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SEASONAL FOOD HABITS OF A POPULATION OF BIGHORN SHEEP IN NORTHWESTERN MONTANA AS DETERMINED BY MICROHISTOLOGIC EXAMINATION OF FECAL MATERIAL

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Abstract: Food habits of Rocky Mountain bighorn sheep (Ovis c. canadensis) inhabiting a heavily timbered range in northwestern Montana were studied in 1978 and 1986 using microhistologic examination of fecal material. Monthly and seasonal trends in utilization of major forage groups were very similar between years. Sheep diets consisted of graminoids (66%), browse (27%) and forbs (7%) on an annual basis. Three major grasses, rough fescue (Festuca scabrella), Idaho fescue (Festuca idahoensis) and bluebunch wheatgrass (Agropyron spicatum) in decreasing order of importance accounted for 51% of the annual diet.

Bighorn sheep utilize a wide variety of forage species throughout their distribution in North America (Todd 1972). On a smaller geographic scale, Rocky Mountain bighorn sheep within Montana demonstrate notable differences in annual and seasonal food habits (Constan 1972, Frisina 1974, Stewart 1975, Tilton 1977, Brown 1979), generally reflective of diverse habitats ranging from relatively dry grassland types in south-central portions of the state to more mesic timbered ranges in northwestern Montana. Extrapolation of food habits data from one region to another or between seasons in the same area may be misleading and inappropriate for developing site specific environmental impact statements or habitat management plans (Cooperrider et al. 1980).

The Ural-Tweed population of bighorn sheep is the only native herd remaining in northwestern Montana. Their present distribution is a long, narrow band of steep, heavily timbered terrain along the east shore of Lake Koocanusa between Libby and Eureka, Montana. Inundation of the Libby Reservoir impoundment area in conjuntion with fire suppression over the past 50 years has greatly reduced available habitat for this herd. Ponderosa pine (Pinus ponderosa)/bunchgrass disclimax communities, previously maintained by natural fires, are gradually being replaced by densely stocked stands of Douglas-fir (Pseudotsuga menziesii).

Wildlife mitigation associated with the Libby Dam project has provided an opportunity to study the ecology of these sheep with an overall objective of developing habitat and population management plans. One aspect of these investigations, summarized here, was to analyze sheep food habits as they relate to habitat enhancement projects.

The U.S. Army, Corps of Engineers, and Bonneville Power Administration provided funding for the 1978 and 1986 projects, respectively.

METHODS

Food habits data were collected and analyzed for 1978 and 1986. Fecal pellet groups from 240 bighorn sheep were collected at a rate of 20 per month for the period 1 January - 31 December 1978. Only known sheep pellet groups were collected. Monthly composited samples consisted of 2 randomly-selected pellets from each of the 20 pellet groups collected for that month. Composited samples were submitted to the Composition Analysis Laboratory, Colorado State University, Fort Collins, Colorado for determination and quantification of plant fragments through identification of plant epidermal tissue (Sparks and Malechek 1968). For each composited sample, 10 microscope slides were prepared; 20 fields per slide (= 200 fields, were examined at 100X under a binocular microscope to determine relative densities of plant residues. A reference list of plants common on the study area was sent to the Composition Analysis Laboratory to assist in identification of plant fragments to the species level.

Fecal sample collections for the study period 1 January - 31 December 1986 range from 4-26 pellet groups per month with the exception of March when no samples were obtained. A total of 149 pellet groups was collected from known sheep defecations. Monthly composited samples consisted of 5 randomly-selected pellets from each pellet group collected for a given month. Samples for 1986 were sent to the Wildlife Habitat Management Laboratory, Washington State University, Pullman, Washington, for analysis. Three hundred microscope fields at 100X were examined for each monthly composite sample. Research by Todd and Hansen (1973) and Dearden et al. (1975) suggests that the microhistological technique is a valid, reliable and economical method for determining ungulate food habits.

RESULTS AND DISCUSSION

Percent occurrence of individual plant species in the diet of Ural-Tweed bighorn sheep by month, season and year is shown in Tables 1 and 2. Forage species utilized by these sheep were grouped into conventional categories; graminoids (grasses and grass-like plants), browse (woody shrubs and trees), and forbs (herbaceous annuals). For convenience, mosses and lichens were included with forbs. Monthly trends in utilization of these 3 major forage classes were remarkably similar for 1978 and 1986 (Fig. 1). In both years browse consumption increased and grass use declined sharply in February and again in mid-summer (Figs. 2 and 3). The mid-summer inverse relationships between browse and grass consumption was slightly out of phase between the 2 years in that it occurred in July of 1978 and 1 month later in 1986. Between year differences in phenological development of the forage species involved is the most probable explanation for this observation. The 1978 and 1986 data sets continued to demonstrate agreement between use of forage class by sheep on a seasonal basis. For both years, grass use peaked in autumn and reached lowest levels in summer. Browse consumption was lowest and highest for autumn and winter, respectively. Forbs in the diet gradually increased during spring, peaked in August and declined in autumn for both years in accordance with the annual growth and development of herbaceous forage

Table 1. Food habits of bighorn sheep from the Ural-Tweed sheep range based on microhistological examination of fecal samples, 1978.

Taxa	Percent of diet by month												By season				By Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Win	Spr	Sum	Aut	
Agropyron spicatum	7.8	2.3	2.7	5.4	3.5	--	--	5.9	6.0	9.0	9.6	9.7	4.3	3.8	4.0	9.4	5.2
Bouteloua gracilis	--	--	--	--	--	--	--	--	--	0.4	0.2	--	Tr	Tr	Tr	0.2	0.1
Bromus tectorum	1.1	0.2	0.3	0.2	0.6	1.1	0.3	1.4	2.1	1.6	0.2	--	0.5	0.6	1.3	0.6	0.8
Calamagrostis rubescens	0.3	--	--	--	--	--	--	--	--	--	--	--	0.1	Tr	Tr	Tr	Tr
Carex spp.	--	0.3	2.7	2.1	2.1	5.4	--	0.9	1.2	0.6	0.2	0.4	1.0	3.2	0.7	0.4	1.3
Danthonia spp.	--	0.5	0.6	--	--	1.3	--	--	0.7	0.6	--	--	0.4	0.4	0.2	0.2	0.3
Elymus glauca	--	--	--	--	0.2	--	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Festuca idahoensis	7.7	10.7	17.6	12.7	3.4	4.5	10.0	9.9	13.7	13.5	13.7	12.7	12.0	6.9	11.2	13.3	10.8
Festuca scabrella	69.1	25.0	41.1	50.9	30.6	40.3	23.4	23.2	54.9	54.1	54.8	50.6	45.1	40.6	33.8	53.2	43.2
Koleria cristata	1.1	0.7	--	--	0.2	1.1	0.8	3.1	2.5	1.2	0.5	1.3	0.6	0.4	2.1	1.0	1.0
Oryzopsis asperifolia	0.5	--	0.2	--	--	0.6	0.3	--	0.2	--	--	--	0.2	0.2	0.2	Tr	0.2
Poa spp.	--	--	--	0.3	--	0.6	0.3	2.6	3.4	4.9	3.4	2.3	Tr	0.3	2.1	2.9	1.3
Sitanion hystrix	--	--	--	--	--	--	--	0.2	--	--	--	--	Tr	Tr	0.1	Tr	Tr
Stipa richardsonii	0.5	--	0.2	--	0.2	--	--	0.2	--	0.8	0.2	--	0.2	0.1	0.1	0.3	0.2
Graminoids Total	88.1	39.7	65.4	71.6	40.8	54.9	35.1	47.4	84.7	86.7	80.8	77.0	64.4	55.8	55.7	81.5	64.4
Amelanchier alnifolia	4.0	5.9	3.7	8.6	36.4	4.0	3.9	--	--	--	--	--	4.5	16.3	1.3	Tr	5.5
Artemisia frigida	--	--	--	0.2	--	--	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Atriplex spp.	--	--	1.0	--	--	--	--	--	--	--	--	--	0.3	Tr	Tr	Tr	0.1
Berberis repens	1.4	0.3	4.0	--	--	--	1.1	--	0.2	2.4	3.3	3.4	1.9	Tr	0.4	3.0	1.3
Ceanothus sanguineus	--	--	--	--	--	--	--	--	0.8	1.0	--	--	Tr	Tr	0.3	0.3	0.2
Ceanothus velutinus	--	--	--	--	--	--	--	--	--	--	10.3	14.0	Tr	Tr	Tr	8.1	2.0
Chrysothamnus viscidiflorus	--	--	--	--	--	--	--	0.5	0.5	--	--	--	Tr	Tr	0.3	Tr	0.1
Cornus stolonifera	--	--	--	--	--	--	--	--	--	--	0.2	--	Tr	Tr	Tr	0.1	Tr
Holodiscus discolor	1.7	5.7	5.4	--	0.9	11.5	18.2	0.2	--	--	--	--	4.3	4.1	6.1	Tr	3.6
Pachistima myrsinites	--	0.2	0.8	--	--	--	0.3	--	--	0.2	--	--	0.3	Tr	0.1	0.1	0.1
Physocarpus malvaceous	--	--	0.2	0.5	0.9	12.1	23.4	1.4	--	0.4	0.4	--	0.1	4.5	8.3	0.3	3.3
Picea engelmannii	--	--	1.1	2.8	6.5	1.3	0.8	1.2	0.7	1.4	--	--	0.4	3.5	0.9	0.5	1.3
Pinus ponderosa	0.5	1.2	1.4	--	--	--	--	2.6	3.8	4.2	0.7	0.7	1.0	Tr	2.1	1.9	1.3
Potentilla gracilis	--	--	--	--	--	--	--	7.0	1.4	--	--	0.4	Tr	Tr	2.8	0.1	0.9
Prunus virginiana	0.3	--	--	--	--	--	--	--	--	--	--	--	0.1	Tr	Tr	Tr	Tr
Pseudotsuga menziesii	3.5	37.7	13.6	3.8	3.5	3.1	--	--	--	0.8	3.7	1.9	18.3	3.5	Tr	2.1	6.0

Table 1. (Continued).

Taxa	Percent of diet by month												By season				By Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Win	Spr	Sum	Aut	
Purshia tridentata	0.9	4.7	0.2	--	--	2.8	2.2	--	--	--	--	--	1.7	0.9	0.7	Tr	0.9
Rosa spp.	--	--	--	--	--	--	--	2.1	--	--	--	--	Tr	Tr	0.7	Tr	0.2
Rubus spp.	--	--	--	--	--	--	--	--	0.8	0.2	0.4	0.2	Tr	Tr	0.3	0.3	0.1
Salix spp.	--	--	--	--	--	--	--	5.7	0.3	0.4	0.7	1.1	Tr	Tr	2.0	0.7	0.7
Shepherdia canadensis	0.2	--	--	1.1	8.5	1.2	4.2	0.7	--	--	--	--	0.1	3.6	1.6	Tr	1.3
Spiraea betulifolia	--	--	--	--	--	4.2	--	--	--	--	--	--	Tr	1.4	Tr	Tr	0.4
Symphoricarpos albus	0.2	4.5	1.7	--	--	--	4.8	0.7	--	--	--	--	2.1	Tr	1.8	Tr	1.0
Vaccinium spp.	--	--	0.5	--	--	--	--	--	--	0.2	--	--	0.2	Tr	Tr	0.1	0.1
Browse Total	12.1	60.2	33.6	17.0	56.7	40.2	58.9	22.1	8.3	11.2	19.7	21.7	35.3	38.0	29.8	17.5	30.1
Astragalus spp.	--	--	--	--	--	--	--	0.2	--	--	--	--	Tr	Tr	0.1	Tr	Tr
Dryas spp.	--	--	1.4	0.3	--	--	--	--	--	--	--	--	0.5	0.1	Tr	Tr	0.1
Eriogonum spp.	--	--	--	--	--	--	--	2.1	0.5	0.4	--	0.4	Tr	Tr	0.9	0.3	0.3
Geum triflorum	--	--	--	--	0.9	0.6	--	15.2	0.8	1.4	--	0.4	Tr	0.5	5.3	0.6	1.6
Gilia spp.	--	--	--	--	0.4	--	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Lupinus sericeus	--	--	--	11.1	--	1.9	1.1	12.7	5.6	0.2	--	--	Tr	4.3	6.5	0.1	2.7
Oenothera spp.	--	--	--	--	0.4	--	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Phlox spp.	--	--	--	--	--	0.6	--	--	--	0.6	--	0.4	Tr	0.2	Tr	0.3	0.1
Viola spp.	--	--	--	--	0.2	--	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Unknown forbs	0.2	0.2	0.2	--	0.6	1.3	4.8	--	0.2	--	--	--	0.2	0.6	1.7	Tr	0.6
Lichens	0.2	--	--	--	--	--	--	--	--	--	--	--	0.1	Tr	Tr	Tr	Tr
Forbs & Bryophytes Total	0.4	0.2	1.6	11.4	2.5	4.4	5.9	30.2	7.1	2.6	--	1.2	0.7	6.1	14.4	1.3	5.6

Table 2. Food habits of bighorn sheep from the Ural-Tweed sheep range based on microhistological examination of fecal samples, 1986.

Taxa	Percent of diet by month												By season				By Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Win	Spr	Sum	Aut	
Agropyron spicatum	10.9	5.7	--	4.4	5.2	6.0	13.6	1.8	12.0	18.3	5.0	14.4	8.3	5.2	9.1	12.6	8.8
Agrostis interrupta	--	--	--	1.7	1.9	--	--	--	1.0	--	--	--	Tr	1.2	0.3	Tr	0.4
Bromus inermis	0.7	1.4	--	1.5	--	0.4	--	--	--	0.2	--	--	1.1	0.6	Tr	0.1	0.4
Bromus tectorum	0.8	1.4	--	0.9	0.8	1.7	0.9	--	0.8	0.3	--	0.8	1.1	1.1	0.6	0.4	0.8
Calamagrostis rubescens	5.5	4.5	--	8.2	13.0	2.3	10.2	6.9	4.3	4.4	3.5	9.8	5.0	7.8	7.1	5.9	6.6
Carex spp.	--	0.6	--	1.3	4.9	5.2	Tr	2.0	5.6	1.8	1.4	Tr	0.3	3.8	2.5	1.1	2.1
Dactylis glomerata	--	--	--	0.6	0.3	--	--	--	--	--	--	--	Tr	0.3	Tr	Tr	0.1
Danthonia spp.	--	--	--	3.9	0.3	2.3	--	--	1.6	3.2	1.8	4.4	Tr	2.2	0.5	3.1	1.6
Elymus glauca	--	--	--	--	0.5	--	--	--	--	--	0.5	16.7	Tr	0.2	Tr	5.7	1.6
Festuca idahoensis	12.5	9.4	--	11.7	13.0	7.7	20.4	11.1	6.4	16.4	8.2	17.6	11.0	10.8	12.6	14.1	12.2
Festuca scabrella	39.8	29.4	--	20.7	7.5	17.4	18.0	8.3	23.4	18.4	31.8	7.2	34.6	15.2	16.6	19.1	20.2
Koleria cristata	2.4	1.2	--	1.6	1.1	1.8	1.2	2.6	2.3	2.8	3.2	--	1.8	1.5	2.0	2.0	1.8
Oryzopsis asperifolia	--	--	--	--	2.1	2.0	--	--	--	--	--	--	Tr	1.4	Tr	Tr	0.4
Phleum pratense	--	--	--	1.8	2.2	--	--	--	--	7.4	0.8	9.4	Tr	1.3	Tr	5.9	2.0
Poa spp.	2.4	2.3	--	14.3	14.0	10.5	5.5	3.8	8.3	--	8.9	--	2.4	12.9	5.9	5.0	6.4
Sitanion hystrix	--	--	--	--	--	--	--	--	--	--	--	3.8	Tr	Tr	Tr	1.3	0.3
Stipa richardsonii	0.5	0.6	--	3.1	3.3	1.6	1.2	0.8	3.0	1.7	1.0	--	0.6	3.3	1.7	0.9	1.7
Graminoids Total	75.5	56.5	--	77.7	70.1	58.9	71.0	37.3	68.7	74.9	66.1	84.1	66.0	68.9	59.6	75.0	67.3
Amelanchier alnifolia	1.8	15.6	--	0.5	1.0	1.0	--	0.5	0.7	--	3.8	2.6	8.7	0.8	0.4	2.1	2.5
Arctostaphylos uva-ursi	--	--	--	--	1.4	0.7	--	--	--	--	--	--	Tr	0.7	Tr	Tr	0.2
Berberis repens	4.0	1.7	--	--	--	--	--	1.5	0.9	2.0	4.7	2.5	2.9	Tr	0.8	3.1	1.6
Ceanothus sanguineus	0.2	2.0	--	--	--	--	2.3	0.4	9.4	0.3	--	1.7	1.1	Tr	4.0	0.7	1.5
Ceanothus velutinus	5.1	0.7	--	0.9	--	--	1.8	2.9	0.6	4.0	1.5	1.2	2.9	0.3	1.7	2.2	1.7
Holodiscus discolor	--	--	--	--	0.6	1.2	--	2.4	--	0.8	1.1	--	Tr	0.6	0.8	0.6	0.6
Linnaea borealis	--	--	--	--	--	--	--	--	--	--	1.0	--	Tr	Tr	Tr	0.3	0.1
Physocarpus malvaceous	--	--	--	2.1	0.8	5.2	1.8	24.4	0.5	--	--	--	Tr	2.7	8.9	Tr	3.2
Pinus contorta	--	0.3	--	--	--	--	--	--	--	--	0.2	--	0.2	Tr	Tr	0.1	Tr
Pinus ponderosa	0.1	0.2	--	--	0.7	--	--	--	0.7	4.7	--	1.2	0.2	0.2	0.2	2.0	0.7
Populus spp.	--	--	--	--	--	2.7	--	--	--	0.2	0.6	--	Tr	0.9	Tr	0.3	0.3
Prunus virginiana	0.2	5.5	--	--	--	--	--	0.4	--	--	0.3	0.6	2.9	Tr	0.1	0.3	0.6
Pseudotsuga menziesii	7.1	3.2	--	2.2	0.6	1.5	--	0.6	1.5	5.0	3.4	1.7	5.2	1.4	0.7	3.4	2.4

Table 2. (Continued).

Taxa	Percent of diet by month												By season				By Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Win	Spr	Sum	Aut	
Purshia tridentata	--	--	--	--	--	--	--	--	--	--	0.3	0.6	Tr	Tr	Tr	0.3	0.1
Rosa spp.	1.3	6.4	--	0.8	10.4	--	0.8	2.7	2.5	0.5	4.5	8.7	4.0	3.7	2.0	1.9	2.8
Rubus spp.	--	0.6	--	1.6	0.8	1.0	--	--	--	--	--	--	0.3	1.1	Tr	Tr	0.4
Salix spp.	0.8	1.5	--	1.2	--	1.6	0.2	0.9	0.3	--	0.5	0.3	1.2	0.9	0.5	0.3	0.7
Shepherdia canadensis	0.3	0.8	--	2.5	1.2	7.3	4.9	6.7	0.3	--	0.5	1.1	0.6	3.7	4.0	0.5	2.3
Spirea betulifolia	0.4	1.4	--	1.3	--	0.9	--	--	--	--	--	--	0.9	0.7	Tr	Tr	0.4
Symphoricarpos albus	--	0.2	--	--	--	--	2.5	1.1	--	0.6	0.9	0.7	0.1	Tr	1.2	0.7	0.5
Thuja plicata	--	--	--	--	--	--	--	--	--	--	1.1	--	Tr	Tr	Tr	0.4	0.1
Tsuga heterophylla	--	--	--	--	--	--	--	--	--	--	4.3	--	Tr	Tr	Tr	1.4	0.4
Vaccinium spp.	0.3	0.4	--	--	--	1.1	--	--	--	0.6	--	--	0.4	0.4	Tr	0.2	0.2
Browse Total	21.8	40.5	--	13.1	17.5	24.2	14.1	44.5	17.4	18.7	28.7	14.9	31.2	18.3	23.3	20.8	23.2
Achillea millefolium	--	--	--	--	0.6	2.8	2.5	0.4	0.7	--	--	--	Tr	1.1	1.2	Tr	0.6
Allium cernuum	--	--	--	--	--	--	--	--	0.7	--	--	--	Tr	Tr	0.2	Tr	0.1
Antennaria spp.	--	--	--	0.3	1.1	--	--	--	--	--	--	--	Tr	0.5	Tr	Tr	0.1
Arnica cordifolia	--	--	--	--	1.2	0.1	0.7	1.1	1.6	--	--	--	Tr	0.4	1.1	Tr	0.4
Arenaria spp.	--	--	--	--	--	--	--	--	0.5	--	--	--	Tr	Tr	0.2	Tr	Tr
Aster spp.	--	--	--	0.2	0.3	0.4	--	3.4	0.3	--	--	--	Tr	0.3	1.2	Tr	0.4
Balsamorhiza sagittata	--	--	--	--	--	1.0	--	--	0.2	--	--	--	Tr	0.3	0.1	Tr	0.1
Campanula rotundifolia	--	--	--	0.2	--	--	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Cerastium spp.	--	--	--	0.2	--	--	--	--	0.2	--	--	--	Tr	0.1	0.1	Tr	Tr
Cornus canadensis	--	--	--	--	--	1.3	--	--	--	0.5	--	--	Tr	0.4	Tr	0.2	0.2
Erigeron spp.	--	--	--	--	--	--	0.6	0.8	--	--	--	--	Tr	Tr	0.5	Tr	0.1
Eriogonum spp.	--	--	--	--	--	0.3	--	--	--	--	--	--	Tr	0.1	Tr	Tr	Tr
Fragaria spp.	--	--	--	--	--	--	--	1.7	0.2	--	0.2	--	Tr	Tr	0.6	0.1	0.2
Galium boreale	--	--	--	--	0.7	--	--	0.4	--	--	--	--	Tr	0.2	0.1	Tr	0.1
Geranium spp.	--	--	--	--	--	--	--	0.3	--	--	--	--	Tr	Tr	0.1	Tr	Tr
Geum triflorum	--	0.8	--	--	--	--	3.4	1.4	0.6	--	--	--	0.3	Tr	1.8	Tr	0.5
Heuchera cylindrica	--	--	--	0.5	0.9	--	--	--	--	--	--	--	Tr	0.5	Tr	Tr	0.1
Hieracium spp.	--	0.1	--	--	0.1	0.4	0.2	2.1	0.2	--	0.2	--	0.1	0.2	0.8	0.1	0.3
Lupinus sericeus	--	--	--	--	0.3	1.4	1.4	1.1	--	--	--	--	Tr	0.6	0.8	Tr	0.4
Penstemon spp.	--	--	--	0.9	--	--	0.8	--	--	--	--	--	Tr	0.3	0.3	Tr	0.2

Table 2. (Continued).

Taxa	Percent of diet by month												By season				By Year
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Win	Spr	Sum	Aut	
Phlox spp.	--	--	--	0.5	--	1.6	--	--	--	--	--	--	Tr	0.7	Tr	Tr	0.2
Potentilla spp.	--	--	--	--	0.5	--	0.8	0.5	0.9	--	--	--	Tr	0.2	0.7	Tr	0.2
Pteridium aquilinum	--	--	--	--	--	0.7	--	--	--	--	--	--	Tr	0.2	Tr	Tr	0.1
Pyrola spp.	--	--	--	0.8	0.3	--	--	--	0.3	--	0.9	--	Tr	0.4	0.1	0.3	0.2
Sedum lanceolata	0.2	--	--	--	--	--	--	--	--	--	--	--	0.1	Tr	Tr	Tr	Tr
Smilacena stellata	--	--	--	1.2	0.3	0.3	--	--	1.9	--	--	--	Tr	0.6	0.6	Tr	0.3
Taraxacum officinale	--	--	--	0.2	--	2.4	0.6	0.8	0.7	--	--	--	Tr	0.9	0.7	Tr	0.4
Thalictrus spp.	--	--	--	0.2	--	0.8	--	--	--	--	--	--	Tr	0.3	Tr	Tr	0.1
Trifolium spp.	--	--	--	--	3.4	2.0	--	--	--	--	--	--	Tr	1.8	Tr	Tr	0.5
Vicia americana	--	--	--	--	--	--	1.1	0.6	0.2	--	--	--	Tr	Tr	0.6	Tr	0.2
Viola spp.	--	--	--	1.0	--	--	--	--	--	--	--	--	Tr	0.3	Tr	Tr	0.1
Xerophyllum tenax	--	--	--	--	--	--	--	--	1.1	--	--	--	Tr	Tr	0.4	Tr	0.1
Unknown forbs	--	--	--	1.2	1.2	1.4	0.2	0.6	0.2	0.2	--	--	Tr	1.3	0.3	0.1	0.5
Lichens	1.6	2.3	--	0.9	2.5	--	2.6	3.0	2.8	4.2	3.1	0.7	2.0	1.1	2.8	2.7	2.2
Mosses	0.9	--	--	0.9	--	--	--	--	0.5	0.8	0.8	0.3	0.5	0.3	0.2	0.6	0.4
Forbs & Bryophytes Total	2.7	3.0	--	9.2	13.4	16.9	14.9	18.2	13.9	5.7	5.2	1.0	2.9	13.2	15.7	4.0	9.5

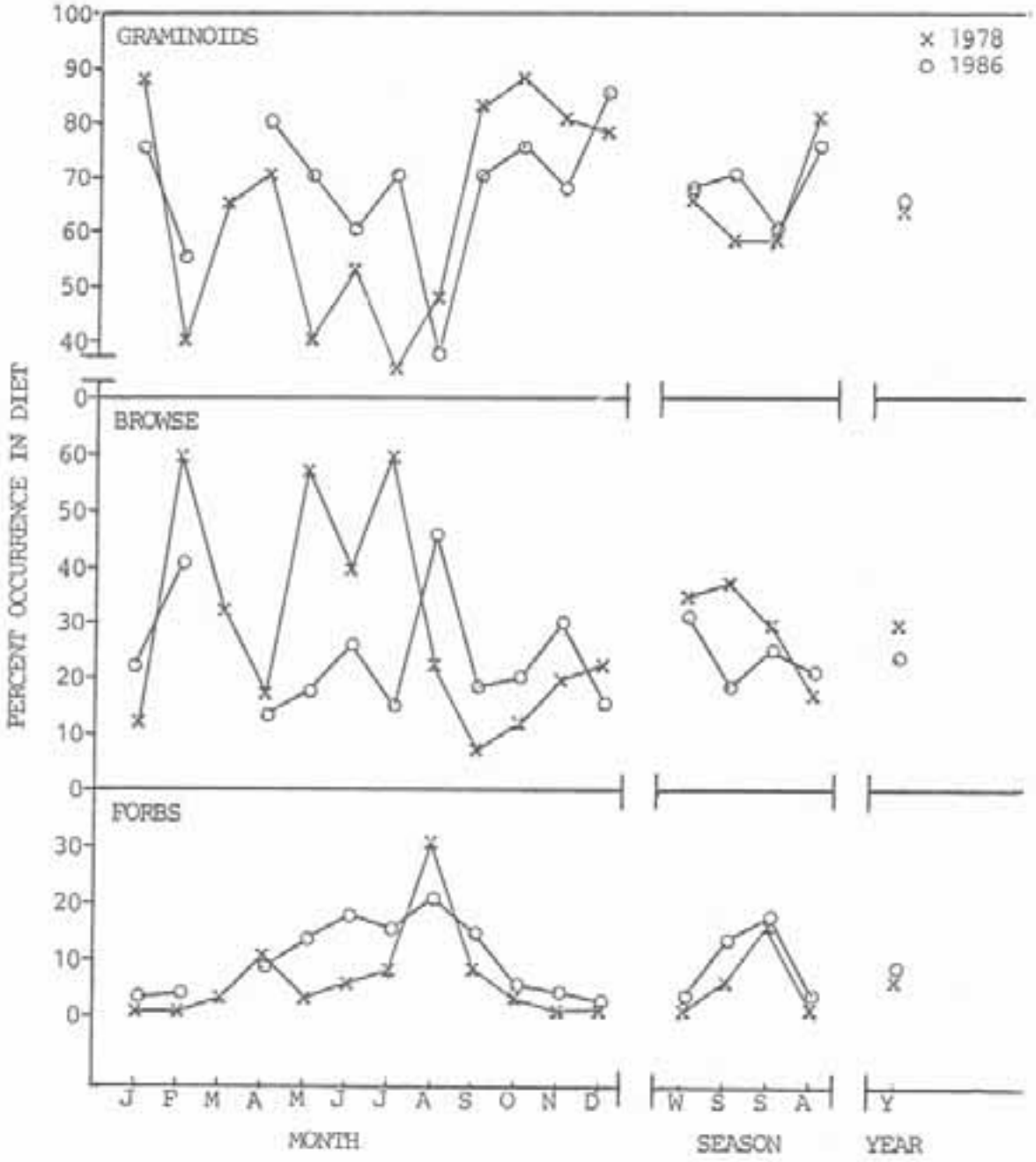

Figure 1.Use of graminoids, browse and forbs by bighorn sheep on the Ural-Tweed sheep range, northwestern Montana.

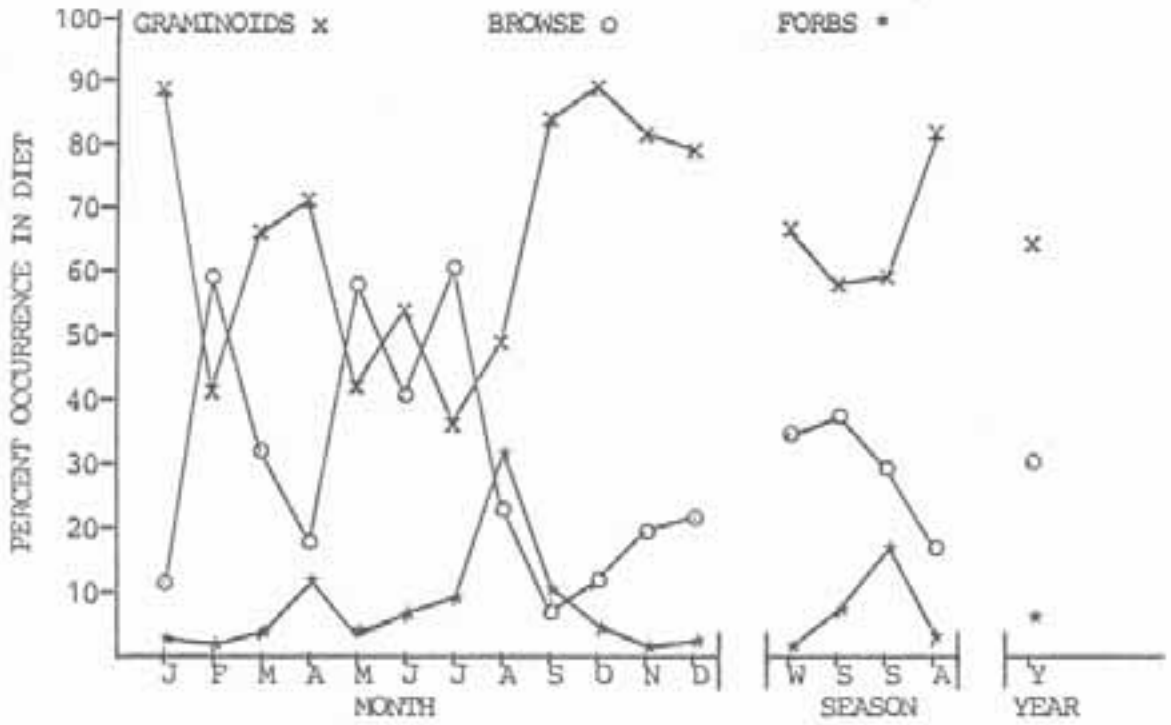

Figure 2.Forage class use by bighorn sheep on the Ural-Tweed range, 1978

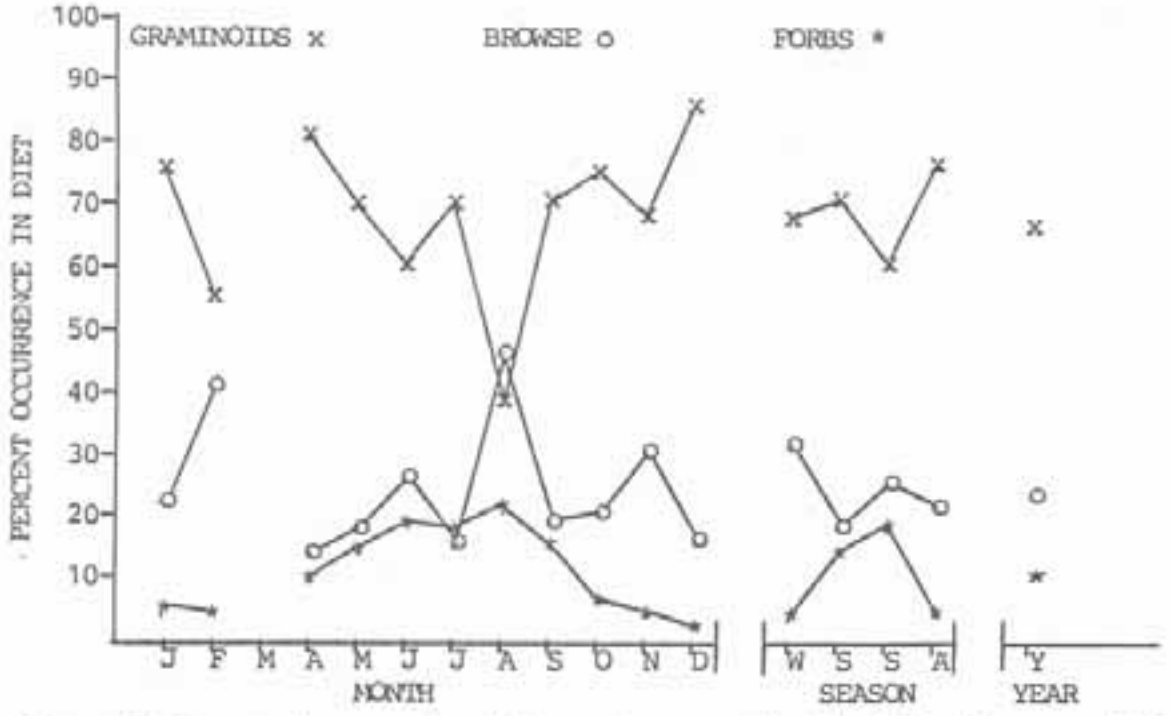

Figure 3.Forage class use by bighorn sheep on the Ural-Tweed range, 1986

species. Between year comparisons for annual usage of the three major forage groups also showed agreement in that diets consisted of graminoids, 64 and 67%, browse, 30 and 23%, and forbs, 6 and 10% for 1978 and 1986, respectively.

Overall similarities in patterns of forage use between years suggested that pooling of the 2 data sets was acceptable and would provide a generalized expression of food habits for Ural-Tweed sheep (Fig. 4). Using combined data, graminoids, browse and forbs contributed 66%, 27% and 7%, respectively, to the annual diets of bighorn sheep on this range. Seasonally, graminoids provided 65, 62, 57 and 78%; browse contributed 34, 28, 28, and 19%; and forbs supplied 1, 10, 15 and 3% to the diets of these sheep for winter, spring, summer and fall, respectively. Food habits studies from other bighorn sheep populations in Montana have shown winter diets consisting of graminoids, browse and forbs in the following ratios: 36, 43 and 21% for the Sun River herd (Frisina 1974); 38, 51 and 11% for the Thompson Falls herd (Tilton) 1977; 44, 30 and 27% for West Rosebud sheep (Steward 1975); 61, 22 and 17% for Yellowstone National Park sheep (Oldemeyer 1971); and 72, 8 and 17% for Gallatin Canyon sheep (Constan 1972). The proportions of grasses in the diets of Sun River sheep for spring (94%) and fall (92%) and for West Rosebud sheep for spring (80%), summer (61%) and fall (82%) were considerably higher and browse use much lower than that recorded on this study. On an annual basis, forbs contributed much more to the diets of Sun River sheep (21%) and West Rosebud sheep (22%) than for Ural-Tweed sheep (7%).

A preference index for individual forage species selected by sheep was not calculated because availability of these plants for grazing throughout the year was unknown. However, a relative ranking of important forage species was established through percent occurrence of those species in the monthly, seasonal and annual diet as well as their constancy in the diet - number of months a particular species occurred in the sample (Table 3). Each of three major grasses, rough fescue, Idaho fescue and bluebunch wheatgrass, in decreasing order of importance, occurred in the diets of these sheep every month of the year and collectively accounted for 51% of their annual forage intake. Five other grasses, each appearing in the samples 11 or 12 months of the year, and collectively contributing 9.6% to the annual diet of these sheep were bluegrasses (Poa spp.), pinegrass (Calamagrostis rubescens), Junegrass (Koleria cristata), needlegrass (Stipa richardsonii) and cheat grass (Bromus tectorum) in drecreasing rank order. Douglas-fir and serviceberry (Amelancheir alnifolia) individually appeared in fecal samples 11 months of the year and ranked fourth and fifth as important forage species for these sheep.

Microhistological analysis of fecal material showed rough fescue to be the single most important dietary component for bighorn sheep through all seasons of the year. Pitt and Wikeem (1978) identified rough fescue as the preferred forage species by sheep for spring and summer months on native rangeland in south-central British Columbia. Other investigators working with sheep in the Rocky Mountains have identified bluebunch wheatgrass as the primary grass species of importance to bighorn sheep (Demarchi 1967, Frisina 1974, Tilton 1977). Pitt and Wikeem (1978) suggest the high use of bluebunch wheatgrass may only reflect the abundance and availability of this forage on some ranges rather than an

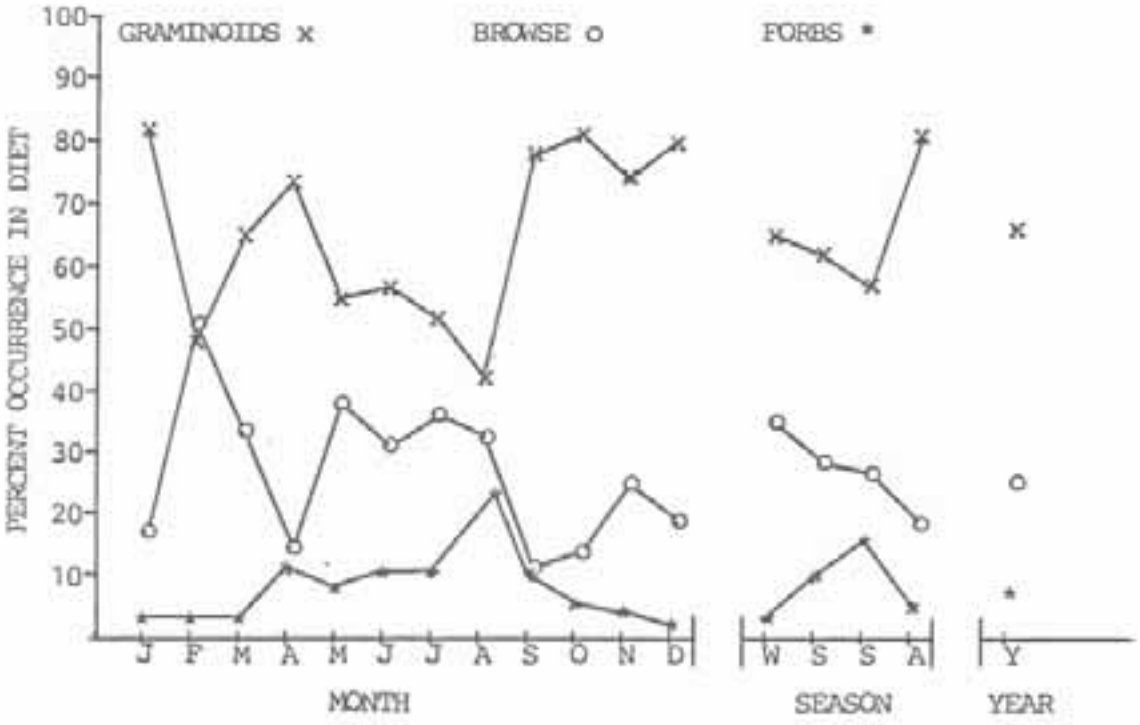

Figure 4.Bighorn sheep forage class utilization on the Ural-Tweed sheep range, 1978 and 1986 combined.

Table 3. Forage taxa of bighorn sheep with at least 1% seasonal or annual use (1978 and 1986 combined). Species are listed in descending order of use based on microhistological examination of fecal samples.

Taxa	1978 and 1986 Combined									
	Percent of diet by season				By year	Number of months in diet				Total
	Win	Spr	Sum	Aut		Win	Spr	Sum	Aut	
Festuca scabrella	40.9	27.9	25.2	36.2	32.5	3	3	3	3	12
Festuca idahoensis	12.6	8.8	11.9	13.7	11.8	3	3	3	3	12
Agropyron spicatum	5.4	4.1	6.6	11.0	6.7	3	3	3	3	12
Pseudotsuga menziesii	13.1	2.5	0.3	2.8	4.7	3	3	2	3	11
Amelanchier alnifolia	5.8	8.6	0.9	1.1	4.1	3	3	3	2	11
Poa spp.	0.8	6.6	4.0	2.9	3.6	2	3	3	3	11
Physocarpus malvaceous	0.1	3.6	8.6	0.1	3.1	1	3	3	2	9
Calamagrostis rubescens	1.7	3.9	3.6	3.0	3.0	2	3	3	3	11
Holodiscus discolor	3.0	2.4	3.5	0.3	2.3	3	2	2	2	9
Ceanothus velutinus	1.0	0.1	0.9	5.2	1.8	2	1	3	3	9
Shepherdia canadensis	0.2	3.6	2.8	0.3	1.7	2	3	3	2	10
Carex spp.	1.0	3.5	1.6	0.7	1.7	2	3	3	3	11
Berberis repens	2.6	--	0.6	3.1	1.6	3	0	3	3	9
Lupinus sericeus	--	2.4	3.7	Tr	1.5	0	3	3	1	7
Rosa spp.	1.3	1.9	1.4	1.0	1.4	2	2	3	3	10
Koleria cristata	0.9	1.0	2.1	1.5	1.4	2	3	3	3	11
Geum triflorum	0.1	0.2	3.6	0.3	1.1	1	2	3	2	8
Pinus ponderosa	0.8	0.1	1.2	1.9	1.0	3	1	2	3	9
Lichens	0.7	0.6	1.4	1.3	1.0	2	2	3	3	10
Danthonia spp.	0.3	1.3	0.4	1.7	0.9	2	3	1	3	9
Phleum pratense	--	0.7	--	2.9	0.9	0	2	0	3	5
Stipa richardsonii	0.3	1.7	0.9	0.6	0.9	3	3	3	2	11
Symphoricarpos albus	1.4	--	1.5	0.4	0.8	3	0	2	3	8
Ceanothus sanguineus	0.4	--	2.2	0.5	0.8	2	0	3	2	7
Elymus glauca	--	0.1	--	2.9	0.7	0	1	0	2	3
Bromus tectorum	0.7	0.9	0.9	0.5	0.7	3	3	3	3	12
Picea engelmannii	0.4	1.8	0.5	0.2	0.7	1	3	3	1	8
Salix spp.	0.4	0.5	1.2	0.5	0.6	2	2	3	3	10
Unknown forbs	0.1	1.0	1.0	Tr	0.5	3	3	3	1	10
Purshia tridentata	0.9	0.5	0.4	0.1	0.5	3	1	1	2	7
Potentilla gracilis	--	--	1.4	0.1	0.4	0	0	2	1	3
Spirea betulifolia	0.3	1.1	--	--	0.3	2	2	0	0	4
Prunus virginiana	1.0	--	0.1	0.1	0.3	2	0	1	2	5

actual preference for this species by sheep. Rough fescue is well recognized as a highly nutritious forage plant on western rangelands and should be emphasized along with Idaho fescue and bluebunch wheatgrass in habitat improvement projects on the Ural-Tweed sheep range.

Bighorn sheep on western Montana sheep ranges demonstrate a high incidence of browse in their diets compared to some sheep in other western states. Use of browse is particularly high during winter months. Schallenberger (1965) reported the winter diet of Sun River sheep consisted of 43% browse, 36% grass and 21% forbs, and suggested winter severity with above average snowpack may have been responsible for the high incidence of browse in the diet of these sheep. Tilton (1977) concluded that the scarcity of grassland on the winter range was responsible for high percentage of browse (51%) in the winter diet of sheep from Thompson Falls. This herd was exhibiting all the signs of a high quality expanding population during Tilton's study, suggesting that a high browse component in the diet was not necessarily a detriment to these sheep. The high incidence of Douglas-fir and other browse in the diet of Ural-Tweed sheep during February 1976 corresponded with peak snowpack and frozen crust conditions on the winter range, which probably explained the change from grasses to browse in the diet. Matthews (1973) found that browse was conspicuously lacking and severely overutilized on the Wildhorse Island sheep range, and concluded that this was the major factor limiting further growth of the sheep population. Availability of high quality browse contributes to a diverse forage base on sheep winter ranges in northwestern Montana and is an attribute to sheep populations in this area.

The occurrence of forbs in the diet of Ural-Tweed sheep was minimal in comparison to that recorded in other studies where they were found to be the preferred forage class during spring and summer months (Pitt and Wikeem 1978, Johnson and Smith 1980). There is no alpine habitat, and very few sub-alpine meadows exist on the Ural-Tweed sheep range. Much of the historic summer range is presently occupied by dense stands of lodgepole pine (Pinus contorta) resulting from fire suppression activities following large scale fires in the early 1900's. Lack of abundant forbs on the summer range of these sheep may prevent them from entering the fall in optimum condition. Summer range habitat enhancement projects should focus on improving the abundance and availability of palatable forb species.

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