Winter Foods of Mule Deer in Piceance Basin, Colorado

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Highlight: *Fecal samples were examined to estimate the foods of mule deer on winter range in the Piceance Creek Basin in northwestern Colorado. The deer were assumed to be under extreme hardship because of the cold temperatures, the amounts and duration of snow on the ground, and a winter die-off. Pinyon pine and Utah juniper comprised 83% of the total foods eaten between December and March. Big sagebrush, antelope bitterbrush, and Utah serviceberry contributed about 13%. Ten other species of plants occurred in small quantities.*

The winter diet of mule deer (*Odocoileus hemionus*) under stress in the Piceance Basin of western Colorado was estimated by collecting fecal pellets and identifying the plant fragments within them. It has been reported that all the species of plants ingested by herbivores can be found by a microhistological examination of the fecal residues (Hercus, 1960; Ward, 1970; Todd and Hansen, 1973; and Dunnet et al., 1973) and we assume the plants found in the feces of mule deer in this study adequately describe the diets.

Winter is the most critical time of year for deer in the Piceance Basin as forage quality and abundance are at their lowest levels. Deer die-offs of considerable magnitude occur during severe winters. Malnutrition is presumed to be the predominant cause of death, however, only limited information is available on the diet of physiologically stressed deer during a severe winter. Kufeld et al. (1973) report winter diets of mule deer in the Rocky Mountain area to be quite variable.

Study Area

Deer winter range in the Piceance Basin encompasses about 1,744 km. The terrain is diverse, varying from rugged badlands, abrupt cliffs, and sharp ridges to broad open valleys, upland parks, small basins, and low to moderately rounded hills with most lying between 1829 and 2286 meters in elevation (Baker, 1970). Mean annual precipitation recorded at the Little Hills Game Experiment Station in the Piceance Basin Averages 33 cm.

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Coniferous tree overstory dominates on about two-thirds of the winter range, consisting of nearly equal proportions of pinyon pine (*Pinus edulis*) and Utah juniper (*Juniperus osteosperma*) with a small amount of Rocky Mountain juniper (*J. scopulorum*). The abundant and varied browse understory (Baker, 1970) includes big sagebrush (*Artemisia tridentata*), black sagebrush (*A. nova*), true mountainmahogany (*Cercocarpus montanus*), Utah serviceberry (*Amelanchier utahensis*), antelope bitterbrush (*Purshia tridentata*), snowberry (*Symphoricarpos tetonensis*), Gambel oak (*Quercus gambelii*), rabbitbrushes (*Chrysothamnus viscidiflorus, C. nauseosus,* and *C. depressus*), black greasewood (*Sarcobatus vermiculatus*), common winterfat (*Eurotia lanata*), and shadscale saltbush (*Atriplex confertifolia*) occur on the study areas. Grasses and one sedge common on deer winter range are Indian ricegrass (*Oryzopsis hymenoides*), beardless bluebunch wheatgrass (*Agropyron inerme*), fairway crested wheatgrass (*A. cristatum*), needleandthread (*Stipa comata*), cheatgrass brome (*Bromus tectorum*), Sandberg bluegrass (*Poa secunda*), giant wildrye (*Elymus cinereus*), blue grama (*Bouteloua gracilis*), prairie Junegrass (*Koeleria cristata*), and sedge (*Carex* sp). A variety of forbs is present, but no one species is both widespread and abundant.

Fecal pellets are collected from two approximately 100 km^2 noncontiguous areas. One study area was a pinyon-juniper-mixed browse type (Fig. 1) with an understory containing big sagebrush, true mountainmahogany, Utah serviceberry, snowberry, rabbitbrushes, antelope bitterbrush,

Fig. 1. *Appearance of conditions in January on mule deer winter range for the pinyon-juniper-browse type.*

and Gambel oak. The other area was a pinyon-juniper-sagebrush type. Big sagebrush and lesser amounts of black sagebrush dominated the understory and open parklands.

The 1972-73 winter was probably the coldest on record at Little Hills. The December mean temperature was -9°C, the lowest recorded for that month. The January and February means of -11°C and -7°C were the second lowest recorded for these months. The 8.4 cm of precipitation received during the same 3 month period was about 30% above average. Most snow fell in December and reached maximum 53 cm near the end of the month. Snow depths were generally less on south slopes and greater on north slopes and higher elevations, where accumulations reached 76 cm or more. Little snow fell after mid-January, but low temperatures prevailed and 38 cm of snow was still on the ground at Little Hills in late February. Low temperatures minimized snow crusting, which was nearly nonexistent until early February. After that, crusting was still not severe and was limited to south exposures.

Deer density was about 17 deer per km^2 on the entire Piceance winter range in December 1972 (Bartmann, 1974a), but densities varied among sites as winter progressed. The amount of winter range occupied by deer decreased as the snow accumulated. The estimate of winter mortality was nearly 7 dead deer per km^2, or about 40% of the December population (Bartmann, 1974b).

Methods and Procedure

Plant parts consumed by deer were identified by a microhistological examination of fecal samples obtained in early and late December, 1972, and in mid-January and mid-March, 1973. Collections were made after recent snowfalls to insure pellet freshness. Pellet groups were sampled at approximate one-half mile intervals. No more than five groups were sampled at any one site. One fecal pellet per group was saved and from 100 to 160 pellets were composited for analysis for each study area on each sampling date.

Microscope slides of fecal sample material were prepared as described by Sparks and Malechek (1968), Ward (1970), and Flinders and Hansen (1972). Microscope fields were systematically located on each slide and viewed at 100X. Twenty fields were examined on each of 20 slides that were prepared for each sample. The number of identifiable fragments per field varied from one to five and averaged about three. The relative percent density of recognized plant fragments in each sample was estimated according to procedures described by Sparks and Malechek (1968) and Flinders and Hansen (1972).

By use of practice slides a technician was trained to identify and quantify plant fragments. Each fragment in a sample was identified if its observed characteristics matched the leaf, stem, flower, seed, or other plant part of the same material on a reference slide.

Thirteen mixtures containing different proportions of the most important browse species were hand compounded to simulate the relative proportions they might comprise in winter deer diets. The plant materials consisted of the aboveground parts presumed fed upon by deer. These mixtures were used to get correction factors for over or underestimation of dry weight by the lab technician using the microhistological technique.

The relationship between the estimated percentage dry weight (X) and actual percentage dry weight (Y) was compared for each species in the hand-compounded mixtures, using regression equations which fit a straight line through the origin. These equations provided correction factors which were used to estimate the percentage that each food comprised in the winter diets of deer, when determined by a microhistological examination of fecal samples. This procedure has been shown to improve the accuracy for estimating dry weight percentages using the microhistological technique (Dearden et al., 1974).

Results

Fifteen plants were identified as eaten by mule deer during winter, but only five occurred in all sampling periods. Pinyon pine, Utah juniper, big sagebrush, Utah serviceberry and antelope bitterbrush made up 96% of the deer foods in the sagebrush type and 98% in the mixed browse type (Table 1).

Trees were the most abundant winter deer foods. Pinyon pine comprised 47% of the diet in the sagebrush type and 61% in the mixed browse type. Utah juniper averaged 39 and 20% in the same types.

Big sagebrush was the third most important food. It made up 7% in the sagebrush and 8% in the mixed browse type. Grasses, grasslikes, and forbs were estimated in only small percentages.

In early December 1971, we collected at random sites about 100 deer pellet groups from the same mixed browse area described for the present work. Microhistological analysis

Table 1. Percentages of plant fragments in mule deer feces from the Piceance Creek drainage in northwest Colorado, winter 1972-73.

	Vegetation types							
	Pinyon-juniper-sagebrush				Pinyon-juniper-browse			
Plant names	1 Dec. 1972	Late Dec. 1972	Jan. 1973	Mar. 1973	1 Dec. 1972	Late Dec. 1972	Jan. 1973	Mar. 1973
Pinyon (*Pinus edulis*)	39	44	56	47	33	70	70	70
Juniper (*Juniperus osteosperma*)[1]	43	43	27	41	18	20	22	17
Big sagebrush (*Artemisia tridentata*)[2]	9	6	10	4	21	4	3	5
Antelope bitterbrush (*Purshia tridentata*)	2	2	1	3	3	<1	1	1
Utah serviceberry (*Amelanchier utahensis*)	3	3	<1	2	17	4	4	6
Wheatgrass (*Agropyron*)	1		5		<1			
Sedges (*Carex*)	1	1		1	<1			
Tansymustard (*Descurainia*)	1			1				
Alfalfa (*Medicago sativa*)		1		<1	3	1	<1	<1
Fringed sagewort (*Artemisia frigida*)	<1			<1				
Mountainmahogany (*Cercocarpus montanus*)		<1		<1	2		<1	
Gambel oak (*Quercus gambelii*)	<1	<1		<1	<1	1	<1	<1
Needleandthread (*Stipa comata*)				<1	1			
Unknown sp. (Compositae)		<1			1		<1	
Bladderpod (*Lesquerella montana*)		<1						

[1] May include a small amount of *J. scopulorum*.
[2] May include some *A. nova*.

identified seven browse species with sagebrush accounting for 50%, pinyon 34%, mountainmahogany 12%, and juniper 2% of the relative density of identified plant fragments. Snow depths in 1971 and 1972 were similar in late November and early December, and temperatures averaged only slightly warmer in 1971 than in 1972.

Linear regression tests revealed that the percentage of each species in the 1972-73 samples was closely correlated between study areas. The percentage of each food item was also similar in each vegetation type ($P > .05$) with the exception of Utah juniper, which had a significantly higher percentage in the pinyon-juniper-sagebrush type.

Changes in the percentage of the major foods through the four sampling periods showed little in the way of trends. The early December sample from the mixed browse type generally had less pinyon and juniper but more sagebrush and serviceberry than in later samples. This might be associated with the milder weather conditions that existed during December, but a similar change was not evident in the sagebrush type.

Discussion

Most authors have reported that mule deer eat little or no pinyon and only modest amounts of junipers (Smith, 1952; Julander, 1955; and Leach, 1956). Kufeld et al. (1973) lists several unpublished reports which indicated that throughout the West pinyons and junipers are used from lightly to heavily during certain winters (December, January, February). Richens (1967) reported Utah juniper and pinyon pine as unpalatable to mule deer on his study area in Utah. His survey showed considerable natural reproduction of pinyon and juniper as opposed to little for the "palatable" species. He surmised the advance of pinyon and juniper was at the expense of choice forage plants such as sagebrush, bitterbrush, and mahogany.

In our study, pinyon and juniper comprised about four-fifths of the mule deer foods on winter range. The implied importance of the two species in the deer's winter diet is partially supported by previous food habits information from the area (Carhart, 1941; Bartmann and McKean, 1969).

Hansen and Reid (1975) found pinyon averaged 24% (by a microhistological analysis) in mule deer feces from near Fort Garland in south central Colorado from December, 1970, to March, 1971. Snow depth only reached about 15 cm in February, and the mean temperature was about -8°C in January, -5°C in December and February, and -3°C in March on this winter range.

Reasons for the high percentages of pinyon and juniper in winter diets of deer are open to conjecture. We suggest that there may be a relationship between extremely cold winter temperatures and high percentages of pinyon and juniper. Mean temperatures and snow may alter the relative palatability of some species. Smith and Hubbard (1954) mentioned a possible relationship between low temperatures and lowered sagebrush consumption in their deer feeding trials. Leach (1956) pointed out that the more severe the winter the more juniper became an important deer food on some California ranges.

To estimate the value of pinyon and juniper as mule deer winter foods, one needs to know the amounts eaten per deer per day and the digestibilities of them. Although the diets may have been primarily pinyon and juniper, if the digestibilities and intake rates were low, these trees should not be considered as valuable as they could be if deer intake rates were higher. Studies on food intake rates of deer should be conducted to evaluate the apparent importance of pinyon and juniper to wintering mule deer.

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