Winter Diets of Elk and Deer in the Blue Mountains, Oregon

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Reference Abstract

Skovlin, Jon, and Martin Vavra. 1979. Winter diets of elk and deer in the Blue Mountains, Oregon. USDA For. Serv. Res. Pap. PNW-260, 21 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

From an analysis of fecal pellets, diets of elk and deer were compared during early and late winter of 1973-74 to determine the level of competition. Forage competition between elk and deer was not great even though winter conditions were harsher than normal on the five dual-use winter ranges studied. Shrubs were not as important here as in other winter range areas of the West. Idaho fescue was the single most important item in their diets.

KEYWORDS: Food habits (wildlife), range management, cervidae, Blue Mountains (Oregon), forage management.

RESEARCH SUMMARY

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Dietary contents of pellet droppings from elk and deer were analyzed from collections on five winter-range units throughout the Blue Mountains during early and late winter of 1973-74. Botanical intake was identified by species to establish levels of elk and deer competition for food. Elk consumption of grasses during early and late winter was slightly over one-half and three-quarters of their total intake, and deer use of grass early and late was about one-third and one-half of their intake. Forb use by both elk and deer was insignificant. Elk diets contained less than 25 percent shrubs. Shrubs are apparently not as important to elk and deer in the Blue Mountains as they are on other winter ranges of the mountain west. Conifer use by deer, especially, was high on two winter range units when snow was in excess of 1 foot and temperatures near zero. Idaho fescue was the most often selected species by both animals. Competition for available forage species was not acute under the moderately severe winter conditions that prevailed.

CONTENTS

The northern Blue Mountains of Oregon and Washington provide year-round forage supplies for one of the most densely populated elk herds in North America; they also support a substantial population of mule deer.

Wildlife biologists and habitat managers have long recognized the probability of competition between Rocky Mountain elk (*Cervus canadensis nelsoni*) and Rocky Mountain mule deer (*Odocoileus hemionus hemionus*) for forage on winter ranges in the Blue Mountains (Cliff 1939, Buechner 1952). Elk, because of their greater size, mobility, and foraging capability, have an advantage over deer when wintering conditions become severe. The extent of competition between elk and deer for local plant species, however, is not known.

Summer ranges, though obligated for livestock grazing, do not usually present competition problems among big game animals nor between big game and livestock (Edgerton and Smith 1971, Miller 1974, Skovlin et al. 1976), except in isolated situations (Pickford and Reid 1943). Summer ranges are mainly public land, whereas most winter ranges are private land. Although not a subject of this investigation, summer or fall grazing of foothill range by cattle prior to winter use by elk and deer may create local winter food shortages under situations of poor management.

Certain areas in winter or summer in northeastern Oregon may be better suited to the production of deer than of elk because of habitat or forage conditions. Larger numbers of elk on some common-use big-game ranges may jeopardize survival of deer in hard winters. Until recently, no effective method of separating the forage preference of elk from that of deer has been feasible. Analysis of rumen contents is possible but costly in terms of laboratory analysis and animals sacrificed, and it has not been accomplished.

Recent developments in microscopic analysis of fecal material through the use of epidermal plant keys--a relatively inexpensive, suitable method--has made comparisons of diets possible (Ward 1970). Preference ratings derived from this technique are valid for comparing the relative ranking of plant species selected. Absolute values in terms of quantity, however, may vary somewhat by season, plant succulence, or major plant groups; i.e., grasses, forbs, or browse.

The objectives of this study were to (1) determine winter diets of deer and elk, (2) establish whether or not competition for forage on winter range existed between elk and deer, and (3) if it exists, quantify the extent of diet overlap between animal species.

LITERATURE REVIEW

Competition for forage between animal species occurs when two or more species prefer the same food items and the supply or area is limited. Several reviews of the literature have listed the numerous studies reporting on food habits of elk and deer (Capp 1968, Kirsch and Greer 1968, Kufeld 1973, Kufeld et al. 1973). Only a few studies, however, have attempted to identify competition on common-use winter range over a broad regional area, such as the Blue Mountains.

Working on the North Fork of the John Day River in the southern Blue Mountains, Cliff (1939) suggested that "feeding habits of mule deer and elk are quite similar in this region." He also observed that deer have a tenacious instinct to use customary feeding areas in winter but elk would seek out new areas of available forage in hard winters. Early studies of winter range in nearby Idaho also warned that increasing elk numbers presented a threat to resident deer populations (Case 1938).

Based on 3 years of data from analysis of stomach contents of elk and deer in Idaho and western Montana, DeNio (1938) showed that elk preferred winter diets consisting mainly of grasses but that mule deer preferred mainly shrubs and conifers. Availability of preferred species has been shown to influence the composition of elk and deer diets (Morris and Schwartz 1957). Cowan (1947) concluded from studies of feeding time on plants in Jasper National Park, Alberta, that elk were forcing mule deer to shift their winter diets from preferred browse to grass.

Studies of different densities of elk and deer on Blue Mountain winter range in southeastern Washington showed that high elk concentrations could inhibit recovery of the range but that competition for the principal bunchgrass species was probably not severe (Buechner 1952).

Studies of reproduction of both elk and deer have pointed out the several physiological responses that reduce densities of herds when shortages in the food supply become chronic (Buechner and Swanson 1955, Klein 1970, Robinette et al. 1977).

STUDY AREA

The physiographic province of the Blue Mountains of eastern Oregon and Washington is the second largest in the two-State area; the largest is the Columbia Basin which joins the mountain foothills on the north and west. It is at this interface that critical winter range exists (fig. 1). Within the mountains, however, are large, block-faulted valleys, the foothills of which also provide winter forage for more localized herds of elk and deer. Maximum migration of elk from the Columbia Basin winter range at 2,000 feet (600 m) elevation to high summer range at 8,000 feet (2 500 m) elevation is about 40 miles (65 km). Interior migrations are over elevation changes of 2,000 to 3,000 feet (600-900 m) and distances of 5 to 10 miles (8 to 16 km). Specific study sites shown in figure 1 are listed in table 1.

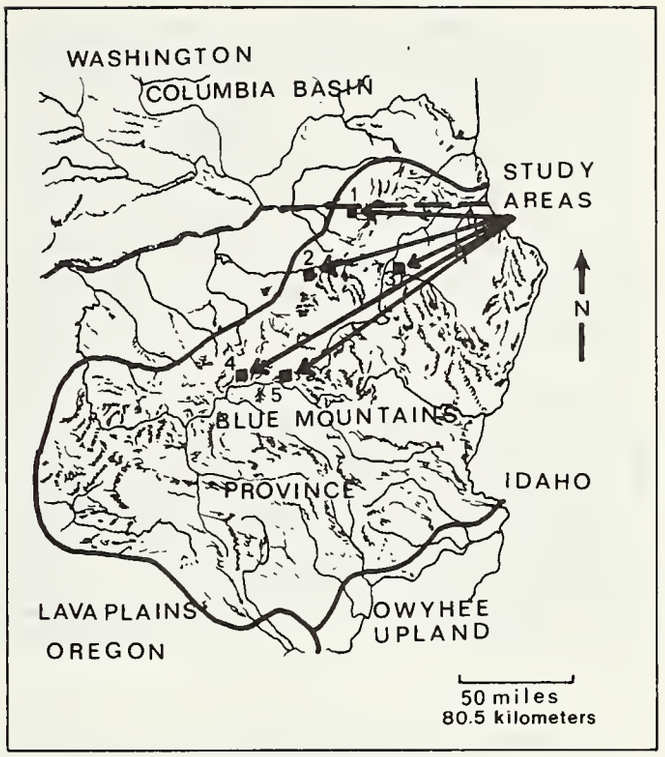

Figure 1.—A physiographic map of the Blue Mountains shows the five locations of elk and deer winter range where early and late diet sampling was studied (study area numbers correspond to those in tables 1 and 3-5).

Table 1--Winter range study areas within Blue Mountain management units where elk and deer competition for forage was most likely acute

Study area	River basin	Sample site	Location[1/]	Mean elevation	
				Feet	Meters
1. Walla Walla	Walla Walla	Flume Canyon	T. 5 N., R. 37 E.	2,000	610
2. Umatilla	Umatilla	Meacham Creek	T. 2 N., R. 36 E.	2,000	610
3. Minam	Grande Ronde	Wallowa River	T. 2 N., R. 41 E.	2,500	762
4. Heppner	John Day	Ditch Creek	T. 7 S., R. 28 E.	3,500	1 067
5. Ukiah	John Day	Bridge Creek	T. 6 S., R. 31 E.	3,500	1 067

[1/] Based on the Willamette meridian.

Figure 2.—An aerial photo of the Umatilla winter-range sampling area (area 2 in fig. 1 and table 1) illustrates typical canyon relief and shows the intermingled arrangement of forest and grassland communities.

The Blue Mountains consist of a large, arched syncline, uplifted from basalts of the Columbia Basin floor. At foothill elevations over about 3,000 feet (900 m) winter-range areas consist of north slopes covered with mixed pine-fir forest and south slopes with open bunchgrass and scattered pine (fig. 2).

Grassland soils range from the lower prairie type chernozems of the Palouse formation to the shallow basalt lithosols of the intermingled upland forest openings. Forest soils are predominantly western brown forest soils with inclusions of wind-transported pumicite from earlier volcanism in the Cascade Range.

Climate is influenced mostly by marine airmasses from the Pacific Ocean which furnishes precipitation having a winter high and a summer low. Along lower foothills and mountain valleys, precipitation is mainly rainfall in amounts of 10 to 15 inches (25-38 cm), with a spring peak in May. Fall rains initiate regrowth of grassland forage in about 3 out of 4 years. In the mountains, precipitation ranges between 20 and 40 inches (51-102 cm) and is largely in the form of snow that accumulates beginning in November.

In late fall, deer precede elk from the mountains to these winter ranges. Elk remain on the summer range into December, and it is often January before snow depth drives them down onto foothill winter range. Depending on spring "breakup" and initial growth of forage, elk begin migrating from winter range between mid-March and early April. Deer may linger longer, but both species are usually off winter range by late April. Normally, Blue Mountain winter ranges provide between 3 and 4 months of concentrated use by big game.

Winter forage is derived from a variety of habitats. These are broadly characterized by the foothill grassland and ponderosa pine[1] savannah types with inclusions of Douglas-fir on the moist, north slopes. Cheatgrass is a common invader in all grassland associations. In abundance, it is largely an indicator of poor range condition caused from past heavy grazing by livestock (Griffiths 1902). Range fires, more common in the past, are still a feature of community development.

Foothill grasslands consist mainly of three associations, (1) the bluebunch wheatgrass/Sandberg bluegrass, (2) bluebunch wheatgrass/Idaho fescue, and (3) Idaho fescue/snowberry (Daubenmire 1970). Herbaceous species common to all study areas were: bearded bluebunch wheatgrass, cheatgrass, Idaho fescue, onespike danthonia, prairie junegrass, and Sandberg bluegrass. Forbs included balsam root, erigeron (fleabane), lomatium (biscuitroot), lupine, onion, rushpussytoes, stoneseed, and western yarrow. Shrubs included buckwheat (Wyeth eriogonum), chokecherry, rabbitbrush, rose, sagebrush, and snowberry.

Forest communities associated with these winter ranges include the (1) ponderosa pine/bluebunch wheatgrass, (2) ponderosa pine/Idaho fescue, (3) ponderosa pine/snowberry, and (4) ponderosa pine/ninebark (Daubenmire and Daubenmire 1968); components of the Douglas-fir/snowberry and Douglas-fir/pinegrass associations also exist in small amounts. In addition to many of the above grassland species, forest type herbaceous species included: cheatgrass, elk sedge, hawkweed, heartleaf arnica, letterman needlegrass, northwest sedge, pinegrass, rose pussytoes, Ross sedge, strawberry, western fescue, and western needlegrass. Common shrubs of the forest were: chokecherry, creambush rockspirea, oceanspray, Oregon grape, and ninebark. Trees included: Douglas-fir, ponderosa pine, and western juniper.

The salient feature of winter range in and surrounding the Blue Mountains is that the classical type shrub communities often associated with other big-game winter range throughout the Rocky Mountains and intermountain west are absent.

METHODS

In consultation with the Oregon Department of Fish and Wildlife, Northeast Region, 5 winter range units of a possible 25 were selected to represent ranges having the highest probability for competition between deer and elk (fig. 1). Biologists managing wildlife on these areas were given material and sampling instructions for early and late winter collections of fecal pellets. Early sampling was done during the inventory of herd composition in December of 1973; the late season collection was from the same sampling sites but during March and April of 1974 when population trends were determined.

[1]Scientific plant names are listed in the appendix.

Field biologists gathered the freshest possible fecal pellet groups for each collection. Four groups each for elk and deer were collected from the five areas during early and late season for laboratory analysis. Samples were kept frozen from the time of collection until they were analyzed.

Analysis followed the technique of Sparks and Malechek (1968). Some modification in preparation of samples made material placed on microscope slides more color free. Pellets were put in a blender with ethanol and blended at low speed for 1 minute to homogenize the sample. The resulting solution was allowed to soak for 24 hours, and the ethanol was poured off. Fecal material was then dried in a forced air oven. When completely dry, the material was ground through an intermediate Wiley mill fitted with a 1-mm screen.[2] After the samples were ground, they were soaked in water for 3 hours and put in a blender for 2 minutes at high speed. Samples were poured from the blender through a 200-mesh screen and washed in water to remove fine material. Three microscope slides were prepared from the washed material. Twenty fields on each of the three slides were the basis for observation.

A factorial analysis of variance was applied to specific constituents making up most of the diets. Data were pooled in two ways. A two-factor analysis was run so that species and seasons within areas could be compared. A three-factor run considered areas, seasons, and species. Results from the Walla Walla study area did not fit the data set and were deleted from this analysis. Unique features of this area were the unusually high amounts of pinegrass, sagebrush, and Douglas-fir that were not common or present in the other four areas.

Kulcyznski's formula found in Oosting (1956) was used to compare deer and elk diets for degree of overlap. Hansen and Reid (1975) applied the formula to analysis of food habits.

To aid interpretation of the data, we examined weather records from three local stations[3] to correlate possible storm periods with the dates of field inventory.

RESULTS

The weather records showed that conditions during the 1973-74 sampling periods were somewhat more severe than those of the previous 10-year period (fig. 3). December 1973, the month of early sampling, had temperatures 6°F (2.9°C) below the monthly December mean for the previous decade. March, the month of late sampling, had near normal temperatures. Precipitation

[2]Mention of products by name is for the information and convenience of the reader and does not constitute an official endorsement by the U.S. Department of Agriculture to the exclusion of other suitable products.

[3]Official weather stations were Meacham, Minam, and Ukiah, Oregon; each located within several miles of the Umatilla, Minam, and Ukiah study areas, respectively (see fig. 1 and table 1).

(primarily snow) for these two periods was approximately 150 and 110 percent, respectively, of the 10-year average.

Three-Factor Analysis

By the three-factor analysis, we compared differences in selection of plant species (1) among areas and (2) between elk and deer for (3) early or late seasons. Differences for the three-factor analysis of variance are shown in table 2.

Elk consumed more bluebunch wheatgrass ($P<0.05$) than did deer. Also, slightly more of this grass ($P<0.10$) was consumed during the later period.

Use of elk sedge was sporadic and generally light over areas, seasons, and species. Only elk consumed much elk sedge and then only late in the Minam unit and early in the Heppner unit.

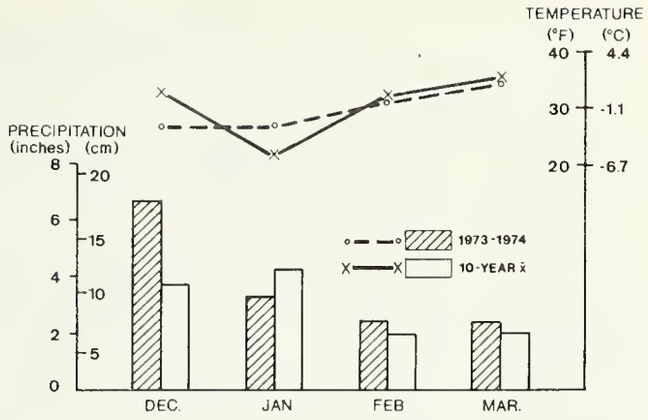

Figure 3.--A comparison of average monthly temperatures and precipitation for the winter of 1973-74 with the previous 10-year period shows weather conditions for the year of study were somewhat more harsh than those of the previous decade.

Idaho fescue was consumed more ($P<0.05$) by elk than deer. Use in the Walla Walla unit was high by both game species. Idaho fescue was the most important single species consumed by elk over all areas and seasons.

Table 2--Differences among selected diet constituents resulting from the three-factor analysis of variance as shown by F values and levels of significance[1/]

Species and groups	Study areas[2/] (1-4)	Species (elk-deer)	Season (early-late)	Interaction (species-season)
Bluebunch wheatgrass	2.155	10.585**	4.268**	1.040
Elk sedge	.838	5.830	.281	.008
Idaho fescue	1.238	5.741**	2.842	.367
Sandberg bluegrass	2.919*	3.991*	2.376	3.353*
All grasses	2.775	7.072**	8.427**	.130
All browse	3.442*	7.960**	.039	.037
Ponderosa pine	2.834*	3.007	2.584	.995

[1/] * $P<0.10$; ** $P<0.05$; *** $P<0.01$.

[2/] Data from area 5, the Walla Walla unit, were not included in this analysis because it was unique in terms of diet selection.

Table 3--Differences among selected diet constituents resulting from the 2-factor analysis of variance as shown by F values and level of significance[1/]

Study area and variable	Bluebunch wheatgrass	Elk sedge	Idaho fescue	Sandberg bluegrass	All grasses	All browse	Ponderosa pine
Walla Walla:							
Season	0.140	0.134	0.518	2.658	0.146	0.198	0.672
Species	.427	1.948	1.359	2.118	5.771**	5.311**	.687
Interaction	6.165**	.071	1.195	3.588*	1.385	.025	1.795
Umatilla:							
Season	.540	5.483**	9.686***	1.000	25.395***	.004	9.750***
Species	1.286	2.437	.018	1.000	.406	1.643	14.361***
Interaction	.224	1.243	.001	1.000	.055	1.476	19.293***
Minam:							
Season	1.031	2.068	7.198**	1.921	15.608***	2.126	47.402***
Species	.255	3.196*	5.836**	1.921	4.657*	3.122	4.037*
Interaction	.071	.581	4.274*	1.921	.220	2.442	3.585*
Heppner:							
Season	1.208	1.893	34.703***	5.644**	7.953**	4.001*	.893
Species	6.205**	3.793*	51.513**	7.537**	9.839***	53.768***	.825
Interaction	.822	1.893	32.886**	9.680***	.609	1.581	1.095
Ukiah:							
Season	.092	.702	.970	4.244**	2.424	.521	2.066
Species	2.404	1.610	37.378***	14.009***	39.780***	7.167**	16.079***
Interaction	.092	.901	.612	5.687**	.440	.378	.683

[1/] * P<0.10; ** P<0.05; *** P<0.01.

For Sandberg bluegrass, slight differences (P<0.10) were noted for area, species, and species-season interaction. In the Heppner and Ukiah units, elk consumed more Sandberg bluegrass early and deer consumed more during the later period. Sandberg bluegrass was only consumed in small quantities by deer in the Minam unit and by elk in the Umatilla unit.

In summary, elk consumed more grass (all grasses) (P<0.05) in their diet than did deer. Both game species consumed more grass (P<0.05) during the late period. Browse (all browse) consumption by deer was greater (P<0.05). Both deer and elk consumed more browse in their diets on the Heppner unit than elsewhere. Ponderosa pine consumption varied slightly among areas (P<0 10). Both deer and elk consumed large amounts of pine needles from the Minam and Umatilla units.

Two-Factor Analysis

By the two-factor analysis, we compared deer and elk diets within each area. Comparisons between animal species and seasons were tested, along with their interactions (table 3). Diet means (percent) are presented for comparison in table 4.

Table 4--Mean diet composition of selected species and forage groups by area, species, and season[1/]

Study area and species	Season	Bluebunch wheatgrass	Elk sedge	Idaho fescue	Sandberg bluegrass	All grasses	All browse	Ponderosa pine
		Percent						
Walla Walla:								
Elk	Early	13	1	21	1	90	4	3
	Late	32	2	17	30	95	2	1
Deer	Early	29	0	22	5	82	13	1
	Late	4	0	42	2	72	12	7
Umatilla:								
Elk	Early	5	1	2	0	11	1	10
	Late	13	5	47	1	71	6	22
Deer	Early	0	0	0	0	0	13	87
	Late	2	2	44	0	66	6	16
Minam:								
Elk	Early	2	7	2	0	17	1	65
	Late	4	21	22	0	61	0	25
Deer	Early	0	0	0	0	1	3	96
	Late	3	4	3	4	35	37	26
Heppner:								
Elk	Early	6	28	10	12	70	16	9
	Late	10	4	56	4	90	8	4
Deer	Early	0	0	2	7	28	66	4
	Late	1	0	2	42	49	45	4
Ukiah:								
Elk	Early	1	2	73	1	93	0	6
	Late	1	8	56	0	86	1	11
Deer	Early	0	0	6	6	51	7	32
	Late	0	0	4	23	34	11	50

[1/]Means for all grasses, all browse, and ponderosa pine should approach 100 percent; however, differences are due to other less important diet constituents.

Walla Walla Unit

Bluebunch wheatgrass was important to both elk and deer on this unit. A significant species-season interaction ($P<0.05$) for bluebunch wheatgrass was observed; elk consumption of wheatgrass came late, but deer use was early. Idaho fescue was also important, both early and late, to elk and deer. Neither elk sedge nor ponderosa pine were important constituents of the diet. Elk consumed more Sandberg bluegrass late than did deer; deer consumed more early than did elk; this species-season interaction was apparent ($P<0.10$). Early and late diets were composed of 90 and 95 percent grasses for elk; for deer, 82 and 72 percent. Pinegrass contributed heavily to both elk and deer diets on this unit. This suggests little preferred forage was available on the Walla Walla area because pinegrass is below 3-percent protein at this time of year (Skovlin 1967).

Deer consumed significantly more browse ($P<0.05$) in their diets than did elk. Sagebrush was the most common species consumed early and ninebark was the most common consumed late.

Umatilla Unit

Bluebunch wheatgrass, elk sedge, and Sandberg bluegrass were not important diet constituents in this unit. Late season elk and deer diets were, however, composed of 47 and 44 percent Idaho fescue, respectively. Considerably less fescue ($P<0.01$) was consumed by both species during the early period.

Consumption of all grasses was similar for both species. Late diets contained considerably more grass ($P<0.01$). More browse species were consumed by deer than by elk. Oregon grape made up most of the browse portion of the diets. Both deer and elk consumed 6 percent browse in their late diets. Deer used more ponderosa pine ($P<0.01$) than elk did during the early period; but during the late period its incidence in diets of both animals was similar.

Minam Unit

Both bluebunch wheatgrass and Sandberg bluegrass were minor diet constituents of deer and elk in the Minam unit. Elk diets contained slightly more elk sedge ($P<0.10$) and more Idaho fescue ($P<0.05$) than deer diets did. Both plant species were used primarily during the late period.

Grasses accounted for slightly more ($P<0.10$) of the elk diets than of the deer diets. Both deer and elk consumed considerably more grass ($P<0.01$) during the late sampling period.

Browse species were not important to elk in the Minam unit. Deer use of browse came late and was highly variable among samples collected. Of the 37 percent browse in the diet, ninebark and creambush rockspirea (ocean-spray) made up 26 and 9 percent, respectively. Elk and deer consumed 65 and 96 percent, respectively, of their early diets of ponderosa pine. During the late period, considerably less ponderosa pine (25 and 26 percent for elk and deer, respectively) ($P<0.01$) was consumed.

Heppner Unit

Bluebunch wheatgrass and elk sedge were consumed more ($P<0.05$ and P.0.10, respectively) by elk than by deer. Elk also consumed more Idaho fescue ($P<0.05$) than did deer. Elk consumed considerably more fescue ($P<0.01$) during the late season than the early season. A significant ($P<0.05$) species-season interaction existed. Sandberg bluegrass occurred more in deer diets than in elk diets ($P<0.05$). Elk used this species more early, whereas deer use occurred late ($P<0.01$).

Considerably more grasses ($P<0.01$) were found in elk diets both early and late than in deer diets. Grass consumption by both deer and elk was greater during the late period ($P<0.05$).

Deer in the Heppner unit consumed 66 and 45 percent of their early and late diets respectively, as browse. Elk consumed considerably less ($P<0.01$); but both species consumed slightly more browse ($P<0.10$) during the early period. Snowbrush ceanothus was the primary species consumed, but up to 8 percent Oregon grape was also consumed. Ponderosa pine was not a major constituent of the diets, although it was consumed by both species and during both periods.

Ukiah Unit

Neither bluebunch wheatgrass nor elk sedge were important in deer and elk diets. Idaho fescue, selected by elk over all other species, made up 73 and 56 percent of early and late elk diets, respectively. Sandberg bluegrass appeared slightly more ($P<0.10$) in deer diets, especially during the late period. A significant ($P<0.05$) species-season interaction was present. Elk diets contained more grasses ($P<0.01$).

Browse species were higher in deer diets than in elk diets ($P<0.05$); early and late deer diets, however, contained only 7 and 11 percent. Deer consumed 32 and 50 percent ponderosa pine in their early and late diets, respectively--considerably more than that consumed by elk ($P<0.01$).

DISCUSSION

Considering overall seasons and areas, elk consumed 60 percent grass; deer, considerably less--33 percent. This species-diet relationship fits the classic belief that deer do not consume much grass but browse more consistently (Gill 1976). In the Blue Mountains, however, only deer in the Heppner unit consumed much browse in their diet. With the exception of late use in the Minam unit, deer in all other units consumed less than 15 percent browse in their diets (table 4).

The foothills of the Blue Mountains are not considered browse-producing winter ranges. Unless snow cover decreases availability, grasses could apparently make up the entire diet of both deer and elk. It appears though that in most cases deer and, to a lesser extent, elk use ponderosa pine as a portion of their normal diet.

Diet Overlap

Similarity index values for study locations and sampling dates are shown in table 5. Elk and deer were found to be compatible on most winter ranges during both early and late periods. The Minam unit showed a similarity value of 0.67 for early use; however, this is a bias datum caused by unusual weather conditions during that sampling period. Ponderosa pine was the principal species influencing the high diet overlap figure.

Table 5--Similarity index values of deer and elk diets by area and season

Study area	Early	Late	Mean
Walla Walla	0.71	0.42	0.57
Umatilla	.16	.81	.49
Minam	.67	.50	.59
Heppner	.42	.15	.29
Ukiah	.27	.25	.26

Dietary overlap also occurred on the Umatilla unit during the late sampling. Elk and deer diets were similar for amounts of Idaho fescue and ponderosa pine (table 4). Both animal species were eating new growth Idaho fescue at this period. Management of this particular winter range should be geared to Idaho fescue as it is the principal forage species consumed by elk and deer in the spring. Grasses were important early to both elk and deer on the Walla Walla unit. Care should be taken to leave areas with sufficient residual grasses available after cattle have grazed on this summer range.

Plant Values

Bluebunch wheatgrass, common in both elk and deer diets, was highly important in the Walla Walla unit. With one exception, both elk and deer always consumed more wheatgrass during late season than early season. The late sampling occurred after new forage growth was available in all units. Bluebunch wheatgrass was important as green forage. Deer on the Walla Walla unit were an exception. They consumed 29 percent bluebunch wheatgrass in their diets during the early period.

Elk sedge was also found in most diet samples, but never in consistently large amounts. In deer diets, sedge never exceeded 5 percent of the intake. This species is found in association with timbered areas which are primarily on the north-facing slopes of the winter range. Late season snow cover is more persistent here, and initiation of spring growth is later. Sedge, as well as other species found in association with the north slopes, was a minor diet component because of lower availability in late season.

Idaho fescue was the most important grass in both elk and deer diets over all areas. In all areas and seasons, elk averaged 33 percent fescue in the diet; deer, 8 percent. Deer on the Umatilla and Walla Walla units, however, consumed 44 and 42 percent, respectively, of Idaho fescue in their late diets.

Sandberg bluegrass was important on some units as a component of deer diet but was only important to elk in the early period on the Walla Walla unit and to a lesser extent on the Heppner unit. Deer have been shown to prefer Sandberg bluegrass in the spring even when other species are readily available (Vavra and Sneva 1979).

Ponderosa pine constitued 39 percent of the deer diet but only 19 percent of the elk diet over all areas and seasons. The high percentages recorded for both elk and deer in the Minam and Umatilla units for the early sampling are a reflection of sampling date. An unidentified conifer made up over two-thirds of early elk diets on the Umatilla unit. Samples were collected in the other units 1 week before the Umatilla and Minam units. A severe winter storm passed through northeastern Oregon at the time of sampling in the Umatilla and Minam units. Snow depth was in excess of 1 foot and temperatures were near $0^{o}F$. Little forage was available and low temperatures caused animals to move less; ponderosa pine was available in quantity with a minimum of exposure to the weather and was therefore readily consumed.

High composition of conifers in the winter diet is not unusual for deer and is often encountered for elk. In northern Idaho and western Montana, DeNio (1938) reported 36 percent conifers in winter diets of deer and 13 percent in winter diets of elk; Morris and Schwartz (1957) found that diets of deer in January in western Montana contained 74 percent conifers; diets of elk, however, contained only trace amounts.

Winter Diet and Animal Behavior

Snow and cold weather cause a change in animal behavior and apparently an attendant shift in diet, reflecting availabiity of forage. When sampling was done during or after a storm period, consumption of conifers by both elk and deer increased, causing a lower intake primarily of grass. This was a result of lower foraging activity (energy conservation) when animals were inhabiting forested areas for thermal cover.

Based on observations of elk and deer after protracted storms, forage is first grazed on open windswept ridges and upper, south-facing slopes where it first becomes available. These habitats should be favored for winter use of elk and deer in planning strategies for allocating the forage resource among ungulates.

As pointed out earlier, elk have greater foraging ability than deer because of differences in physical characteristics related to size. They have a higher browsing reach, greater mobility to seek better forage areas--especially through deep snow--and greater strength to paw frozen or crusted snow to obtain low growing food plants.

Animal Interaction and Nutrition

The importance of grasses in the diet increased in the late sampling. Increased consumption occurred mainly because new growth was available at that time. Elk and deer consumed 77 and 46 percent grasses, respectively, in their late diets. The early samples revealed 43 and 20 percent grasses in diets of both elk and deer. Grass consumption by deer elsewhere is also usually highest during this late time of year (Dietz and Nagy 1976, Vavra and Sneva 1979.

Dietz and Nagy (1976) suggested that overconsumption of young grass in the spring may result in digestive problems that could prove fatal. Deer in this study in the spring still maintained a diet of 54 percent browse and pine to add bulk to the diet and thus prevented digestive upsets. Maintaining this balance of bulk to new growth would be more critical for deer because of their decreased ratio of rumen size to total body mass and their increased metabolic rate compared with that of elk (interpreted from Bell 1971). Dietz and Nagy (1976) also stated that, because of the relatively small rumino-reticular size in deer,consumption of vegetation high in water content would decrease dry matter volume in the rumen and prevent intake adequate for maintenance.

About relative body maintenance, Bell (1971) stated that smaller ruminants need more protein and energy per unit of body weight per day than large

animals do. Smaller animals (deer) could therefore lose weight more rapidly than larger ones (elk) during stress periods on equal but submaintenance diets. The absolute maintenance requirement is higher for the large ruminant than for the small ruminant. Therefore, the larger ruminant must consume more food per unit of body weight, but the food can be of lower quality than the smaller ruminant requires.

Deer, with this apparent need for higher quality winter forage, tend to be more selective of high quality forage than elk are, as evidenced by a significantly greater intake of shrubs; about four times more shrubs occurred in diets of deer than of elk. Deer also made twice as much spring use of Sandberg bluegrass as did elk; bluegrass is the first species to break dormancy in the spring and undoubtedly contained the highest protein content of all species sampled during the late period.

If deer and elk have the same food supply, elk can negatively influence deer populations if there are enough elk to remove the highest quality vegetation available. Under this situation, deer could not assimilate enough food daily to meet requirements. If the food on a winter range was of high quality but low in quantity, however, deer would be favored. On most western winter ranges the former situation exists. Therefore, on areas of common elk and deer use where dietary overlap occurs, increases in the elk population could conceivably decrease the deer population. On the other hand, where overlap is low, probably greater animal biomass could be sustained under use by both elk and deer than where only one species was maintained.

Management of winter ranges, then, should insure the presence of high quality forage for deer and high quantity forage for elk. Populations of elk need to be monitored closely because of their potentially severe impact on deer populations on common-use winter ranges.

SUMMARY AND CONCLUSIONS

During early and late winter on five important winter-range areas in the Blue Mountains, a study of elk and deer diets revealed that competition for forage between these two species is not normally high. The study also showed that shrubs are not as important in elk and deer diets here as on other big-game ranges throughout the intermountain west.

Weather data showed the period of study (1973-74) to be somewhat colder, with more snow than normal for the previous 10-year period.

Overall, grass made up 60 percent of the winter diet of elk and 33 percent of the deer diet, whereas shrubs made up less than 5 percent and 25 percent of the elk and deer diets, respectively. Conifers and several minor food items made up the balance; forbs were not a significant contribution to the diet in winter.

Different plant species contributed varying amounts to elk and deer diets, depending on the particular winter range. For example, bluebunch wheatgrass was most important on one range, whereas elk sedge or Idaho fescue was most important on another. For deer, Sandberg bluegrass was important on three areas, Idaho fescue on two, and wheatgrass another. Of all plants, Idaho fescue made the greatest contribution to the diets of both animals. Ponderosa pine was a consistent dietary item; and during storm periods, it was used in large quantities, especially by deer.

Some plant species, such as bluebunch wheatgrass, were routinely used more heavily by elk early in the winter than late. Seasonal use by deer was more variable. Deer made substantial use of Sandberg bluegrass during late winter, mainly as a result of spring greenup. Elk, on the other hand, made highest use of Sandberg bluegrass in early winter on these same areas; this animal-season interaction for Sandberg bluegrass was significant.

Diet overlap between elk and deer, as determined by analysis, was not high except for late season grazing in one unit Early season competition appeared to be moderately high on another unit, but this was mainly a result of weather and high consumption of ponderosa pine which is a low-value forage in superabundant supply.

As expressed here, evaluation of winter diet should be interpreted in terms of animal behavior characteristics which often reflect weather patterns. Snow cover decreases the availability of forage from which animals can select. Together with extremely cold temperatures, deep snow can decrease animal mobility, further biasing preference. In terms of survival under adverse weather, elk have greater mobility and better foraging ability than deer do.

Nutritional aspects of these dual-use winter ranges again place deer at a disadvantage relative to elk because of the low quality of available forage. Deer need higher quality forage than elk do because of their relatively higher metabolism and smaller rumen size to body mass. Apparently because deer select more nutritious forage, such as shrubs and emerging bluegrass, they are able to survive nearly as well as elk when presented the same available forage under normal winter conditions.

Based on early and late winter diets selected by elk and deer throughout the Blue Mountains, there appears to be little cause for concern about forage competition. Because of the competitive advantages enumerated, however, elk populations should be closely managed on ranges where high diet overlap exists.

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APPENDIX

Scientific and Common Names of Plant Species Mentioned[1]

Grasses:

Bearded bluebunch wheatgrass	*Agropyron spicatum*
Cheatgrass	*Bromus tectorum*
Idaho fescue	*Festuca idahoensis*
Letterman needlegrass	*Stipa lettermanii*
Mountain bromegrass	*Bromus carinatus*
Onespike danthonia	*Danthonia unispicata*
Pinegrass	*Calamagrostis rubescens*
Prairie junegrass	*Koeleria cristata*
Sandberg bluegrass	*Poa sandbergii*
Western fescue	*Festuca occidentalis*
Western needlegrass	*Stipa occidentalis*

Grasslike Plants:

Elk sedge	*Carex geyeri*
Northwestern sedge	*Carex concinnoides*
Ross sedge	*Carex rossii*

Forbs:

Balsamroot	*Balsamorhiza* sp.
Erigeron (fleabane)	*Erigeron* sp.
Hawkweed	*Hieracium* sp.
Heartleaf arnica	*Arnica cordifolia*
Lomatium (biscuitroot)	*Lomatium* sp.
Lupine	*Lupinus* sp.
Onion	*Allium* sp.
Rose pussytoes	*Antennaria rosea*
Rush pussytoes	*Antennaria luzuloides*
Stoneseed	*Lithospermum ruderale*
Strawberry	*Fragaria* sp.
Western yarrow	*Achillea millifolium lanulosa*

Shrubs:

Buckwheat (Wyeth eriogonum)	*Eriogonum heracleoides*[2]
Chokecherry	*Prunus virginiana*[3]
Creambush rockspirea (ocean-spray)	*Holodiscus discolor*
Ninebark	*Physocarpus malvaceus*
Oregon grape	*Berberis repens*
Rabbitbrush	*Chrysothamnus* sp.
Rose	*Rosa*
Sagebrush	*Artemisia* sp.
Shiny leaf spirea	*Spiraea lucida*
Snowberry	*Symphoricarpos albus*
Snowbrush ceanothus	*Ceanothus velutinus*

Trees:

Douglas-fir	*Pseudotsuga menziesii*
Ponderosa pine	*Pinus ponderosa*
Western juniper	*Juniperus occidentalis*

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[1]Nomenclature follows that of Garrison et al. (1976).

[2]Locally considered a half shrub.

[3]Considered a tree in most areas.

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1979. Winter diets of elk and deer in the Blue Mountains, Oregon. USDA For. Serv. Res. Pap. PNW-260, 21 p. Pacific Northwest Forest and Range Experiment Station, Portland, Oregon.

From an analysis of fecal pellets, diets of elk and deer were compared during early and late winter of 1973-74 to determine the level of competition. Forage competition between elk and deer was not great even though winter conditions were harsher than normal on the five dual-use winter ranges studied. Shrubs were not as important here as in other winter range areas of the West. Idaho fescue was the single most important item in their diets.

KEYWORDS: Food habits (wildlife), range management, cervidae, Blue Mountains (Oregon), forage management.

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