and other abundant plants might be utilized or controlled to increase the efficiency of biological production on the Red Desert. If the resource manager desired to use large herbivores to increase utilization of sagebrushes, this could be done by increasing the abundance of pronghorns and mule deer which feed extensively on certain sagebrushes. Wild horses, cattle, elk, and domestic sheep could be stocked to

Table 3. Annual average percentage of major plants in the diets of large ungulates on the Red Desert of Wyoming during 1974 and 1974.

Category of food	Horses	Elk	Cattle	Sheep	Antelope
Wheatgrass (<i>Agropyron</i> spp.)	37	46	54	14	<1
Needlegrass (<i>Stipa</i> spp.)	36	14	11	22	1
Sagebrush (<i>Artemisia</i> spp.)	<1	3	1	3	78
Antelope bitterbrush (<i>Purshia tridentata</i>)		22	<1	1	1
Saltbush (<i>Atriplex</i> spp.)	2	4	9	47	6
Indian ricegrass (<i>Oryzopsis hymenoides</i>)	10	2	9	1	<1
Sedges (<i>Carex</i> spp.)	5	1	4	1	<1
Common winterfat (<i>Eurotia lanata</i>)	3	1	5	2	<1
Russianthistle (<i>Salsola kali</i>)	<1	<1		<1	5
Black greasewood (<i>Sarcobatus vermiculatus</i>)	<1	<1		5	1
Brome (<i>Bromus</i> spp.)	2	1	1	1	<1
Vetches (<i>Astragalus</i> and <i>Oxytropis</i>)		1	<1		2
Elaeagnus (<i>Elaeagnus commutata</i>)		<1			2
Sixweekgrass (<i>Vulpia</i> spp.)	<1	<1	2	1	
Snowberry (<i>Symphoricarpos</i> spp.)	1		<1	<1	
Bluegrass (<i>Poa</i> spp.)	1	1	1	1	<1
Dropsseed (<i>Sporobolus</i> spp.)	<1	<1		<1	
Bladderpod (<i>Lesquerella</i> spp.)		<1	<1		
Rubber rabbitbrush (<i>Chrysothamnus nauseosus</i>)	1	<1	<1	<1	1
Rose (<i>Rosa</i> spp.)		1			<1
Globemallow (<i>Sphaeralcea</i> spp.)	1			<1	
Cryptantha (<i>Cryptantha</i> spp.)		<1	1		<1
Inland saltgrass (<i>Distichlis stricta</i>)	<1	<1	1	<1	

provide uniform and sustained use of all the grasses and forbs. It is unlikely that deer and pronghorns would seriously reduce the food supply for wild horses, cattle, and elk but additional research is needed to determine the best stocking rates by season of use.

It is not possible to generalize relative to the effect of herbivores on plant diversity and production on the Red Desert. Herbivores can impart diversity to ecosystems by affecting both habitat and plant populations. Antelope, which specialize in one or a few food plants, could particularly affect vegetation diversity should their abundance become excessive. Under the special conditions of the Red Desert, wild horses and cattle might suppress the abundance of wheatgrass, needlegrass, and ricegrass. These grasses contribute only a minor share to the estimated primary production of the study area. Since domestic sheep appear to be a "broad-spectrum" grazer, which feeds on certain palatable dominants, their effects on diversity and herbage production may depend on the timing of feeding controlled by management. Some of the dominant plants are not generally palatable to each herbivore species although they may be nutritiously adequate for each of the herbivores.

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Election Results

The 1,830 ballots cast in the 1976 election were counted on December 2. Selected by the membership to serve the Society during the next 3 years were:

President Elect **Robert M. Williamson**
Directors **John L. Artz**
John Bohning

The new officers will be installed at the forthcoming Annual Meeting in Portland, at which time Dr. Thadis W. Box, the current president elect, will succeed to the presidency. Bob Williamson will serve as president in 1978, and the two newly elected directors will serve for the 3-year term 1977-1979.

Retiring next month from the Board of Directors are Past President Dillard H. Gates, and Directors Richard E. Eckert, Jr., and Carlton H. Herbel. The very significant service rendered to the Society by these men is greatly appreciated.

Bob Williamson is at present forest supervisor, Gila National Forest.

John Artz is extension range specialist and associate professor, University of Nevada Reno. John Bohning is range and wildlife staff officer for Prescott National Forest.

A committee of members of the Colorado Section counted the ballots. Ballots and tally sheets are kept on file in the Society office for 1 year.