

Nutritional values of major mule deer winter forage species in the Bridger Mountains, Montana
by Mary Alice Morton

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Fish and Wildlife Management
Montana State University
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Abstract:
Nutritional parameters of major mule deer winter forage species and maximum potential forage production of herbaceous plants were evaluated within each of four different habitat types on the west slope of the Bridger Mountains in southwestern Montana. Habitat types sampled were: Agropyron spicatum/Festuca idahoensis h. t., Purshia tridentata/Agropyron spicatum h.t., Purshia tridentata/Artemisia tridentata h.t., and Artemisia tridentata/Festuoa idahoensis h.t. Six major forage species, big sagebrush, bitterbrush, arrowleaf balsamroot, common salsify, Idaho fescue and downy chess brome were sampled during early, mid, and late winter during 1974-75 and early and mid-winter 1975-76. In addition, samples were taken of Rocky Mountain juniper, chokecherry, nootka rose and Douglas fir. Big sagebrush had the highest protein content of the browse species, 9.8 percent during the winter of 1974-75 and 9.4 percent in 1975-76, while nootka rose had the least, 5.2 percent in 1974-75 and 5.4 percent in 1975-76. Arrowleaf balsam-root had the highest protein content of the herbaceous species, 6.3 percent in 1974-75 and 5.8 percent in 1975-76, while downy chess brome had the least, 2.6 percent in 1974-75 and 4.0 percent in 1975-76. Big sagebrush had the lowest crude fiber level, approximately 17.0 percent during both winters. Downy chess brome had the highest crude fiber content, approximately 40 percent during both winters. The evergreen species, big sagebrush, juniper, and Douglas fir, had the highest content of crude fat during both winters and downy chess brome had the least. Arrowleaf balsamroot had the highest level of ash content during both winters and also contained the greatest amounts of calcium during 1975-76, 2.61 percent. Chokecherry and juniper were also high in calcium content (1.53 and 1.04 percent, respectively). Several significant differences were found in nutrient levels of certain species from different habitat types. Significant variations from year to year were also noted. Four herbaceous species provided an estimated total of 104,095 kilograms of plant matter within the combined areas of the four habitat types at the onset of winter in 1975. Arrowleaf balsamroot was the most abundant species in three of the four habitat types, accounting for 65 percent of the total production. Idaho fescue was most abundant in one type, comprising 28 percent of the total. Downy chess brome and common salisfy provided 6 percent and 2 percent of the total, respectively.

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NUTRITIONAL VALUES OF MAJOR MULE DEER WINTER FORAGE SPECIES IN THE BRIDGER MOUNTAINS, MONTANA

by

MARY ALICE MORTON

A thesis submitted in partial fulfillment
of the requirements for the degree

of

MASTER OF SCIENCE

in

Fish and Wildlife Management

Approved:

Chairperson, Graduate Committee

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MONTANA STATE UNIVERSITY
Bozeman, Montana

December, 1976

ACKNOWLEDGMENT

To the following, the author wishes to express her sincere appreciation for their contributions to this study: Dr. Richard J. Mackie, Montana State University, who directed the study and aided in preparation of the manuscript; Dr. Robert L. Eng and Dr. William Gould, Montana State University, for reviewing the manuscript; Dr. Don C. Quimby, retired, and Dr. Theodore Weaver, Montana State University, for advice and encouragement during the course of the study; Mr. Arnold Foss, Regional Game Manager, Montana Fish and Game Department, for cooperation in supplying equipment and advice on technical matters; Mr. Kenneth Greer, Montana Fish and Game Department Laboratory Supervisor, for use of the laboratory facilities; and to my many friends and fellow graduate students, especially Dave Pac, who gave their assistance and moral support. The author would also like to thank local landowners for their friendship and help, especially Mrs. Ralph Armstrong, Mr. and Mrs. Claude Maher and Mr. Lloyd Maher. The author was supported by the Montana Fish and Game Department under Federal Aid Projects W-120-R-6, W-120-R-7, W-130-R-6, and W-130-R-7.

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ABSTRACT

Nutritional parameters of major mule deer winter forage species and maximum potential forage production of herbaceous plants were evaluated within each of four different habitat types on the west slope of the Bridger Mountains in southwestern Montana. Habitat types sampled were: *Agropyron spicatum/Festuca idahoensis* h.t., *Purshia tridentata/Agropyron spicatum* h.t., *Purshia tridentata/Artemisia tridentata* h.t., and *Artemisia tridentata/Festuca idahoensis* h.t. Six major forage species, big sagebrush, bitterbrush, arrowleaf balsamroot, common salsify, Idaho fescue and downy chess brome were sampled during early, mid, and late winter during 1974-75 and early and mid-winter 1975-76. In addition, samples were taken of Rocky Mountain juniper, chokecherry, nootka rose and Douglas fir. Big sagebrush had the highest protein content of the browse species, 9.8 percent during the winter of 1974-75 and 9.4 percent in 1975-76, while nootka rose had the least, 5.2 percent in 1974-75 and 5.4 percent in 1975-76. Arrowleaf balsamroot had the highest protein content of the herbaceous species, 6.3 percent in 1974-75 and 5.8 percent in 1975-76, while downy chess brome had the least, 2.6 percent in 1974-75 and 4.0 percent in 1975-76. Big sagebrush had the lowest crude fiber level, approximately 17.0 percent during both winters. Downy chess brome had the highest crude fiber content, approximately 40 percent during both winters. The evergreen species, big sagebrush, juniper, and Douglas fir, had the highest content of crude fat during both winters and downy chess brome had the least. Arrowleaf balsamroot had the highest level of ash content during both winters and also contained the greatest amounts of calcium during 1975-76, 2.61 percent. Chokecherry and juniper were also high in calcium content (1.53 and 1.04 percent, respectively). Several significant differences were found in nutrient levels of certain species from different habitat types. Significant variations from year to year were also noted. Four herbaceous species provided an estimated total of 104,095 kilograms of plant matter within the combined areas of the four habitat types at the onset of winter in 1975. Arrowleaf balsamroot was the most abundant species in three of the four habitat types, accounting for 65 percent of the total production. Idaho fescue was most abundant in one type, comprising 28 percent of the total. Downy chess brome and common salisfy provided 6 percent and 2 percent of the total, respectively.

INTRODUCTION

Until the late 1940's mule deer *(Odocoileus hemionus)* were a scarce sight in the Bridger Mountains of southwestern Montana. Local residents reported increasing numbers in the 1950's and this increase was documented by Wilkins (1957) who undertook the first study of mule deer range use, food habits and population distribution on the Armstrong Winter Range. Browse utilization and condition surveys were conducted by the Montana Fish and Game Department in the spring from 1957 through 1960 and 1965 through 1967. Schwarzkoph (1973), who performed a study similar to that of Wilkins, reported a dramatic reduction in population numbers and continued deterioration of the range. Buscis (1974) evaluated ecological conditions and habitat relationships on this browse-type winter range as well as the production and utilization of important browse forage species. Data on the nutritional composition of major winter forage species, both browse and herbaceous, were lacking. The present study was established: (1) to provide base information on the nutritional composition of several major winter forage species; (2) to evaluate nutrient content of these plants on different habitat types; and (3) to provide information on the contribution of certain herbaceous species to forage production.

Field studies were conducted on a full time basis during the winters of 1974-75 and 1975-76 and part time during the spring,

summer and fall of 1975.

DESCRIPTION OF THE STUDY AREA

The Bridger Mountains (Fig. 1) are located in southwestern Montana, northeast of Bozeman. The range extends from Bridger Canyon 37 kilometers (23 miles) northward to Blacktail Mountain. The geology of the Bridger Range has been described by McMannis (1955).

The Armstrong Mule Deer Winter Range is located on a westerly projection of the main Bridger Range 32 kilometers (20 miles) north of Bozeman. Buscis (1974) described the area as encompassing 510 hectares (1260 acres) of lower mountains and footslopes bordered by North Cottonwood Creek on the north and Bill Smith Creek on the south. The northern portion of the study area is generally of west-facing aspect dissected by east-west drainages. From the central portion to the southern boundary of the study area the aspect shifts to the southwest and south, dissected by northeast-southwest and north-south drainages. Slope gradients are severe, commonly being 50 percent or more.

Buscis delineated fourteen different habitat types, arranged in a mosaic-like pattern on the study area (Fig. 2). In this study, four major-use habitat types were chosen as sites for sampling principal mule deer forage species. These habitat types were selected on the basis of previous studies conducted on the winter range. Although vegetational classification schemes of Wilkins (1957) and Schwarzkoph (1973) differ from the present one, both authors cite the sagebrush-

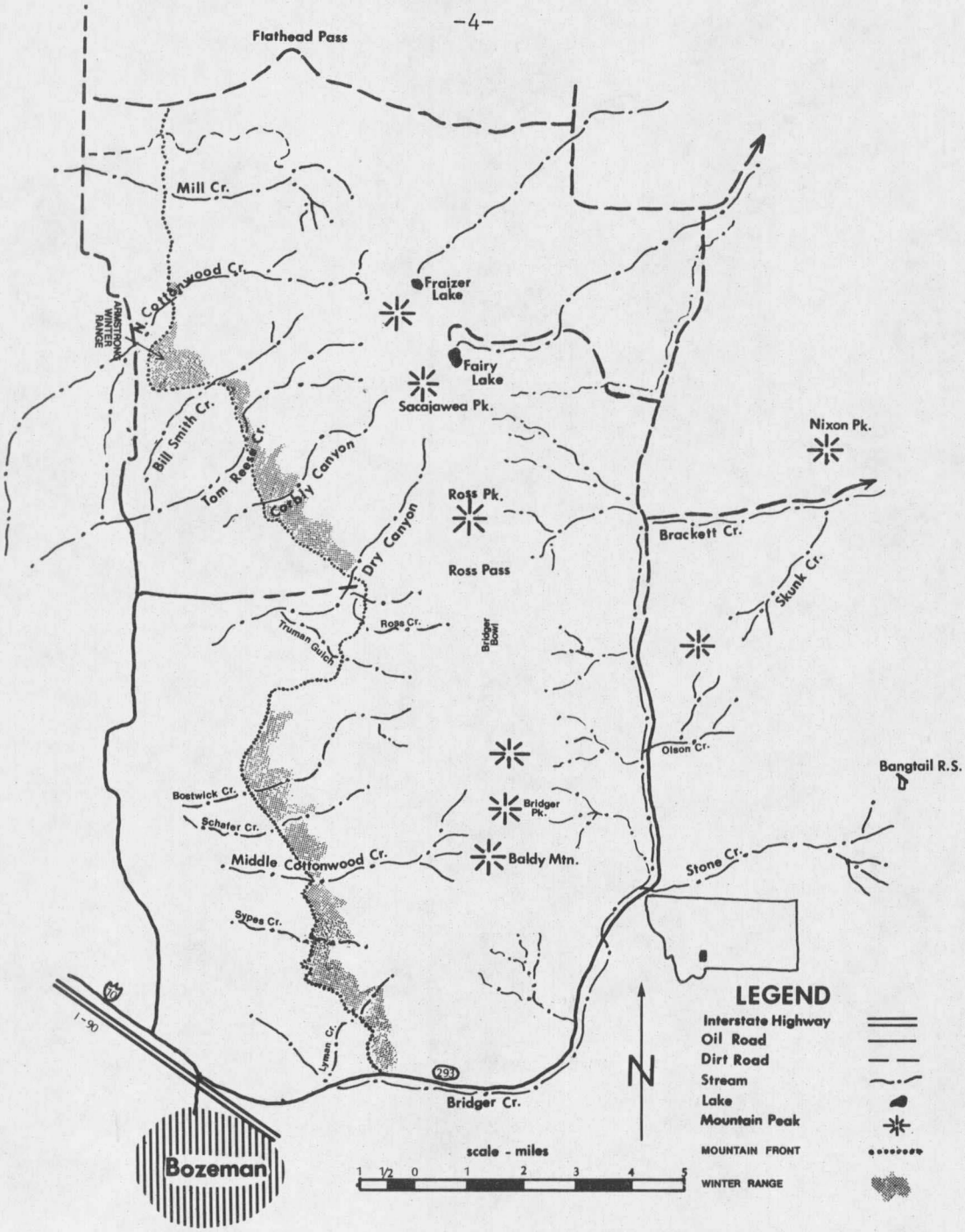


Figure 1. Map of the Bridger Range showing major features and location of the Armstrong Winter Range.



Figure 2. Aerial view of the Armstrong Winter Range showing habitat types defined by Buscis (1974).

1. *Festuca idahoensis/Agropyron spicatum*
2. *Agropyron spicatum/Agropyron smithii*
3. *Purshia tridentata/Agropyron spicatum*
4. *Purshia tridentata/Artemisia tridentata*
5. *Artemisia tridentata/Festuca idahoensis*
6. *Acer glabrum/Philadelphus lewisii*
7. *Populus tremuloides-Prunus virginiana/Symphoricarpos albus*
8. *Juniperus scopulorum-Purshia tridentata/Artemisia tridentata*
9. *Juniperus scopulorum-Purshia tridentata/Agropyron spicatum*
10. *Juniperus scopulorum-Purshia tridentata/Festuca idahoensis*
11. *Pseudotsuga menziesii/Prunus virginiana*
12. *Pseudotsuga menziesii/Symphoricarpos albus*
13. *Pseudotsuga menziesii/Festuca idahoensis*
14. *Pseudotsuga menziesii/Carex geyeri*

bitterbrush and bitterbrush types as major-use areas. Mackie *et al.* (1976) documented the importance of three of the four habitat types chosen in terms of mule deer use. The fourth habitat type was chosen due to its increased use during the late winter-early spring period as shown by Wilkins (1957) and Schwarzkoph (1973).

Festuca idahoensis/Agropyron spicatum (FEID/AGSP) h.t.

This type encompasses 57.1 hectares (141 acres) of the winter range, occurring on the footslopes and lower, steep west-facing mountain slopes up to 1890 meters (6200 feet) on the northern portion of the study area. Dominant and distinguishing species are Idaho fescue *(Festuca idahoensis)* and bluebunch wheatgrass *(Agropyron spicatum)*.

Buscis (1974) reported that samples from three sites indicated that soils are sandy loam in texture, slightly acid to neutral, low to very low in phosphorus content, high in potassium content, medium in organic matter content and very low in salt content. Soil samples from slope gradients of 10 and 58 percent indicated that infiltration rate is moderate, available water holding capacity is medium, permeability is medium and the soils are well drained.

Purshia tridentata/Agropyron spicatum (PUTR/AGSP) h.t.

This type encompasses 36.4 hectares (90 acres) of the winter range and is limited to lower steep mountain slopes having south, southwest and southeast exposures below 1859 meters (6100 feet). Antelope

bitterbrush *(Purshia tridentata)* is the dominant shrub species while bluebunch wheatgrass and downy chess brome *(Bromus tectorum)* are the dominant grasses.

According to Buscis (1974) the soils of six sites show that, in general, they are of sandy loam texture, slightly acidic to neutral, very low in phosphorus content, medium to low in potassium content, low to very low in organic matter content and very low in salt content. Samples from slope gradients of 11 and 60 percent showed that the infiltration rate is moderate, available water holding capacity is very low, permeability is medium to rapid and the soil is well drained.

Purshia tridentata/Artemisia tridentata (PUTR/ARTR) h.t.

This type contains 57.9 hectares (143 acres) of the winter range and is characterized by mixed stands of antelope bitterbrush and big sagebrush *(Artemisia tridentata)*. It occurs in the central portion of the study area on steep southerly and southwesterly exposed slopes below 1951 meters (6400 feet).

Buscis (1974) reported that soils from 10 sites indicate a sandy loam texture, slightly acid to slightly alkaline, low in phosphorus content, medium to high in potassium content, low to medium in organic matter content, and very low in salt content. On a slope of 55 percent, the infiltration was found to be moderate, available water holding capacity low, permeability medium and the soil is well drained.

Artemisia tridentata/Festuca idahoensis (ARTR/FEID) h.t.

This type occurs on 84.2 hectares (208 acres) of the winter range on footslopes, mountain slopes of west, southwest and south exposures and on ridges below 2134 meters (7000 feet). Big sagebrush is the dominant shrub species. Major grasses are bluebunch wheatgrass, Idaho fescue and junegrass *(Koeleria cristata)*.

Buscis (1974) reported that soils from 7 sites were generally sandy loam in texture, slightly acid to neutral, very low to low in phosphorus content, high in potassium content, variable in organic matter content, and very low in salt content. Samples from slope gradients of 13 and 45 percent showed that infiltration rate is moderate, available water holding capacity is low, permeability is medium and the soil is well drained.

For a more detailed description of these and other habitat types found on the Armstrong Winter Range, see Buscis (1974).

Mackie *et al.* (1976) defined the Armstrong Winter Range proper as an area consisting of 319 hectares (788 acres), eliminating a large portion of the upper winter range as classified by Buscis (Fig. 3). Within this area a critical winter range area of 109 hectares (269 acres) was also delineated. Mule deer use of the eliminated area is restricted during most winters due to the accumulation of snow, but is used extensively during spring, summer and fall and occasionally during mild winters (Pac 1976). Habitat types within this area have

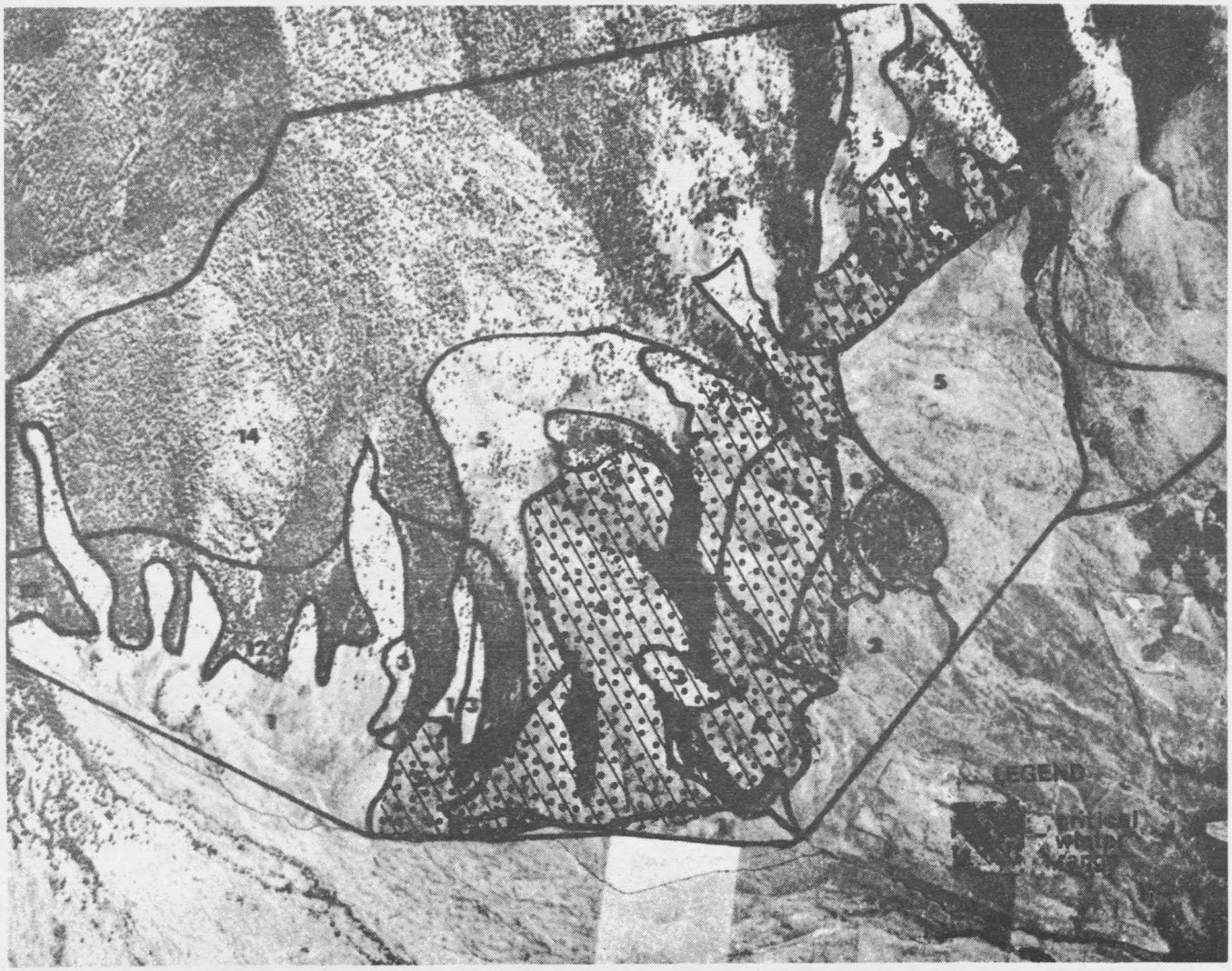


Figure 3. Aerial view of the Armstrong Winter Range and critical winter range area according to Mackie *et al.* (1976).

been modified (Pac 1976) to include dominant understory species *Calamagrostis rubescens*, *Symphoricarpos albus*, and *Agropyron spicatum* as well as the *Pseudotsuga menziesii/Carex geyeri* habitat type reported by Buscis (1974).

Climatological data for the Belgrade FAA weather station, located 16 kilometers (10 miles) southwest of the study area at 1357 meters (4451 feet), show a mean annual temperature of 3.7°C (38.6 F) for 1974. February was the coldest month and July the warmest, having average monthly temperatures of -10.2°C (13.6°F) and 20.4°C (68.7°F), respectively. Mean annual temperature for 1975 was 6.0°C (42.8°F) with January being the coldest month and July the warmest, having average monthly temperatures of -8.7°C (16.4°F) and 20.7°C (69.2°F), respectively. Total annual precipitation in 1974 was 45.95 centimeters (18.09 inches). October and July were the wettest months with 8.05 centimeters (3.17 inches) and 7.54 centimeters (2.97 inches) of precipitation, respectively. December was the driest month, having 1.83 centimeters (0.72 inches) of precipitation. Total annual precipitation in 1975 was 30.84 centimeters (12.14 inches) with May and August being the wettest months, having 6.20 centimeters (2.44 inches) and 4.47 centimeters (1.76 inches) of precipitation, respectively. February was the driest month with 0.38 centimeters (0.15 inches) of precipitation. Total annual snowfall was 91.95 centimeters (36.2 inches) in 1974 and 186.94 centimeters (73.6 inches) in 1975.

Snowfall during 1975 was 30 percent above the norm with 22.86 centimeters (9 inches) or more being received in January, February, March, May, October and November. Average monthly temperatures for January, February and March, 1976, were -6.4°C (20.5°F), -2.4°C (27.7°F) and -3.4°C (25.9°F), respectively. March, 1976, was the wettest month of the three, receiving 2.26 centimeters (0.89 inches) of precipitation and 26.7 centimeters (10.5 inches) of snowfall.

Mule deer arrive on the winter range during late fall and depart in May and June. A few animals utilize portions of the winter range throughout the year. Wilkins (1957) reported that mule deer were common in the area during 1955 and 1956. Mackie *et al.* (1976), based on information supplied by Wilkins (personal communication), estimated between 400 and 500 animals used the Armstrong Winter Range area at that time. Low productivity and high fawn mortality have been reported since 1971 (Schwarzkoph 1973, Hamlin 1974, Mackie *et al.* 1976, and Pac 1976). Mackie *et al.* (1976) estimate the wintering population on the study area to be 230 mule deer during 1973. Schwarzkoph (1973) reported that the male/female ratio at that time appeared to be 48/100. A fawn/doe ratio of 68/100 in December, 1972, was recorded with an estimated over-winter loss of 8-9 fawns/100 does. Hamlin (1974) reported a fawn/doe ratio of 46/100 on the winter range during December, 1973, and indicated a minimal loss of 24 percent of the fawns during the mild winter of 1973-74. The wintering population on Armstrong

Winter Range during January, 1975, was estimated at 200-220 mule deer. A fawn/doe ratio of 30/100 and a male/female ratio of 47/100 were reported during the early winter of 1974-75. By May, 1975, the population decreased to 140-150 animals, indicating a total mortality of 30-35 percent. It was estimated that 22 percent of the adults and 85-90 percent of the fawns did not survive the winter (Mackie *et al.* 1976). An estimated 140-150 deer returned to the winter range in the late fall of 1975. A fawn/doe ratio of about 10/100 existed at that time. Over-winter losses during the relatively mild winter of 1975-76 appeared to be minimal (Mackie, personal communication).

Cattle grazed the study area from the fall of 1974 through January, 1975, and again from April to early November, 1975.

Rocky Mountain elk *(Cervus canadensis)* have been observed on the study area in recent years. Observations of single animals and small groups were made during the winter and spring of 1974-75 and in the fall of 1975. Their use of the area appears to be sporadic during these seasons.

METHODS

Climatological Characteristics and Conditions

Climatological data for the Armstrong Winter Range were recorded at each of three stations during the course of the study. Temperature, relative humidity, wind mileage, solar radiation and precipitation during warmer months were recorded. Snow depth on the ground was recorded at weekly intervals at the lower station throughout the winter of 1974-75 and from November, 1975, through February, 1976.

The lower station was located on the periphery of the winter range at Armstrong Ranch at 1615 meters (5300 feet) and was equipped with a standard weather bureau rain gauge, hygrothermograph and solar radiation recorder. An upper station, containing a hygrothermograph and weather bureau type anemometer, was located at 1783 meters (5850 feet) within a fenced exclosure on a west-southwest facing mountain slope. This site was typical of most of the winter range. The third station, equipped only with a maximum-minimum thermometer, was located in the *Pseudotsuga menziesii/Festuca idahoensis* habitat type on a north facing slope at 1768 meters (5800 feet) elevation.

On four occasions during the study, hygrothermographs had to be removed for repairs. During those periods, daily temperatures were equated to those recorded at the Belgrade FAA weather station.

Food Habits

A one-quart rumen sample was obtained from each of 21 winter-killed deer during the late winter-early spring period of 1975. Preparation and analysis essentially followed Wilkins (1957). Volumes, to the nearest 0.1 percent, were then determined by water displacement. Material with a volume of less than 0.1 percent was recorded as "trace". The percentage of the stomach contents that any one item or general group constituted was computed by monthly periods according to the aggregate percentage method (Martin *et al.* 1946). Frequency of occurrence for each taxon or general group during any one period was calculated.

A few feeding site examinations were conducted throughout the winter and spring of 1974-75. Feeding sites were examined shortly after the animals vacated the area. One bite or nip of a browse plant, forb or grass constituted one instance of use. Instances of use were counted up to 100, after which a general 100+ category was employed. Due to the small number of feeding sites examined these data were not tabulated on a percentage basis but are used as supportive evidence of plant species utilized as forage by mule deer.

Nutritional and Mineral Analyses

On the basis of previous studies, which in part dealt with mule deer forage species on or adjacent to the Armstrong Winter Range (Wilkins 1957, Schwarzkoph 1973, Hamlin 1974, Buscis 1974), six plant

species were initially chosen for nutritional analysis. These included big sagebrush, bitterbrush, arrowleaf balsamroot *(Balsamorhiza sagittata)*, common salsify *(Tragopogon dubius)*, Idaho fescue and downy chess brome. During the course of the investigation, samples of four additional species previously known or found at the time to be utilized by deer in the area were collected where they occurred on the transects and/or within the habitat types concerned. These were Rocky Mountain juniper *(Juniperus scopulorum)*, chokecherry *(Prunus virginiana)*, nootka rose *(Rosa nutkana)* and Douglas fir *(Pseudotsuga menziesii)*.

Three transects, as delineated by Buscis (1974), within each of the four habitat types were selected as sampling sites for collections of plant materials for analysis (Fig. 4). One transect in the PUTR/AGSP habitat type was abandoned after the first collection and replaced by another at a different location within the same habitat type. Another in the ARTR/FEID habitat type was also abandoned after the first collection due to heavy accumulation of snow and was replaced by another at a different site within that habitat type.

Not all of the original six plant species occurred on each transect except in the case of the PUTR/ARTR habitat type where all plants were collected on two of the three transects. Also, although Idaho fescue was a dominant species within the ARTR/FEID habitat type, grazing by cattle prior to the onset of winter left little material available for collection. Throughout the winter, heavy snow



Figure 4. Aerial view of the Armstrong Winter Range outlining AGSP/FEID, PUTR/AGSP, PUTR/ARTR and ARTR/FEID habitat types with transect locations within each type.

accumulation and/or utilization of some species by mule deer on certain transects rendered collection of these species difficult or impossible. Douglas fir did not occur on any of the transects and samples were collected from the PSME/FEID habitat type as well as from the AGSP/FEID habitat type. During the mid-winter collecting period of 1975-76 a "green-up" of grass, primarily consisting of bluebunch wheatgrass and *Poa* spp., was noted at one of the transects in the PUTR/AGSP habitat type. A collection was made of this material.

Collection dates were early winter (mid-December), 1974-75 and 1975-76, mid-winter (early to mid-February), 1974-75 and 1975-76 and late winter (early April) 1974-75.

A spring collection of twelve different forb and grass species was made in late-May, early-June of 1975 on the winter range. Seven species were chosen on the basis of rumen analysis data reported by Wilkins (1957) where they occurred in volumes of one percent or greater. Five species were chosen due to their observed utilization by mule deer during the present study.

Only those plant parts utilized by deer were collected for analysis. Clipped material included current annual growth of big sagebrush, bitterbrush, chokecherry, nootka rose and Douglas fir. Leaves and flower heads of arrowleaf balsamroot, flower heads plus 2.5-5.0 centimeters (one to two inches) of the stems of common salsify and culms and tillers of the grass species were also clipped. In the case of

Rocky Mountain juniper, parts eaten by deer were estimated by observation of feeding animals. Parts collected were found to be of the same type contained within the rumen samples of the winter-killed deer. After the 1974-75 collections were made, feeding site examinations indicated that deer were taking flower heads plus only about 1.3-2.5 centimeters (0.5 to one inch) of the stems of common salsify. Less stem was included in samples of that species collected during 1975-76.

All plant samples were placed in plastic bags and brought into the laboratory within 24 hours after collection where they were weighed and oven-dried at 90°C for 24 hours. Oven-dried samples were then ground in a Wiley Mill using a 25 mesh screen and placed in air-tight 10cc glass bottles. All samples were sent to the Chemistry Station Analytical Laboratory on the Montana State University campus for nutritional and mineral analyses. Samples from all collecting periods were analyzed for protein content. Two sets of samples (late winter 1974-75 and mid-winter 1975-76) were also analyzed for moisture, ether extract, crude fiber and ash contents. Calcium, phosphorus, sodium and potassium mineral analyses for the late winter collecting period of 1974-75 were attempted in the laboratory and failed. These same analyses were done by the Chemistry Station for the mid-winter collection samples of 1975-76.

Forage Production of Herbaceous Species

Estimates of total forage produced and available by habitat type for sagebrush, bitterbrush and Rocky Mountain juniper on the Armstrong Winter Range were reported by Buscis (1974). I attempted to estimate relative availability and forage production only for the four herbaceous species (arrowleaf balsamroot, common salsify, Idaho fescue and downy chess brome) on the four habitat types from which samples were obtained for nutritional analysis. Sampling was conducted during October, 1975, and employed a modification of the canopy-coverage method (Daubenmire 1959). Five 2 X 5 decimeter plots were placed at each of four different locations within each habitat type for a total of twenty plots in each type. Percentage estimates of canopy coverage of each of the four species were recorded within each plot where they occurred. All plant material of the four species within each plot was then clipped and placed in plastic bags. These were brought into the laboratory where they were oven-dried at 90°C for 24 hours and weighed. Average canopy coverages and dry weights were then calculated for each species within each habitat type. Standing crop was calculated by multiplying the average dry weight in grams per decimeter by 100.

Mule Deer Observations

Observations of mule deer, including individually recognizable (collared) animals, were recorded whenever possible during the winter

of 1974-75 to further evaluate distributions, movements, habitat usage and population trends on the Armstrong Winter Range.

RESULTS

Climatological Characteristics and Conditions

Average monthly temperatures recorded at three locations on the Armstrong Winter Range were warmer from October, 1974, through January, 1975, than the 22-year monthly averages for the Belgrade weather station, 16 kilometers (10 miles) to the southwest (Table 1). From February, 1975, through June, 1975, average monthly temperatures were generally cooler on the winter range than the Belgrade averages, particularly during the month of April. Summer and fall temperatures during 1975 were generally near the 22 year Belgrade averages. During the period November, 1975, through March, 1976, temperatures on the study area were equal to or warmer than the 22 year average.

Temperatures at Armstrong Ranch (lower station) were very similar to those recorded in the PUTR/ARTR habitat type (upper station). Temperatures recorded in the PSME/FEID habitat type showed more variation than those at the other sites. Some difference may be accounted for by the calculation of average temperatures on the basis of bi-monthly maximum-minimum readings at this site as opposed to daily hygrothermograph recordings at the other two sites. In addition, this site was on a north-facing slope in contrast to the west-southwest exposure of the site in the PUTR/ARTR habitat type.

TABLE 1. MEAN MONTHLY TEMPERATURES AT THREE WEATHER STATIONS ON THE ARMSTRONG WINTER RANGE, OCTOBER, 1974, THROUGH MARCH, 1976, AND THE 22-YEAR AVERAGES (1952-1973) AT BELGRADE, MONTANA.

	Armstrong Winter Range						Belgrade	
	Armstrong Ranch		PUTR/ARTR h.t.		PSME/FEID h.t.			
	°F	°C	°F	°C	°F	°C	°F	°C
1974								
October	49.4	9.7	52.2	11.2	49.8	9.9		
November	35.4	1.9	35.2	1.8	34.0	1.1		
December	25.4	-3.7	25.4	-3.7	25.8	-3.4		
1975								
January	23.8	-4.6	23.3	-4.8	19.2	-7.1	17.1	-8.3
February	23.0	-5.0	23.3	-4.8	18.5	-7.5	23.5	-4.7
March	26.5	-3.1	26.5	-3.1	25.3	-3.7	28.8	-1.8
April	30.5	-0.8	30.5	-0.8	30.0	-1.1	40.1	4.5
May	44.7	7.1	44.1	6.7	47.5	8.6	50.7	10.4
June	55.6	13.1	51.7	10.9	54.3	12.4	58.7	14.8
July	67.2	19.6	68.7	20.4	62.8	17.1	66.7	19.3
August	61.0	16.1	62.0	16.7	64.0	17.8	65.6	18.7
September	54.1	12.3	58.2	14.6	57.3	14.1	54.4	12.4
October	43.3	6.3	44.7	7.1	44.5	6.9	44.2	6.8
November	30.1	-1.1	29.7	-1.3	39.3	4.1	30.7	-0.7
December	29.4	-1.4	30.4	-0.9	21.5	-5.8	21.5	-5.8
Mean	40.8	4.9	41.1	5.1	40.4	4.7	41.8	5.4
1976								
January	27.2	-2.7	28.6	-1.9	28.5	-1.9		
February	29.1	-1.6	30.2	-1.0	23.3	-4.8		
March	27.2	-2.7	26.5	-3.1	25.5	-3.6		

Monthly maximum and minimum temperatures recorded in the PUTR/ARTR and PSME/FEID habitat types are shown in Figure 5. The site in the PUTR/ARTR habitat type generally had warmer maximum temperatures than the PSME/FEID habitat type site. Minimum temperatures at the two sites paralleled each other during most months.

Recorded precipitation on Armstrong Winter Range was generally greater than amounts received at Belgrade during the same months (Table 2). Both Armstrong Winter Range and Belgrade received above average precipitation during the course of the study when compared with the 22 year annual average 34.11 centimeters (13.43 inches) at Belgrade. June was the wettest month on the study area during 1975 with 15.29 centimeters (6.02 inches) of precipitation recorded. October, 1975, was the wettest month at Belgrade when 8.05 centimeters (3.17 inches) of precipitation were received. The driest month at Belgrade during 1975 was December with 1.83 centimeters (0.72 inches) of precipitation being recorded. May and June are typically the wettest months at Belgrade according to the 22 year average, having precipitation means of 5.46 centimeters (2.15 inches) and 6.53 centimeters (2.57 inches), respectively. February is generally the driest month, receiving an average of 0.97 centimeters (0.38 inches) of precipitation.

Total monthly snowfall was not recorded on Armstrong Winter Range. Weekly measurements of snow depth were made at Armstrong Ranch during the winter months and appear in Appendix Table 16. Total snowfall

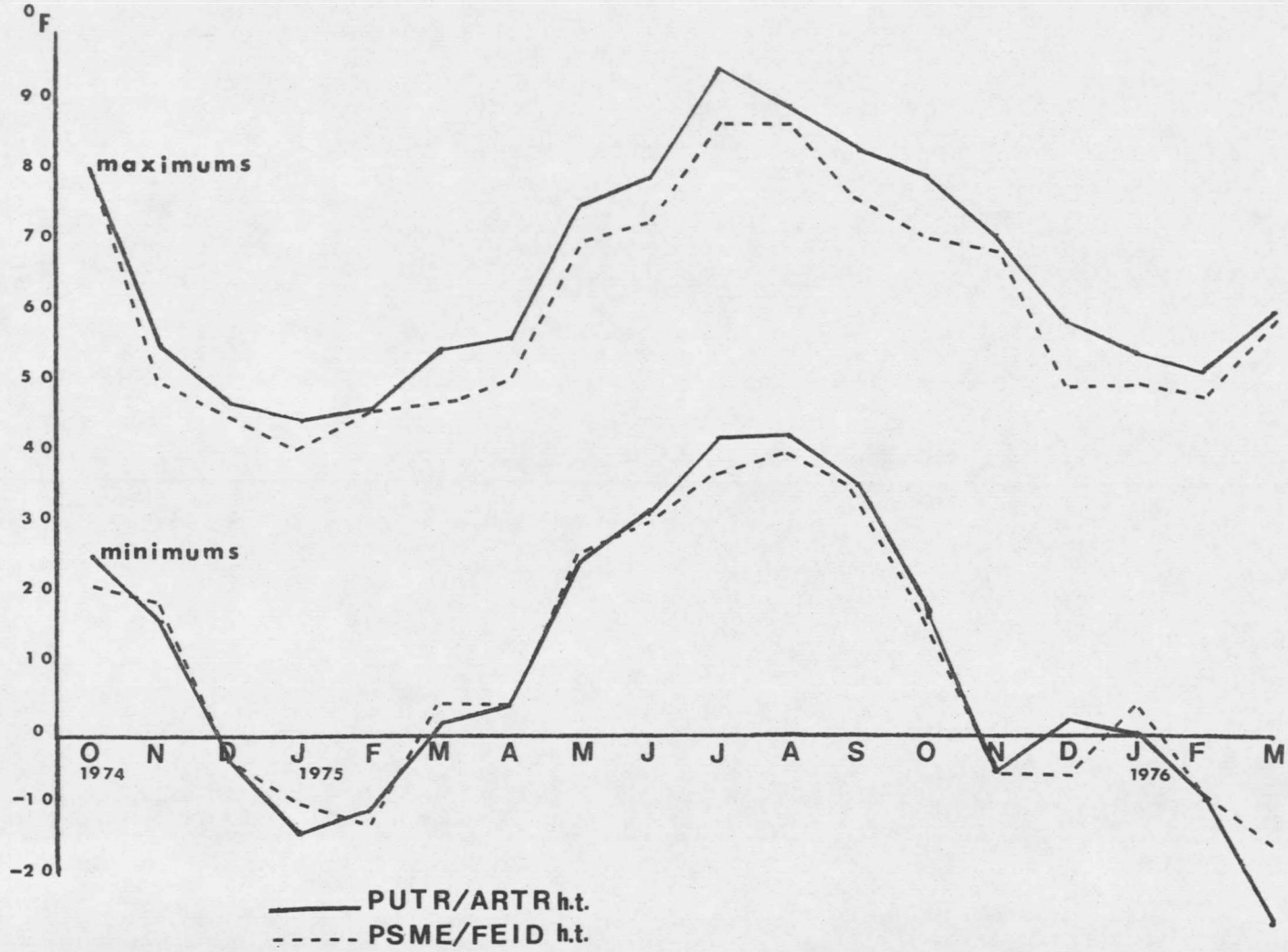


Figure 5. Monthly maximum and minimum temperatures at two sites on Armstrong Winter Range, October, 1974, through March, 1976.

TABLE 2. MONTHLY PRECIPITATION ON ARMSTRONG WINTER RANGE AND MONTHLY PRECIPITATION AND SNOWFALL AT BELGRADE, MONTANA, DURING OCTOBER, 1974, THROUGH MARCH, 1976, AND THE 22-YEAR AVERAGE (1952-1973) OF TOTAL PRECIPITATION AT BELGRADE, MONTANA.

	Precipitation						Snowfall	
	Armstrong Winter Range		Belgrade		Belgrade 22-Year Average		Belgrade	
	inches	centimeters	inches	centimeters	inches	centimeters	inches	centimeters
1974								
October	1.24	3.15	1.29	3.28			trace	-
November	0.72	1.83	0.84	2.13			1.7	4.3
December	-	-	1.25	3.18			8.7	22.1
1975								
January	-	-	1.30	3.30	0.65	1.65	11.8	30.0
February	-	-	1.52	3.86	0.38	0.97	11.7	29.7
March	-	-	1.05	2.67	0.84	2.13	9.2	23.4
April	-	-	0.86	2.18	1.18	3.00	4.9	12.4
May	3.63	9.22	2.12	5.38	2.15	5.46	10.4	26.4
June	6.02	15.29	1.61	4.09	2.57	6.53	0.0	0.0
July	2.81	7.14	2.97	7.54	0.99	2.49	0.0	0.0
August	1.92	4.88	1.04	2.64	1.17	2.97	0.0	0.0
September	1.12	2.84	0.76	1.93	1.20	3.05	0.0	0.0
October	3.75	9.53	3.17	8.05	1.07	2.72	9.8	24.9
November	-	-	0.97	2.46	0.70	1.78	11.9	30.2
December	-	-	0.72	1.83	0.53	1.35	3.9	9.9
Totals	19.25	48.90	18.09	45.93	13.43	34.11	73.6	186.9
1976								
January	-	-	0.22	0.56			2.6	6.6
February	-	-	0.31	0.79			3.2	8.1
March	-	-	0.89	2.26			10.5	26.7

during 1975 at Belgrade was 186.9 centimeters (73.6 inches), 30 percent above average. Snowfall and accumulation of snow on Armstrong Winter Range during the mid and late winter period also were greater than normal. Snow endured longer during this period on south, southwest and west-facing slopes than during winters of average snowfall and temperature. During the winter of 1975-76, snowfall and accumulation of snow on the winter range was more typical than the previous winter.

During average winters, snow accumulations in the Douglas fir habitat types from mid-winter to early spring are 30.5 to 61.0 centimeters (12 to 24 inches) or more (Buscis 1974), impeding or preventing deer use of these areas.

Climatological data from the MSU weather station at Bozeman, for all winters since 1971-72, are shown in Table 3. The winter severity indicies (Picton and Knight 1971) show that the winter of 1974-75 was the most severe, particularly during the mid to late winter and early spring periods when average temperatures were generally cooler, greater amounts of snow were received which remained on the ground longer. The severity index for the winter of 1975-76 did not take into account the probable negative values for the months of April and May. If these figures were included it would be more evident that the winter was mild, especially during the mid and late winter periods.

TABLE 3. CLIMATOLOGICAL DATA, MSU WEATHER STATION, BOZEMAN, AND SEVERITY INDICIES, NOVEMBER THROUGH MAY, 1971-1975, NOVEMBER THROUGH MARCH, 1975-1976.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity[1] Index
November	1971	33.7	0.77	11.2	5	17	- 297
	1972	32.8	0.63	3.0	4	8	- 250
	1973	30.4	1.27	15.8	11	25	+ 104
	1974	35.1	0.67	4.7	2	10	- 377
	1975	30.5	1.33	20.5	12	15	+ 491
December	1971	20.8	0.56	11.1	10	31	+1161
	1972	18.6	0.49	12.2	4	23	+1047
	1973	29.5	1.29	20.5	13	16	+ 234
	1974	25.5	1.02	13.2	6	31	+ 284
	1975	30.0	1.10	15.8	6	22	+ 84
January	1972	19.1	0.86	13.8	10	31	+1068
	1973	19.2	1.10	16.6	9	31	+1837
	1974	21.3	0.42	5.8	14	25	+3743
	1975	22.8	1.58	22.9	14	31	+1369
	1976	26.6	0.60	8.7	9	28	+ 360
February	1972	31.0	0.66	10.2	6	27	- 75
	1973	24.4	0.04	1.8	8	28	+ 483
	1974	32.0	0.43	7.8	4	21	- 206
	1975	21.3	1.11	19.5	17	28	+1659
	1976	30.4	0.52	9.8	4	5	- 187
March	1972	41.0	1.24	13.6	8	8	- 586
	1973	33.9	1.89	23.0	11	31	- 303
	1974	32.6	1.71	24.7	7	26	- 206
	1975	29.1	1.08	20.7	9	31	+ 295
	1976	28.7	1.03	18.5	6	12	+ 262

TABLE 3. Continued.

		Ave. Temp. (°F)	Ppt. (in.)	Total Snowfall (in.)	Max. Snow Depth (in.)	No. Days Snow on Ground	Severity[1] Index
April	1972	41.3	1.91	21.9	4	5	- 652
	1973	38.9	2.84	34.7	14	14	- 520
	1974	45.8	1.87	3.2	0	0	- 764
	1975	32.9	1.77	16.1	8	24	- 141
May	1972	50.7	1.73	trace	1	0	- 958
	1973	51.4	1.44	1.3	trace	0	- 989
	1974	48.3	3.00	12.1	3	3	- 880
	1975	46.9	4.88	21.5	9	6	- 803
Nov.- May	1971-72	33.9	7.7	81.8	10	119	- 329
	1972-73	31.3	8.4	92.6	14	135	+1335
	1973-74	34.3	10.0	89.9	14	116	+2025
	1974-75	30.5	12.1	118.6	17	161	+2286
Nov.- March	1975-76	29.2	4.6	73.3	12	82	+1010
20 Year Ave.		32.4	9.5				

[1]+ Values indicate greater severity.

From October 1 through December 31, 1974, 27.2 percent of the days were clear, 32.6 percent were brightly overcast to moderately cloudy and 40.2 percent were heavily overcast (Table 4). During 1975,

TABLE 4. NUMBER OF DAYS WHICH WERE GENERALLY CLEAR (C), MODERATELY CLOUDY (M), AND HEAVILY OVERCAST (O) ON ARMSTRONG WINTER RANGE, OCTOBER, 1974, THROUGH MARCH, 1976.

	1974			1975			1976		
	C	M	O	C	M	O	C	M	O
January				5	9	17	3	17	11
February				1	16	11	5	19	5
March				2	21	8	9	18	4
April				4	20	6			
May				2	21	8			
June				3	15	12			
July				13	16	2			
August				12	12	7			
September				20	5	5			
October	16	12	3	5	9	17			
November	4	13	13	3	8	19			
December	5	5	21	4	12	15			
Totals	25	30	37	74	157	134	17	54	20

20.3 percent of the days were clear, 43.0 percent were moderately cloudy and 36.7 percent were heavily overcast. January, February, October, November and December, 1975, had the largest number of heavily overcast days while July through September, 1975, had the largest number of clear days. February through June, 1975, had the fewest clear days. From January through March, 1976, 18.7 percent of the days were clear, 59.3 percent were moderately cloudy and 22.0 percent were heavily overcast.

The weather bureau type anemometer located in the PUTR/ARTR habitat type recorded an average of 1764.9 miles of wind per month during 1975 (Table 5). May and June had the largest amounts of wind (2160.5 and 2058.3 miles per month, respectively) while July had the least (1219.4 miles per month). From October 1 through December 31, 1974, the wind blew an average of 1579.9 miles per month. During the period January 1 through March 31, 1976, the average miles of wind per month was 1981.9. The largest amount of wind recorded during one month during the course of the study was 2246.7 miles in March, 1976. Prevailing winds are usually from the west-southwest on the study area and greatest amounts of wind generally occur during the winter and spring months.

Food Habits

Wilkins (1957) determined that browse was the most extensively used forage in the winter food habits of mule deer on Armstrong Winter Range, while forbs ranked second and grass third. During the spring, use of forbs and grass was about equal and browse was utilized the least. Schwarzkoph (1973) also found that browse was the primary item in the diet of mule deer on the study area during winter, but grass ranked second and forbs third. During the early spring, the order of forage classes remained the same but forb use was almost equal to that of grass. Both of these studies cited the importance of big sagebrush

TABLE 5. TOTAL MILES OF WIND PER MONTH, AVERAGE WIND PER DAY AND AVERAGE MILES PER HOUR RECORDED ON ARMSTRONG WINTER RANGE, OCTOBER, 1974, THROUGH MARCH, 1976.

	Miles of Wind Per Month	Average Wind Per Day	Average Miles Per Hour
1974			
October	1429.5	46.1	1.9
November	1660.1	55.3	2.3
December	1650.0	53.2	2.2
Mean	1579.9	51.5	2.1
1975			
January	2029.9	65.5	2.7
February	1622.3	57.9	2.4
March	1834.4	59.2	2.5
April	1844.0	61.5	2.6
May	2160.5	69.7	2.9
June	2058.3	68.6	2.9
July	1219.4	39.3	1.6
August	1561.7	50.4	2.1
September	1499.6	50.0	2.1
October	1802.6	58.2	2.4
November	1935.8	64.5	2.7
December	1611.1	52.0	2.2
Mean	1764.9	58.1	2.4
1976			
January	1743.7	56.3	2.3
February	1955.2	67.4	2.8
March	2246.7	72.5	3.0
Mean	1981.9	65.4	2.7

and Rocky Mountain juniper during the mid to late winter and early spring periods. Bitterbrush use decreased throughout the winter and use of Douglas fir increased toward late winter. Important forbs mentioned by both authors were arrowleaf balsamroot and alfalfa *(Medicago sativa)*.

Additional data on late winter and early spring food habits of mule deer on the Armstrong Range, as determined by rumen analysis of 21 winter-killed deer during 1975, are presented in Table 6. The results of 13 supplemental feeding site examinations conducted through the winter of 1974-75 appear in Table 7.

Browse constituted 56.5 percent by volume of the contents of three rumens collected in March. Rocky Mountain juniper was the most important browse species, followed closely by big sagebrush and Douglas fir. Forbs were of little importance, constituting only 0.1 percent by volume of the rumen contents. Grass and grass-like plants, especially dry grass, were important items, totaling 43.4 percent by volume of the rumen contents.

The results for April may be somewhat atypical. Large amounts of alfalfa occurred in three of the four rumens collected during that period when many deer were utilizing a bait-trap area on the winter range. Because of its artificial nature, volumes constituted by alfalfa were not included in the April calculations. Thus, the importance of grass (71.6 percent by volume) as a forage item in the

TABLE 6. MULE DEER FOOD HABITS ON ARMSTRONG WINTER RANGE DURING LATE WINTER AND EARLY SPRING, 1975, AS DETERMINED BY ANALYSIS OF 21 RUMEN SAMPLES. T=trace amounts of <0.1%).

Plants	March Three Rumen Samples Freq./% Vol.	April Four Rumen Samples Freq./% Vol.	May Fourteen Rumen Samples Freq./% Vol.
Artemisia tridentata	67/18.6	50/T	86/21.8
Ceanothus velutinus	-	-	7/0.1
Crataegus spp.	-	-	7/5.2
Juniperus scopulorum	100/22.2	50/26.0	93/13.9
Prunus virginiana	-	-	29/0.2
Pseudotsuga menziesii	100/15.6	-	57/8.9
Purshia tridentata	33/0.1	-	64/0.1
Ribes lacustre	-	-	7/T
Rosa nutkana	-	-	7/T
Salix spp.	-	-	7/T
Symphoricarpos albus	-	-	7/T
Unidentified browse	-	50/0.1	86/6.6
Browse totals	100/56.5	75/26.1	100/56.8
Achillea millefolium	-	-	50/T
Antennaria spp.	-	-	7/T
Balsamorhiza sagittata	-	25/1.7	86/1.9
Berberis repens	-	-	7/T
Cerastium arvensis	-	-	79/0.3
Chrysopsis villosa	-	-	7/T
Cirsium foliosum	-	-	14/T
Fabaceae (Leguminosae)	-	-	7/T
Geum triflorum	-	-	7/T
Lithophragma parviflora	-	-	7/T
Lupinus sericeus	-	-	7/T
Medicago sativa	-	-	7/T
Ranunculus spp.	-	-	7/T
Rosaceae	-	-	7/T
Taraxicum officinale	-	25/0.4	-
Trifolium pratensis	-	-	7/T
Unidentified forbs	33/0.1	25/0.2	71/3.5
Forb totals	33/0.1	50/2.3	100/3.5

TABLE 6. Continued.

Plants	March Three Rumen Samples Freq./% Vol.	April Four Rumen Samples Freq./% Vol.	May Fourteen Rumen Samples Freq./% Vol.
Bromus tectorum	-	-	7/T
Carex geyeri	33/1.2	-	-
Hay	-	-	7/1.5
Dry grass	100/42.2	100/67.3	100/34.2
Green grass	-	100/4.3	100/3.7
Grass totals	100/43.4	100/71.6	100/39.4
Selaginella densa	-	-	29/T
Foliose lichen	-	-	14/0.2
Lichen totals	-	-	43/0.2

TABLE 7. FREQUENCIES AND RELATIVE LEVELS OF USE ON SEVERAL MULE DEER FORAGE SPECIES ON ARMSTRONG WINTER RANGE AS DETERMINED BY 13 FEEDING SITE EXAMINATIONS. H = HEAVY USE (>100 BITES/SITE), M = MODERATE USE (50-100 BITES/EXAM), AND L = LIGHT USE (<50 BITES/EXAM).

Plants	January 5 Feeding Sites Freq./Use	February 5 Feeding Sites Freq./Use	April 1 Feeding Site Freq./Use	May 2 Feeding Sites Freq./Use
Artemisia tridentata	20/H	40/H	100/H	-
Juniperus scopulorum	-	-	100/H	-
Purshia tridentata	60/H	40/H	-	-
Rosa nutkana	-	20/H	100/L	-
Balsamorhiza sagittata	60/M	20/H	-	50/H
Tragopogon dubius	40/L	-	-	-
Agropyron spicatum	20/M	-	-	-
Festuca idahoensis	-	-	-	50/M
Koeleria cristata	-	-	-	50/M
Unidentified grass	-	-	-	50/M

diet may have been exaggerated. Browse accounted for 26.1 percent by volume of the rumens with Rocky Mountain juniper being the most important browse species. Forb use increased to 2.3 percent by volume of the rumens but still remained minimal. Arrowleaf balsamroot was the most important forb item.

The contents of fourteen rumen samples collected in May were similar to those of March. Browse constituted 56.8 percent by volume of the rumen contents with big sagebrush, Rocky Mountain juniper and Douglas fir, respectively, being the most important species. Forb use remained minimal but increased to 3.5 percent by volume of the rumen contents. Though most of the forbs were in new growth stages, many dessicated species were also eaten. Arrowleaf balsamroot remained the most important forb species. Grass and grass-like plants constituted 39.4 percent by volume of the rumens.

On feeding sites, big sagebrush was extensively used throughout the mid to late winter and early spring periods. Rocky Mountain juniper was generally observed to be heavily utilized during late winter and early spring but occurred in only one feeding site examination, due to difficulty in counting instances of use. Bitterbrush use was heavy during early and mid-winter but decreased toward late winter, as was evidenced also by the contents of rumen samples. Decrease in use of this species might have been correlated with decreased availability as winter progressed. Arrowleaf balsamroot

appeared to be the most heavily used forb item during the course of the study. Throughout the winter, deer utilized dried leaves and flower heads of this species. During early and mid-May, new growth was available and eaten in small amounts. The importance of balsamroot in the diet of mule deer during winter and spring has been documented by Wilkins (1957), Schwarzkoph (1973), Buscis (1974) and Nellis (1969) in Montana, as well as by Trout and Thiessen (1973) in Idaho. The only observed instance of use on dried grass was in January when bluebunch wheatgrass was moderately utilized. Junegrass was one of the first grasses to "green-up" during early spring and was heavily used at one feeding site in May. Idaho fescue and other grasses were observed to be taken as soon as they became succulent.

These results were similar to those of Wilkins (1957) and Schwarzkoph (1973) with respect to forage selection and utilization during the principal winter period. However, due to the severity of the late winter and early spring periods, normal phenology was delayed, possibly for as long as three weeks, making it difficult or impossible for the deer to obtain new green growth until mid-May. Their reliance upon winter staples and emergency foods during the late winter-early spring period was evident from rumen analyses, particularly those collected during the month of May, as well as from feeding site examinations. The majority of the grass and many of the forbs which appeared in the rumens were dessicated and not in new growth stages.

Nutritional and Mineral Analyses

All percentages pertaining to nutritional and mineral analyses are expressed on an air dry weight basis. Moisture percentages of the major mule deer forage species collected on the study area are presented in Appendix Table 17.

Protein

Average protein contents of each mule deer forage species sampled on the Armstrong Winter Range during the winters of 1974-75 and 1975-76 are shown in Table 8 and Figure 6. Protein contents of these species

TABLE 8. AVERAGE PROTEIN CONTENT OF MAJOR MULE DEER FORAGE SPECIES COLLECTED ON ARMSTRONG WINTER RANGE DURING THE WINTERS OF 1974-75 AND 1975-76. (Percent air dry weight)

Plant	1974-75	1975-76
Artemisia tridentata	9.8	9.4
Purshia tridentata	8.3	9.2*
Juniperus scopulorum	7.9	7.7
Prunus virginiana	8.8	9.6
Rosa nutkana	5.2	5.4
Pseudotsuga menziesii	7.0	5.9
Balsamorhiza sagittata	6.3	5.8*
Tragopogon dubius	4.4	5.8*
Festuca idahoensis	4.6	5.0
Bromus tectorum	2.6	4.0*

*Indicates a significant ($p<0.05$) change in protein content from year to year.

during each of three collection periods in 1974-75 and two collection periods in 1975-76 are presented in Appendix Tables 18, 19 and 20.

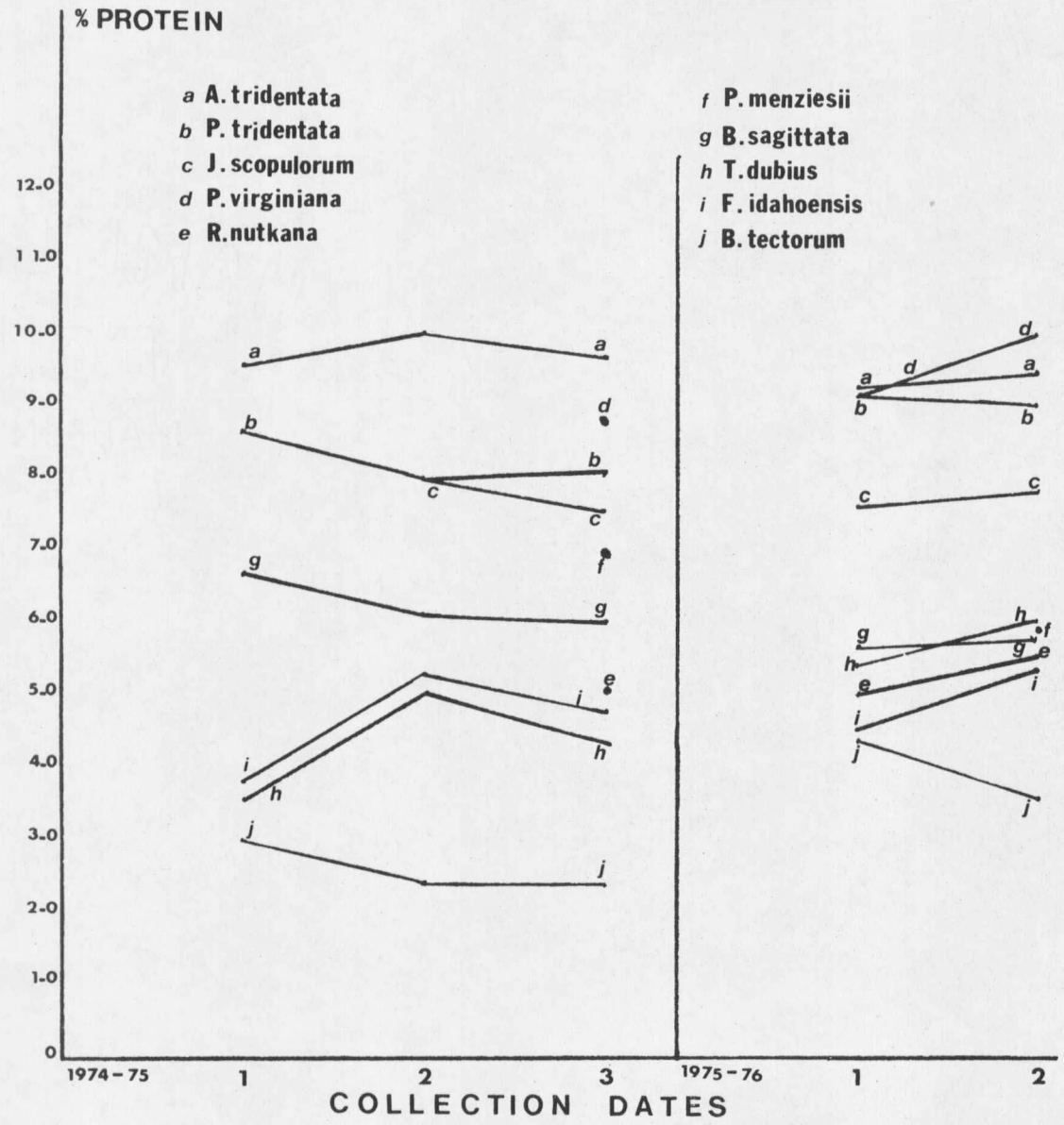


Figure 6. Average protein content of each major mule deer forage species collected on Armstrong Winter Range.

Artemisia tridentata. —— During 1974-75 the average protein content of big sagebrush from all habitat types sampled was 9.6 percent for early winter (December), 10.0 percent during mid-winter (February) and 9.7 percent in late winter (early April). In 1975-76, average protein content of this species was 9.3 percent and 9.5 percent for the early and mid-winter periods, respectively. The over winter averages, 9.8 percent for the winter of 1974-75 and 9.4 percent for 1975-76, were not significantly different.

Comparisons of protein values for big sagebrush among the three habitat types on which it occurred are shown in Figure 7. Protein contents varied considerably between types and between collection periods. Overall values for the PUTR/ARTR habitat type for the winters of 1974-75 and 1975-76 combined were significantly higher ($p<0.01$, $p<0.025$) than those obtained from big sagebrush in the ARTR/FEID habitat type.

Purshia tridentata. —— The average protein contents of bitterbrush on the two habitat types where it occurred were 8.7 percent, 8.0 percent and 8.1 percent for early, mid and late winter, respectively, during 1974-75. The averages for the winter of 1975-76 were 9.2 percent and 9.1 percent for the early and mid-winter periods, respectively. The overall average protein content of this species increased significantly ($p<0.01$) from 8.3 percent during the winter of 1974-75 to 9.2 percent for 1975-76.

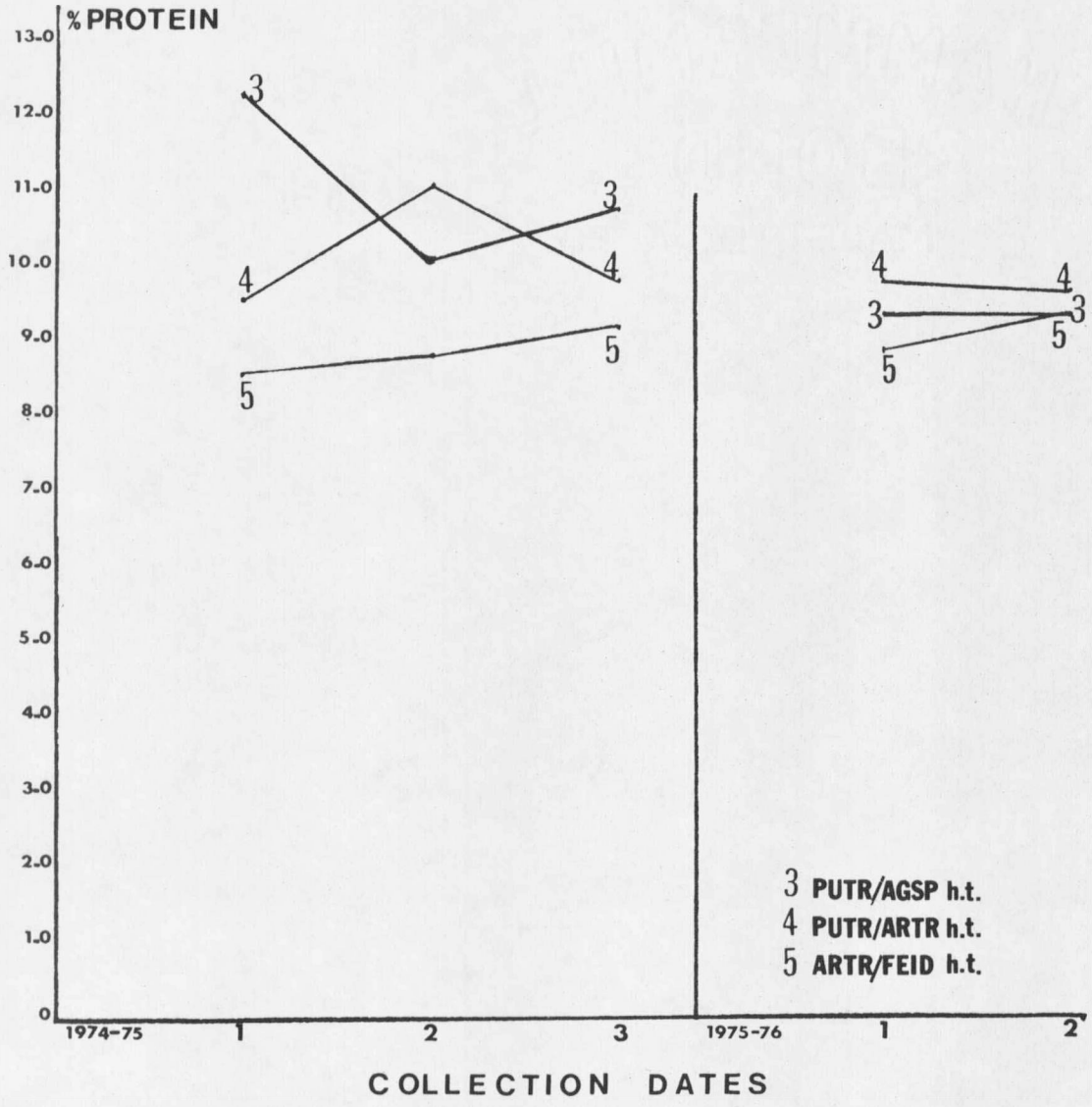


Figure 7. Protein content of *Artemisia tridentata* by habitat type on Armstrong Winter Range.

Comparisons of protein values obtained for bitterbrush on the PUTR/AGSP and PUTR/ARTR habitat types (Figure 8) indicated no significant difference between the two types. Trends between sampling periods were also generally similar.

Juniperus scopulorum. —— Rocky Mountain juniper was not sampled in the first collection period during the winter of 1974-75. Protein values obtained during mid and late winter were 8.1 percent and 7.6 percent, respectively, from all habitat types combined. Average values were 7.6 percent during early winter and 7.8 percent for mid-winter, 1975-76. The overall average protein content of 7.9 percent during 1974-75 decreased slightly to 7.7 percent in 1975-76, but the difference was not significant.

Protein values obtained for this species from the habitat types where it occurred are compared in Figure 9. Differences between the PUTR/AGSP and PUTR/ARTR habitat types were not significant. However, when values for these habitat types for the winters of 1974-75 and 1975-76 were combined the overall means for both were significantly higher than those for the ARTR/FEID habitat type ($p<0.025$, $p<0.025$) as well as the AGSP/FEID habitat type ($p<0.01$, $p<0.005$). Also, the mean protein content for juniper on the ARTR/FEID habitat type for both winters was significantly higher than that for the AGSP/FEID type ($p<0.05$).

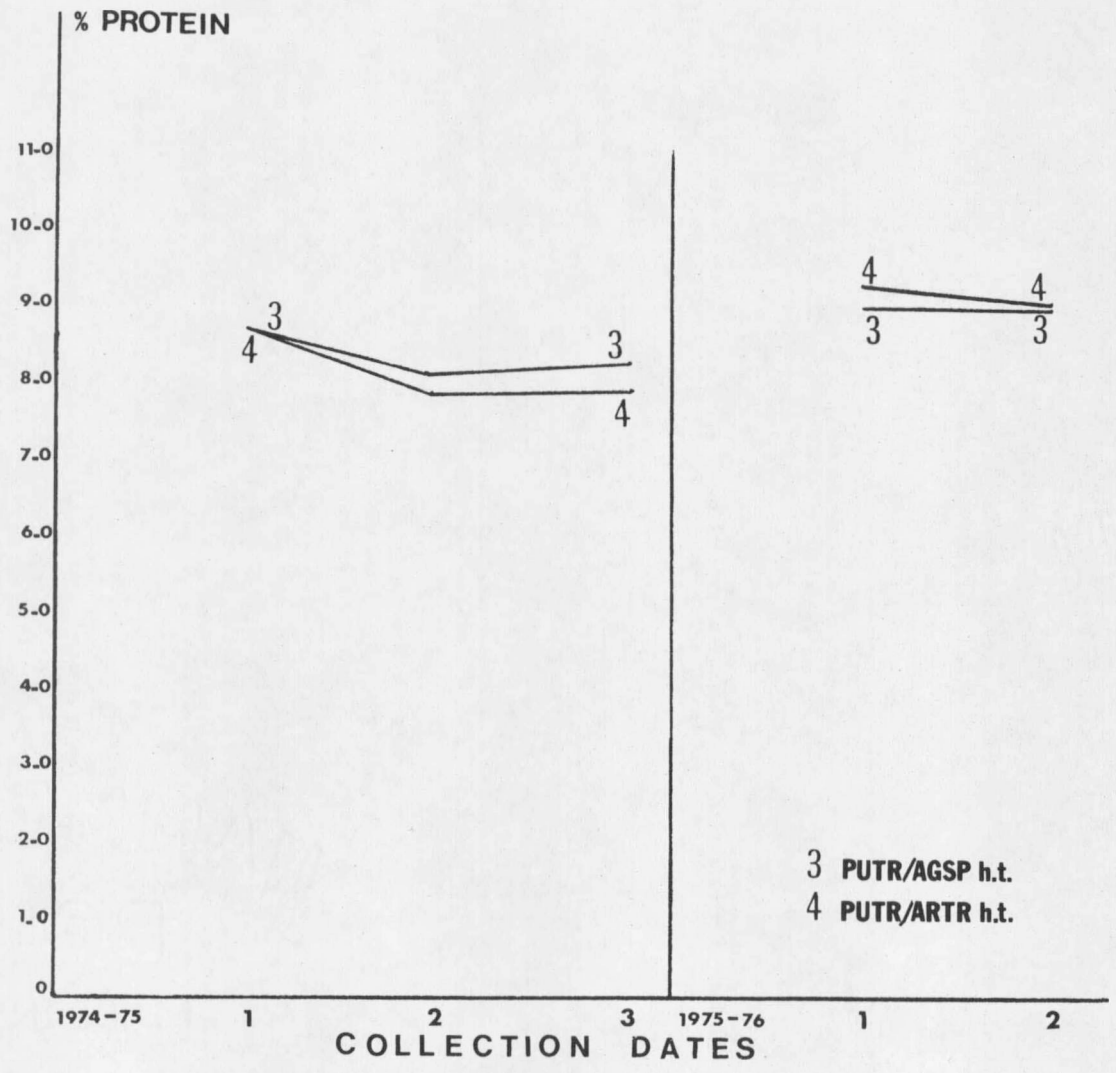


Figure 8. Protein content of *Purshia tridentata* by habitat type on Armstrong Winter Range.

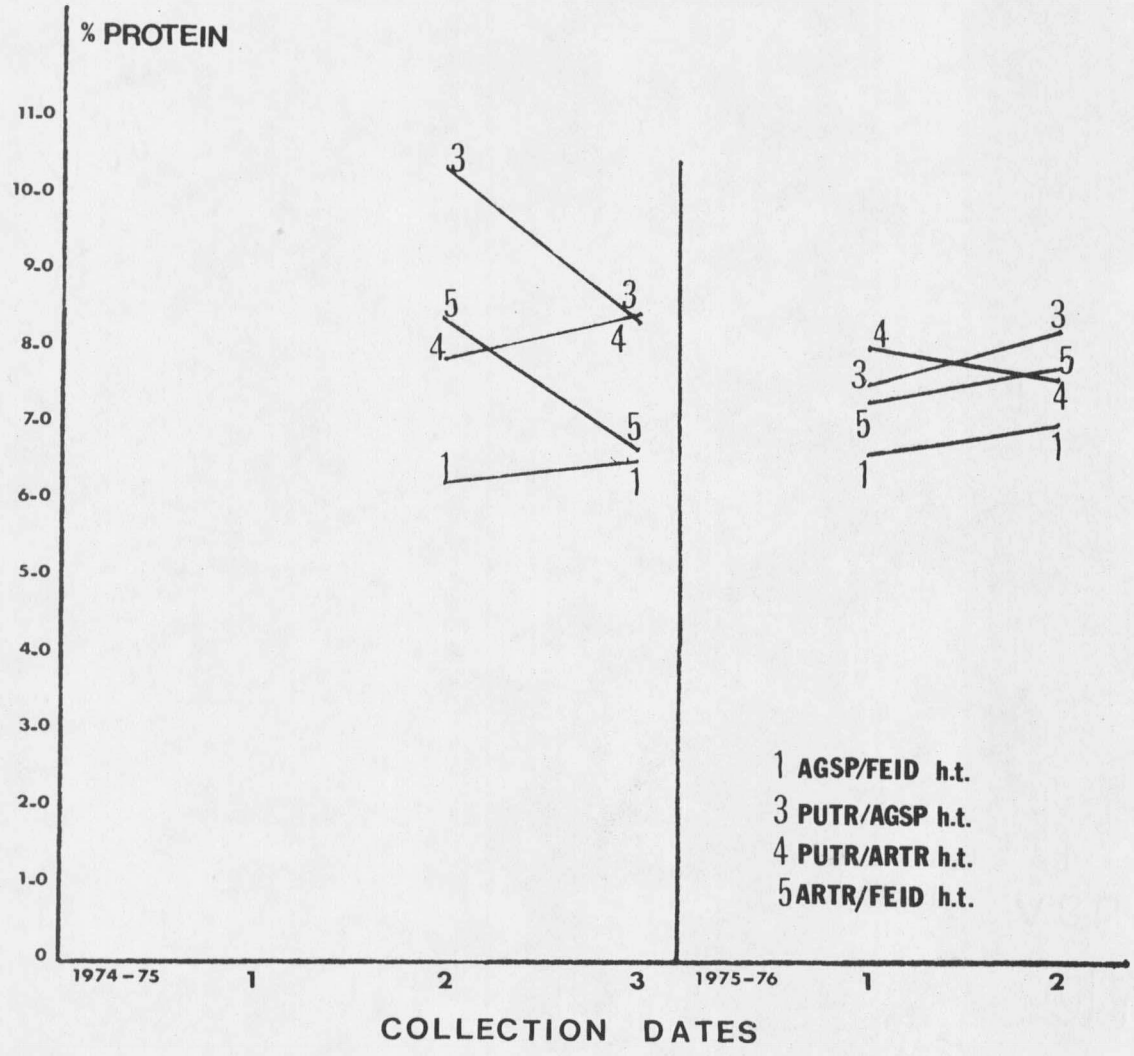


Figure 9. Protein content of *Juniperus scopulorum* by habitat type on Armstrong Winter Range.

Balsamorhiza sagittata. —— The average protein contents of arrowleaf balsamroot for the four habitat types were 6.7 percent during the early winter, 6.2 percent during mid-winter and 6.0 percent during late winter in 1974-75. Values for the first and second collection periods during 1975-76 were 5.7 percent and 5.8 percent, respectively. The overall average of 6.3 percent for 1974-75 was significantly higher ($p<0.05$) than the average of 5.8 percent for 1975-76.

Comparisons of protein contents of balsamroot for the winters of 1974-75 and 1975-76 combined among the four major use habitat types (Figure 10) revealed no significant differences between values for the PUTR/AGSP and PUTR/ARTR habitat types. However, protein levels in both of these habitat types were significantly higher than those of both the ARTR/FEID habitat type ($p<0.01$, $p<0.005$) and the AGSP/FEID habitat type ($p<0.025$, $p<0.05$). There was no significant difference in the protein content of balsamroot between the ARTR/FEID and AGSP/FEID habitat types.

Festuca idahoensis. —— Idaho fescue averaged 3.8 percent, 5.3 percent and 4.8 percent protein, respectively, for early, mid and late winter for the habitat types sampled during 1974-75. Average values for samples during the winter of 1975-76 were 4.5 percent for the early period and 5.4 percent for the mid-winter period. The overall average value increased from 4.6 percent during the winter of 1974-75 to 5.0 percent during 1975-76, but the difference was not significant.

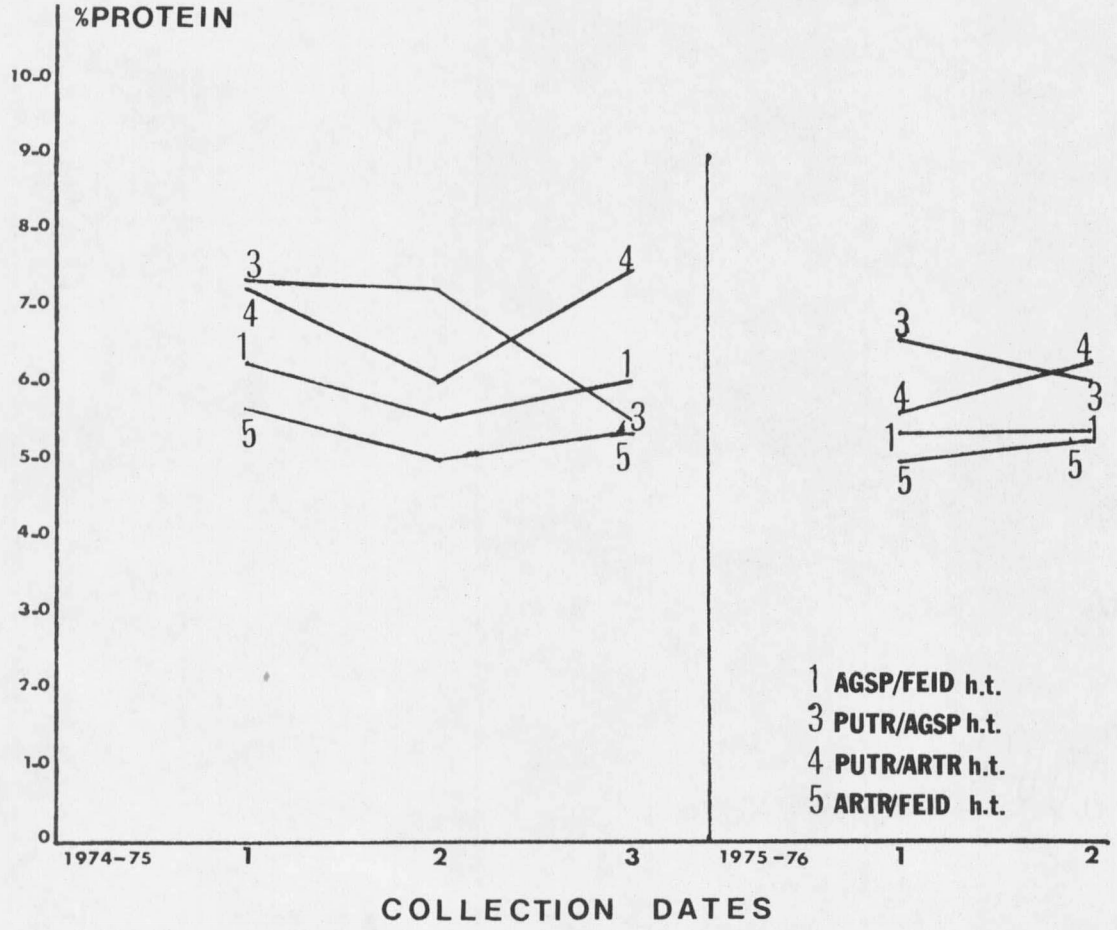


Figure 10. Protein content of *Balsamorhiza sagittata* by habitat type on Armstrong Winter Range.

No significant differences were found between protein contents of Idaho fescue among any of the habitat types in which it occurred, though values for the PUTR/ARTR habitat type appeared to be slightly higher than those for the ARTR/FEID and AGSP/FEID types during the winter of 1975-76 (Figure 11).

Bromus tectorum. —— Average protein contents of downy chess brome during 1974-75 were 3.0 percent for early winter and 2.4 percent for both the mid and late winter collections. Average values during 1975-76 were 4.4 percent and 3.6 percent for the early and mid-winter collection periods, respectively. Overall average protein content increased significantly ($p<0.005$) from 2.6 percent during the winter of 1974-75 to 4.0 percent during 1975-76.

No significant differences were found between protein values obtained from the different habitat types where this species was collected (Figure 12).

Tragopogon dubius. —— The average protein value for common salsify was 3.0 percent for the first collection period during the winter of 1974-75. Values were 5.4 percent and 4.4 percent for composite samples from all habitat types collected during mid and late winter sampling periods. During 1975-76, averages were 5.4 percent for the early period and 6.1 percent protein for a composite sample collected in mid-winter. The overall average of 4.4 percent protein for the winter of 1974-75 was significantly lower ($p<0.005$) than the 5.8 percent

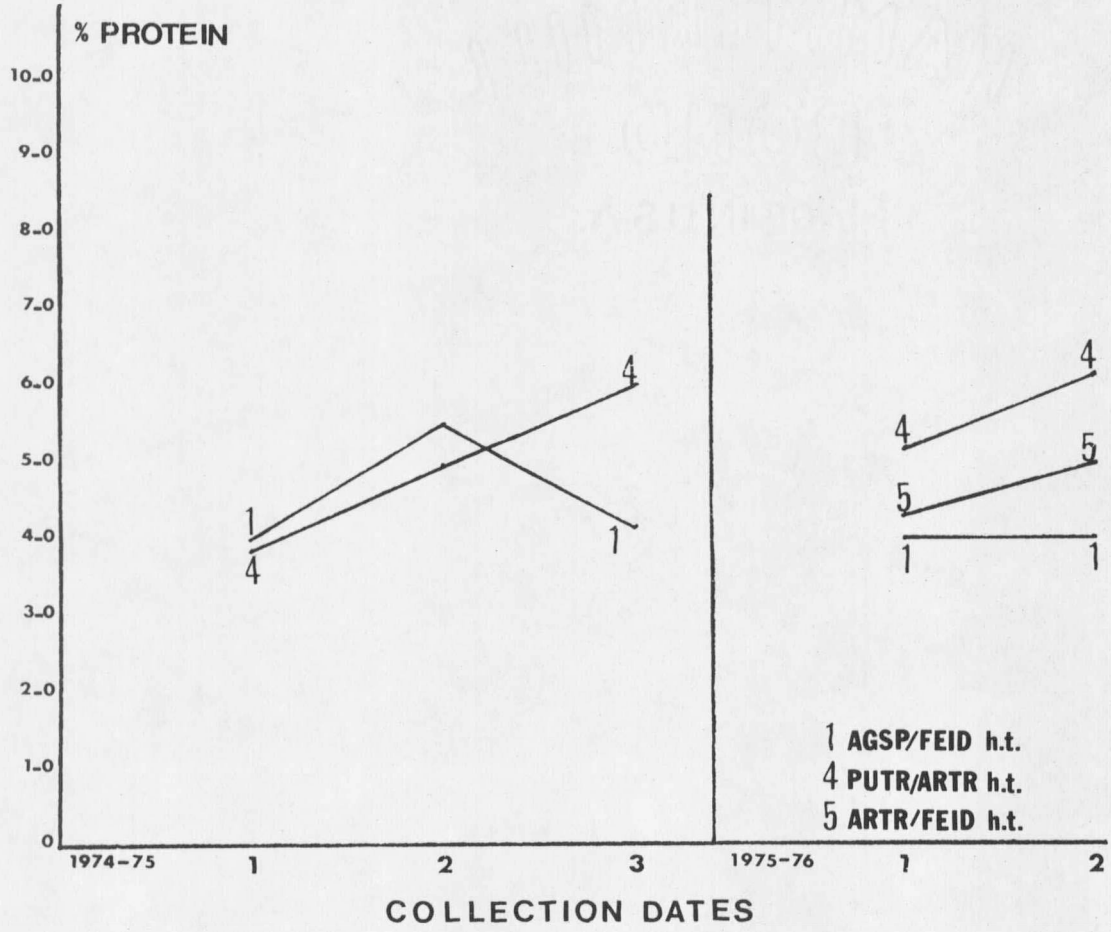


Figure 11. Protein content of *Festuca idahoensis* by habitat type on Armstrong Winter Range.

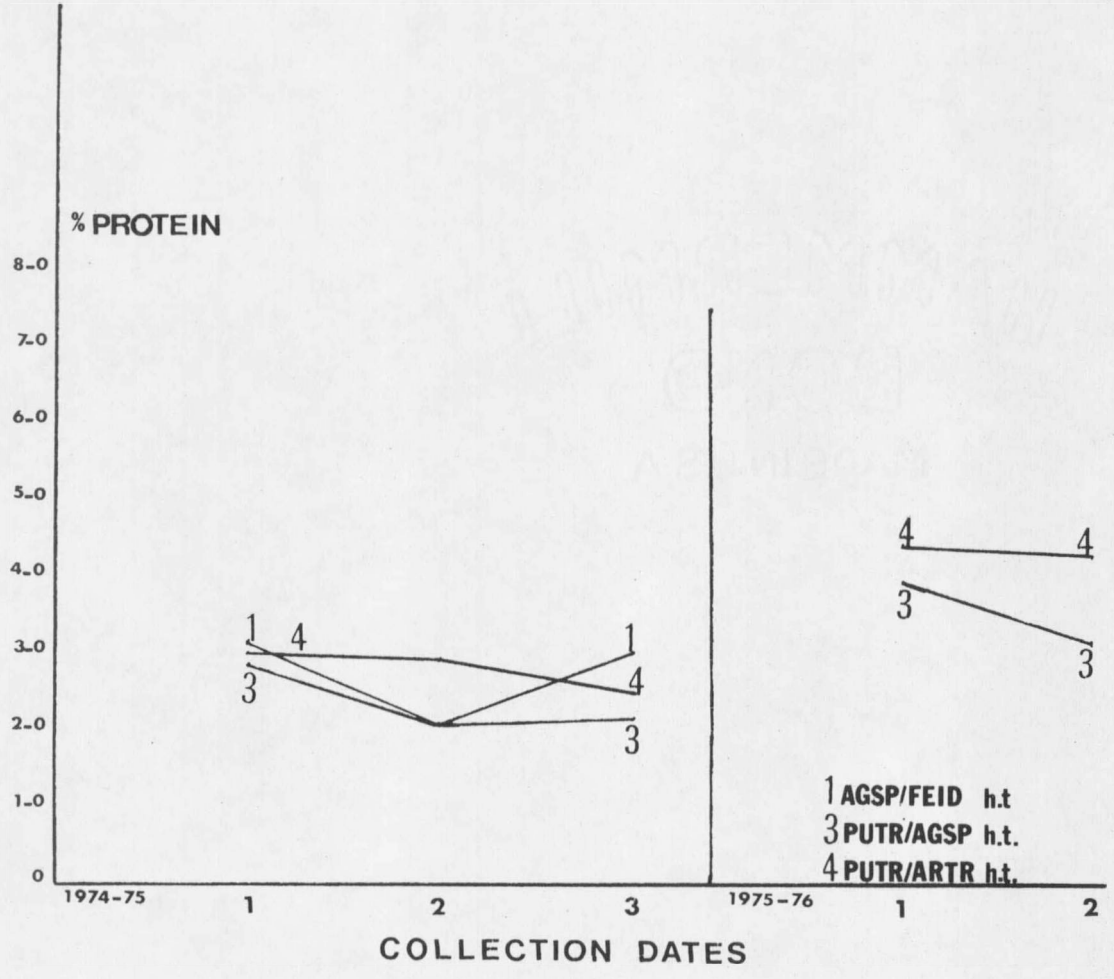


Figure 12. Protein content of *Bromus tectorum* by habitat type on Armstrong Winter Range.

determined for samples collected in 1975-76. This increase may have been due in part to collection of less stem material in samples for 1975-76.

Although common salsify occurred in all four habitat types, composite samples were collected after early winter due to a paucity of available material and differences between habitat types could not be evaluated.

Prunus virginiana. —— A composite sample of chokecherry collected during late winter, 1974-75, yielded a protein content of 8.8 percent. Average contents for 1975-76 were 9.2 percent and 10.0 percent during early and mid-winter, respectively. The overall average value during the winter of 1975-76 was 9.6 percent. The difference in sampling precluded statistical evaluation of the apparent increase from 8.8 percent in 1974-75 to 9.6 percent in 1975-76.

Comparisons of protein content by habitat type for chokecherry are shown in Figure 13. Due to the small number of samples collected, possible differences between habitat types were not tested statistically.

Rosa nutkana. —— Average protein content for two samples of nootka rose collected during late winter, 1974-75, was 5.2 percent. Average values during 1975-76 were 5.1 percent and 5.6 percent protein for early and mid-winter, respectively. The overall average value for the winter of 1975-76 was 5.4 percent.

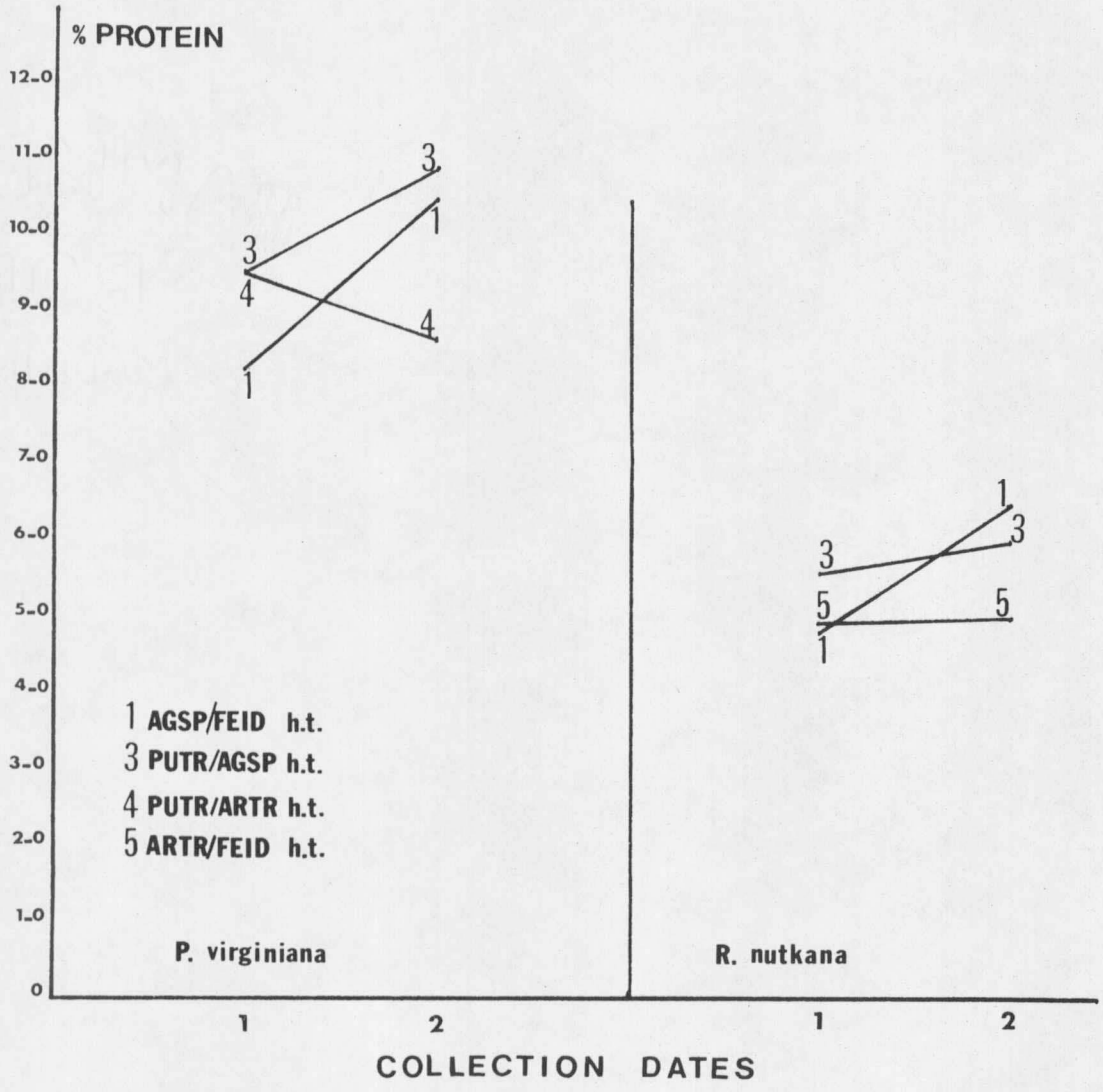


Figure 13. Protein contents of *Prunus virginiana* and *Rosa nutkana* by habitat type during the winter of 1975-76 on Armstrong Winter Range.

Comparisons of protein content by habitat type for this species appear in Figure 13. Again, the small number of samples precluded testing for possible significant differences between habitat types.

Pseudotsuga menziesii. —— The average protein content for three samples of Douglas fir collected during late winter in 1974-75 was 7.0 percent. One sample collected during mid-winter, 1975-76, yielded a protein content of 5.9 percent.

Other Plants. —— One sample of green grass, consisting primarily of bluebunch wheatgrass and *Poa* spp., was collected during mid-winter in 1975-76 from the PUTR/AGSP habitat type and yielded a protein content of 18.9 percent.

Protein contents of twelve early spring mule deer forage species collected on Armstrong Winter Range are presented in Table 9. Five collections were made in the *Agropyron spicatum/Agropyron smithii* habitat type in addition to ten collections made in one or more of the four major-use habitat types. In general, the grass species and forb species collected during the flowering stage were lowest in protein content with the exception of western spring beauty *(Claytonia lanceolata)* which contained one of the highest protein contents of the twelve species collected. Arrowleaf balsamroot also yielded a high percentage of protein content.

TABLE 9. PROTEIN CONTENTS OF SEVERAL EARLY SPRING MULE DEER FORAGE SPECIES ON ARMSTRONG WINTER RANGE.[1] (Percent air dry weight)

Plant	Habitat Type	% Protein
Achillea millefolium	AGSP/FEID & ARTR/FEID	22.0
Agropyron spicatum	AGSP/FEID	21.6
Balsamorhiza sagittata	AGSP/AGSM	26.3
Balsamorhiza sagittata	AGSP/FEID & ARTR/FEID	27.0
Bromus tectorum	ARTR/PUTR	15.3
*Cerastium arvensis**	ARTR/PUTR	16.5
*Claytonia lanceolata**	AGSP/FEID	26.2
*Claytonia lanceolata**	AGSP/FEID & ARTR/FEID	26.4
Festuca idahoensis	AGSP/AGSM	17.3
*Fritillaria pudica**	AGSP/AGSM	16.0
Lupinus sericeus	AGSP/FEID	25.2
Lupinus sericeus	AGSP/FEID & ARTR/FEID	22.8
*Ranunculus glaberrimus**	AGSP/AGSM	16.4
Tragopogon dubius	ARTR/PUTR	21.4
Zigadenus elegans	AGSP/AGSM	18.5

[1]All plants were collected in pre-flowering, new growth condition except those indicated with an asterisk which were flowering at the time collected.

Crude Fiber, Ether Extract and Ash

Average crude fiber, ether extract and ash contents of the major mule deer forage species collected on Armstrong Winter Range during late winter, 1975, and mid-winter, 1976, are shown in Tables 10, 11 and 12 and Figures 14, 15 and 16, respectively. Detailed data for each species, by collection site, habitat type, and year, are presented in Appendix Tables 21, 22 and 23. The general nutritive composition of all plants collected during these two sampling periods is presented in Appendix Table 24.

TABLE 10. AVERAGE CRUDE FIBER CONTENT OF MAJOR MULE DEER FORAGE SPECIES COLLECTED ON ARMSTRONG WINTER RANGE DURING THE WINTERS OF 1974-75 AND 1975-76. (Percent air dry weight)

Plant	1974-75	1975-76
Artemisia tridentata	17.5	17.0
Purshia tridentata	24.9	25.4
Juniperus scopulorum	21.4	22.7
Prunus virginiana	22.9	22.8
Rosa nutkana	30.1	29.4
Pseudotsuga menziesii	20.6	20.2
Balsamorhiza sagittata	28.8	28.2
Tragopogon dubius	32.8	32.1
Festuca idahoensis	36.5	30.7*
Bromus tectorum	41.3	40.2

*Indicates a significant ($p<0.05$) change in crude fiber content from year to year.

TABLE 11. AVERAGE ETHER EXTRACT CONTENT OF MAJOR MULE DEER FORAGE SPECIES COLLECTED ON ARMSTRONG WINTER RANGE DURING THE WINTERS OF 1974-75 AND 1975-76. (Percent air dry weight)

Plant	1974-75	1975-76
Artemisia tridentata	10.7	9.1*
Purshia tridentata	5.5	6.4*
Juniperus scopulorum	17.3	15.4*
Prunus virginiana	3.1	2.8
Rosa nutkana	2.9	2.9
Pseudotsuga menziesii	9.5	11.1
Balsamorhiza sagittata	2.4	3.5
Tragopogon dubius	6.8	9.2
Festuca idahoensis	3.1	5.9*
Bromus tectorum	1.0	1.9

*Indicates a significant ($p<0.05$) change in ether extract content from year to year.

TABLE 12. AVERAGE ASH CONTENT OF MAJOR MULE DEER FORAGE SPECIES COLLECTED ON ARMSTRONG WINTER RANGE DURING THE WINTERS OF 1974-75 AND 1975-76. (Percent air dry weight)

Plant	1974-75	1975-76
Artemisia tridentata	3.0	2.7*
Purshia tridentata	2.4	2.1
Juniperus scopulorum	4.3	3.2*
Prunus virginiana	5.1	4.1
Rosa nutkana	3.4	3.7
Pseudotsuga menziesii	2.6	3.3
Balsamorhiza sagittata	17.2	10.1
Tragopogon dubius	-	4.7
Festuca idahoensis	7.7	10.0*
Bromus tectorum	3.7	5.8*

*Indicates a significant ($p<0.05$) change in ash content from year to year.

Artemisia tridentata. —— Average crude fiber content of big sagebrush was 17.5 percent during the winter of 1974-75 and 17.0 percent during 1975-76, a decrease of insignificant proportion. This species contained the lowest crude fiber content of all plants sampled. There was no significant difference in values between the PUTR/ARTR and ARTR/FEID habitat types.

Average ether extract percentages of big sagebrush decreased significantly ($p<0.025$) from 10.7 percent during 1974-75 to 9.1 percent during 1975-76. No significant difference in values existed between the PUTR/ARTR and ARTR/FEID habitat types. This species contained one of the highest levels of ether extract of all species sampled.

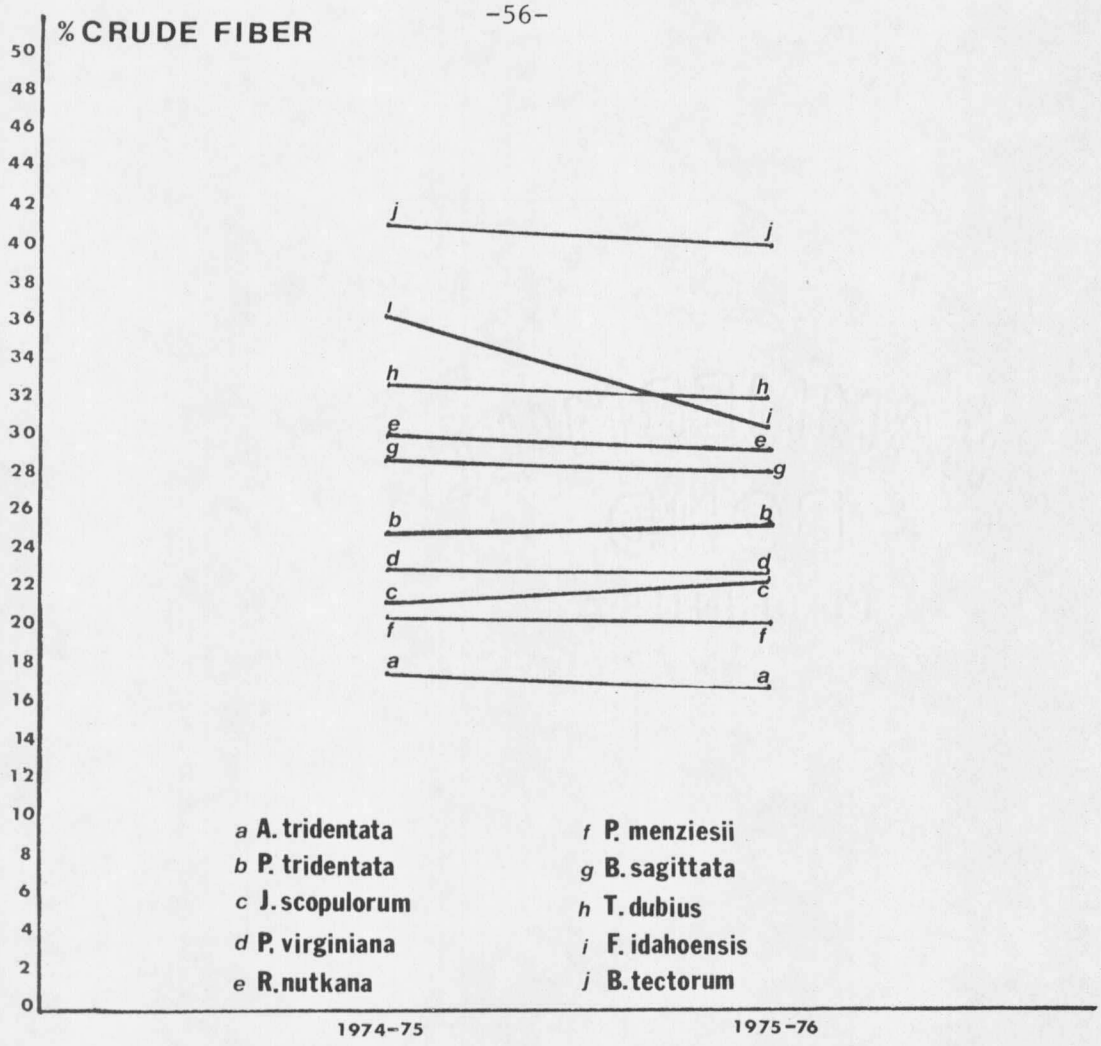


Figure 14. Average crude fiber content of each major mule deer forage species collected on Armstrong Winter Range.

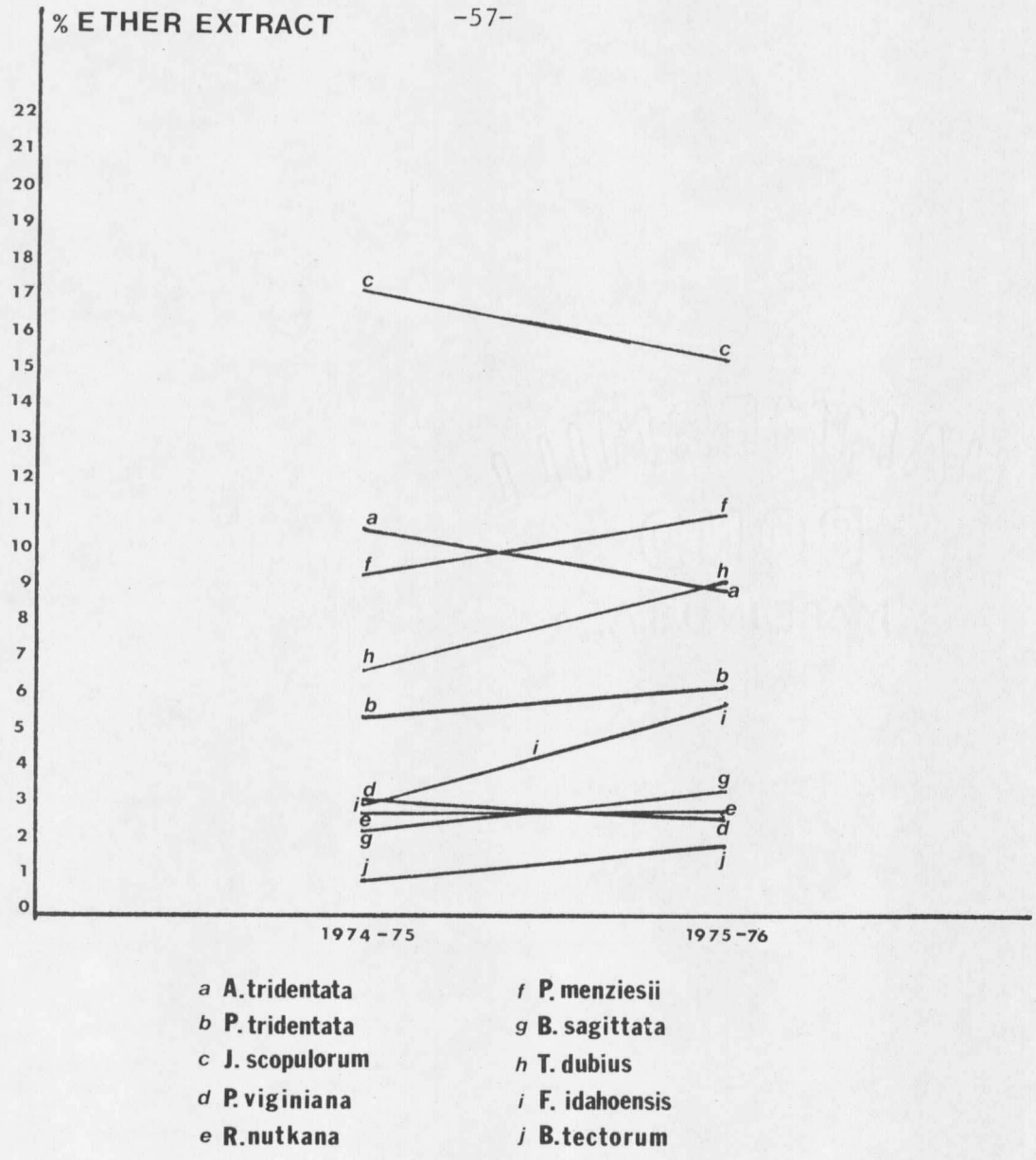


Figure 15. Average ether extract content of each major mule deer forage species collected on Armstrong Winter Range.

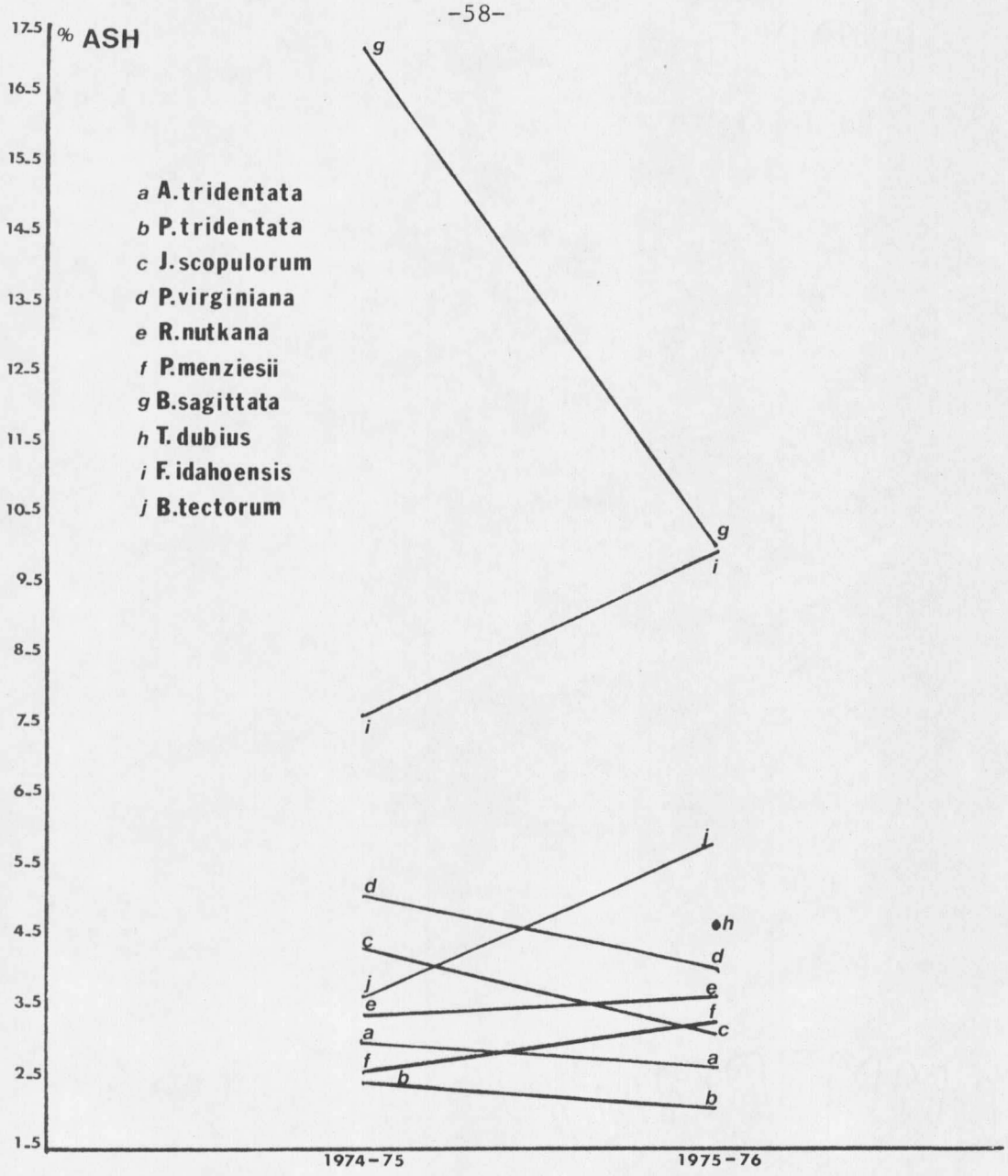


Figure 16. Average ash content of each major mule deer forage species collected on Armstrong Winter Range.

Average ash contents of big sagebrush decreased significantly ($p<0.05$) from 3.0 percent in 1974-75 to 2.7 percent during 1975-76. There was no significant difference between ash content of this species for the PUTR/ARTR and ARTR/FEID habitat types. Big sagebrush contained one of the lowest amounts of ash for all species collected.

Purshia tridentata. —— The average crude fiber contents of bitterbrush were 24.9 percent and 25.4 percent during the winters of 1974-75 and 1975-76, respectively. Statistical analysis was not attempted since the variances of these average values were not equal, but the difference between years appeared to be insignificant. Crude fiber content for the PUTR/ARTR habitat type may have been slightly higher than the PUTR/AGSP habitat type but variances were found to be unequal, and statistical t-tests were not conducted.

The average ether extract value of 5.5 percent for bitterbrush during 1974-75 increased significantly ($p<0.05$) to 6.4 percent in 1975-76. No significant difference was found in the levels between the PUTR/AGSP and PUTR/ARTR habitat types.

There was no significant difference between the average ash content of 2.4 percent for bitterbrush during 1974-75 and the 2.1 percent which existed in 1975-76. Ash content was significantly higher ($p<0.05$) in samples from the PUTR/AGSP habitat type than in the PUTR/ARTR type. This species contained the lowest amount of ash of all plants sampled.

Juniperus scopulorum. —— No significant difference existed between the average crude fiber content of Rocky Mountain juniper during 1974-75 and 1975-76 when values were 21.4 percent and 22.7 percent, respectively. No significant differences were found in samples from habitat types where this species was sampled. Juniper contained one of the lowest amounts of crude fiber of all species sampled.

Average ether extract content of Rocky Mountain juniper decreased significantly ($p<0.025$) from 17.3 percent during the winter of 1974-75 to 15.4 percent during 1975-76. This species yielded the highest ether extract percentages of all species sampled. No significant differences were found between the habitat types where juniper occurred.

Average ash content of juniper decreased significantly ($p<0.005$) from 4.3 percent during 1974-75 to 3.2 percent in 1975-76. No significant differences were found between habitat types.

Balsamorhiza sagittata. —— Arrowleaf balsamroot averaged 28.8 percent crude fiber in 1974-75 and 28.2 percent during 1975-76, an insignificant decrease. There were no significant differences found between percentages of crude fiber for the AGSP/FEID, PUTR/AGSP and PUTR/ARTR habitat types. Values for the ARTR/FEID type were lower but the significance was not tested.

Average ether extract contents of balsamroot were 2.4 percent and 3.5 percent during the winters of 1974-75 and 1975-76, respectively. The average percentage increased but the significance was not examined.

This species contained one of the lowest amounts of ether extract for all species sampled. The only significant difference found among habitat types was between the PUTR/AGSP and PUTR/ARTR types, where values were higher for the latter ($p<0.05$).

Average ash content for balsamroot during the winter of 1974-75 was 17.2 percent. This high level was due to the extremely large values for the PUTR/AGSP habitat type. Average ash content during 1975-76 was 10.1 percent. Statistical t-tests were not conducted due to unequal variances. It is apparent, however, that the average ash content decreased from 1974-75 to 1975-76. Again, due to the inequality of variances, only values for the PUTR/ARTR and ARTR/FEID habitat types could be compared statistically by a t-test and no significant difference was found. Arrowleaf balsamroot contained the highest percentage of ash, not only during 1974-75, but also in 1975-76.

Festuca idahoensis. —— The average crude fiber content of Idaho fescue decreased significantly ($p<0.05$) from 36.5 percent during 1974-75 to 30.7 percent during 1975-76. No significant difference was found in the crude fiber content for the AGSP/FEID type when compared to the PUTR/ARTR type. This species contained one of the highest amounts of crude fiber for all species sampled.

Idaho fescue averaged 3.1 percent ether extract during 1974-75 and 5.9 percent in 1975-76, representing a significant ($p<0.005$) increase. No significant difference was found between samples from the

AGSP/FEID and PUTR/ARTR habitat types.

The average ash content of Idaho fescue increased significantly ($p<0.05$) from 7.7 percent in 1974-75 to 10.0 percent in 1975-76. This species yielded one of the highest ash contents of all species sampled. There was no significant difference between ash content of this species from the AGSP/FEID and PUTR/ARTR habitat types.

Bromus tectorum. —— Downy chess brome contained the highest amount of crude fiber of any plant tested - 41.3 percent during 1974-75 and 40.2 percent in 1975-76. The difference was not significant. No significant difference was found between crude fiber values for the PUTR/AGSP and PUTR/ARTR habitat types.

This species yielded the lowest ether extract percentages of all plants sampled, those being 1.0 percent during 1974-75 and 1.9 percent in 1975-76. The apparent increase was not statistically tested due to unequal variance. No significant difference was found between values for the PUTR/AGSP and PUTR/ARTR habitat types where this species was most widely sampled.

Average ash content of downy chess brome was 3.7 percent during 1974-75 and 5.8 percent during 1975-76, representing a significant ($p<0.005$) increase. No significant difference was found between the PUTR/AGSP and PUTR/ARTR habitat types.

Tragopogon dubius. —— The average crude fiber contents from composite samples of common salsify were 32.8 percent and 32.1 percent during the

winters of 1974-75 and 1975-76, respectively. This represents one of the highest crude fiber contents of any plant sampled.

Common salsify contained ether extract values of 6.8 percent and 9.2 percent, respectively, during 1974-75 and 1975-76. Though these values were not statistically tested, they indicated an increase from year to year which may be due in part to the greater stem length included in the 1974-75 samples.

Due to a lack of available material, common salsify was not analyzed for ash content during the winter of 1974-75. The composite sample collected during 1975-76 yielded a content of 4.7 percent ash.

Prunus virginiana. —— The crude fiber content from a composite sample of chokecherry collected during 1974-75, 22.9 percent, was very similar to the 22.8 percent determined during 1975-76.

The composite sample of this species contained 3.1 percent ether extract during 1974-75, compared to an average value of 2.8 percent in 1975-76. These levels were among some of the lowest for all species sampled.

Ash comprised 5.1 percent of the composite sample of chokecherry collected during 1974-75, and 4.1 percent of the 1975-76 sample.

Rosa nutkana. —— Average crude fiber contents of nootka rose were 30.1 percent and 29.4 percent during 1974-75 and 1975-76, respectively. Statistical testing for differences was precluded by the small number of samples collected, but the decrease did not appear significant.

Average ether extract content of nootka rose was 2.9 percent during both the winters of 1974-75 and 1975-76. This species yielded one of the lowest percentages of ether extract among plants tested.

A composite sample of nootka rose collected during the winter of 1974-75 contained 3.4 percent ash, compared to 3.7 percent in the sample for 1975-76.

Pseudotsuga menziesii. —— Average crude fiber content of Douglas fir was 20.6 percent during 1974-75, a value similar to the 20.2 percent for the composite sample collected in 1975-76. These levels were among the lowest for any species sampled.

The average ether extract content of Douglas fir during 1974-75 was 9.5 percent. A value of 11.1 percent was determined from the composite sample in 1975-76. This species contained one of the highest amounts of ether extract.

The average ash contents of Douglas fir were 2.6 percent during 1974-75 and 3.3 percent in 1975-76. This species contained one of the lowest amounts of ash, especially during the winter of 1974-75.

Other Plants. —— The crude fiber content of the green grass collected in the PUTR/AGSP habitat type was 17.3 percent. This sample contained 4.8 percent ether extract and 11.6 percent ash.

Mineral Analyses

Average values for calcium, phosphorus, sodium and potassium and

average calcium/phosphorus (Ca/P) and sodium/potassium (Na/K) ratios for the major mule deer forage species collected on Armstrong Winter Range during the mid-winter sampling period of 1975-76 appear in Table 13. Detailed data for each habitat type, collection site, and year, are presented in Appendix Tables 25, 26 and 27. Due to the small number of samples, no statistical tests for habitat type differences were conducted. No mineral analyses were conducted on common salsify or nootka rose due to a lack of available material.

Artemisia tridentata. —— The average calcium and phosphorus contents of big sagebrush (Table 13) were 0.48 percent and 0.18 percent, respectively; and the average Ca/P ratio was 2.7, one of the lowest determined. Values for the three habitat types where this species was sampled appeared to be consistent.

The average sodium content of big sagebrush was 0.03 percent while the average potassium content was 0.73 percent, having an average Na/K ratio of 0.04, also one of the lowest for all species sampled. Values for the PUTR/ARTR and ARTR/FEID habitat types (Appendix Tables 26 and 27) appeared to be fairly consistent. The sodium and potassium percentages from one sample for the PUTR/AGSP habitat type were somewhat lower but the Na/K ratio was similar.

Purshia tridentata. —— The average calcium and phosphorus contents of bitterbrush were 0.58 percent and 0.12 percent, respectively, while the average Ca/P ratio was 5.0. Calcium values obtained for the

TABLE 13. AVERAGE CALCIUM, PHOSPHORUS, SODIUM AND POTASSIUM CONTENTS AND AVERAGE CALCIUM/PHOSPHORUS (Ca/P) AND SODIUM/POTASSIUM (Na/K) RATIOS OF MAJOR MULE DEER FORAGE SPECIES COLLECTED ON ARMSTRONG WINTER RANGE DURING FEBRUARY, 1976. (Mineral contents expressed as percent air dry weight)

Plant	Calcium	Phosphorus	Ca/P	Sodium	Potassium	Na/K
Artemisia tridentata	0.48	0.18	2.7	0.03	0.73	0.04
Purshia tridentata	0.58	0.12	5.0	0.02	0.24	0.07
Juniperus scopulorum	1.04	0.14	7.5	0.04	0.48	0.11
Prunus virginiana	1.53	0.18	8.9	0.02	0.46	0.06
Pseudotsuga menziesii	0.89	0.12	7.4	0.005	0.65	0.01
Balsamorhiza sagittata	2.61	0.07	38.3	0.009	0.09	0.10
Festuca idahoensis	0.43	0.09	5.8	0.01	0.36	0.03
Bromus tectorum	0.29	0.07	6.1	0.008	0.10	0.08

PUTR/AGSP type appeared to be higher than those for the PUTR/ARTR type (Appendix Table 25) whereas phosphorus values from the two habitat types were fairly similar. Therefore, the Ca/P ratios obtained from the PUTR/AGSP type were somewhat higher than those of the PUTR/ARTR type (Appendix Table 27).

The average sodium content of bitterbrush was 0.02 percent and the average potassium content was 0.24 percent, having an average Na/K ratio of 0.07. Values for the two habitat types where this species occurred were apparently constant.

Juniperus scopulorum. —— The average calcium content for Rocky Mountain juniper was 1.04 percent, one of the highest values for all plants collected. The average phosphorus content was 0.14 percent and the average Ca/P ratio was 7.5. While phosphorus values appeared to be consistent among all habitat types, calcium percentages were somewhat lower in the PUTR/AGSP habitat type and a higher value was obtained from the composite sample collected in the AGSP/FEID habitat type. The Ca/P ratios thus appeared to be lower for the PUTR/AGSP type and higher for the AGSP/FEID type as compared with values for the other two habitat types.

The average sodium content for juniper was 0.04 percent while the average potassium content was 0.48 percent and the average Na/K ratio was 0.11, the highest for all species sampled. Sodium and potassium content appeared to vary between habitat types and this was reflected

in average Na/K ratios for each type.

Balsamorhiza sagittata. —— Average calcium content for arrowleaf balsamroot was 2.61 percent, the highest value determined. The average phosphorus content was a low 0.07 percent and, therefore, the average Ca/P ratio of 38.3 was the highest for all species sampled. These values were consistent among habitat types.

The average sodium content of balsamroot was 0.009 percent and the average potassium content of 0.09 percent was the lowest for all species sampled. The average Na/K ratio for this species was 0.10. These values also appeared to be constant among the four habitat types.

Festuca idahoensis. —— The average calcium content of Idaho fescue was 0.43 percent. The average phosphorus content was 0.09 percent and the average Ca/P ratio was 5.8. Though calcium values appeared to be consistent among habitat types, phosphorus levels were apparently lower in the AGSP/FEID type and higher in the PUTR/AGSP type as compared to the other two habitat types. These differences were reflected in the high and low Ca/P ratios for the AGSP/FEID and PUTR/AGSP habitat types, respectively.

Average sodium and potassium levels for this species were 0.01 percent and 0.36 percent, respectively. The average Na/K ratio was 0.03. The sodium value for the PUTR/AGSP type appeared to be somewhat higher than values for the other three habitat types. Potassium values varied among habitat types. Na/K ratios were fairly consistent

among habitat types excepting that the figure for the PUTR/AGSP type was slightly higher.

Bromus tectorum. —— The average calcium level of downy chess brome (0.29 percent) was the lowest among all plants collected, as was the average phosphorus value of 0.07 percent. The average Ca/P ratio was 6.1. These values appeared to be consistent between the two habitat types where this species was sampled.

One of the lowest average sodium values, 0.008 percent, was yielded by downy chess brome while the average potassium content was 0.10 percent, again, one of the lowest for all species sampled. The average Na/K ratio for this species was 0.08. These values appeared to be fairly consistent.

Prunus virginiana. —— The average calcium and phosphorus contents of chokecherry (1.53 percent and 0.18 percent, respectively) were among the highest for all species sampled. The average Ca/P ratio for this species was 8.9.

The average sodium content of chokecherry was 0.02 percent and the average potassium content was 0.46 percent, yielding an average Na/K ratio of 0.06.

Pseudotsuga menziesii. —— A composite sample of Douglas fir contained 0.89 percent calcium and 0.12 percent phosphorus, having a Ca/P ratio of 7.4.

The sodium content of this sample was 0.005 percent, the lowest of any species tested. The potassium content was 0.65 percent and the Na/K ratio was 0.01, also the lowest of any species sampled.

Other Plants. — Calcium and phosphorus contents of the green grass collected from the PUTR/AGSP habitat type were 0.59 percent and 0.25 percent, respectively, having a Ca/P ratio of 2.4.

Sodium and potassium levels of this sample were 0.03 percent and 1.20 percent, respectively, yielding a Na/K ratio of 0.03.

General edaphic characteristics of the four major-use habitat types, including soil content of calcium, phosphorus, sodium and potassium are presented in Table 14. The soils of the four types showed similarities in contents of the four elements, except perhaps for potassium, where the AGSP/FEID and ARTR/FEID types displayed higher values than the PUTR/AGSP and PUTR/ARTR habitat types, and for phosphorus, where the ARTR/FEID type was rated low in content of this element as opposed to the very low rating of the other three habitat types. These differences generally were not reflected in the element content of the plant species in each of the four habitat types. Hundley (1959) reported that nutritional content of twigs of five browse species at each of four locations where soils were generally similar in chemical composition showed no consistent differences between areas.

TABLE 14. EDAPHIC CHARACTERISTICS OF THE FOUR MAJOR-USE HABITAT TYPES INCLUDING TEXTURAL CLASSIFICATION, pH, FIVE IMPORTANT ELEMENTS, ORGANIC MATTER AND SALT HAZARD ON THE ARMSTRONG WINTER RANGE.*

Habitat Type+	Soil Textural Class	pH	Phosphorus ppm[1]	Potassium ppm	Salt µmhos[2]	Organic Matter %	Calcium meg[3]	Magnesium meg	Sodium meg
AGSP/FEID	SL[4]	6.7	24(VL)[5]	522(H)	0.3	5.3(M)	16.1	3.25	0.34
PUTR/AGSP	SL	6.9	18(VL)	155(M)	0.3	3.3(L)	15.1	3.69	0.35
PUTR/ARTR	SL	6.9	23(VL)	224(M)	0.2	3.8(L)	14.4	4.00	0.40
ARTR/FEID	SL	6.7	31(L)	394(H)	0.3	5.0(M)	14.5	2.67	0.39

*Values compiled from data presented by Buscis (1974).

+Values are averages from several stands within each habitat type.

[1]ppm = pounds per one million pounds of soil.

[2]µmhos = milimhos, 1 mho = $\frac{1}{\text{ohm}}$

[3]meg = milliequivalents per 100 grams of soil.

[4]SL = silt loam.

[5]Ratings from Montana Soils Testing Laboratory Report, ST-Form 3, Jan. 8, 1971: VL = very low; L = low; M = medium; and H = high.

Forage Production of Herbaceous Species

Standing crop estimates for arrowleaf balsamroot, common salsify, Idaho fescue and downy chess brome within each of the four major-use habitat types on Armstrong Winter Range at the onset of winter in 1975 are presented in Table 15.

Arrowleaf balsamroot was the most abundant of the four herbaceous species in all but the AGSP/FEID habitat type where it occurred at an estimated 270 kilograms/hectare (241 pounds/acre). Total standing crop for the area encompassed by that type on the winter range was estimated at 15,417 kilograms. Production and standing crops of balsamroot on other types were estimated as 343 kilograms/hectare (306 pounds/acre) and 12,485 kilograms total for the PUTR/AGSP habitat type; 385 kilograms/hectare (344 pounds/acre) and 22,292 kilograms total for the PUTR/ARTR habitat type, where it was most abundant; and 203 kilograms/hectare (181 pounds/acre), totaling 17,093 kilograms in the ARTR/FEID habitat type.

Common salsify was generally the least abundant of the four species. This species provided 9 kilograms/hectare (8 pounds/acre) or 514 kilograms total within the AGSP/FEID habitat type. Within the PUTR/AGSP habitat type, where it was most abundant, salsify occurred at about 13 kilograms/hectare (12 pounds/acre) for a total standing crop of 473 kilograms for the entire area. This species provided 8 kilograms/hectare (7 pounds/acre), totaling 463 kilograms within the

TABLE 15. CANOPY COVERAGE, FREQUENCY AND STANDING CROP FOR *Balsamorhiza sagitta*, *Tragopogon dubius*, *Festuca idahoensis* AND *Bromus tectorum* ON ARMSTRONG WINTER RANGE AT THE ONSET OF WINTER, 1975.+

Plant Species and Habitat Type	Canopy Coverage %	se	n	Frequency %	Average Dry Weight gm/0.1m^2	Standing Crop kg/ha
Balsamorhiza sagittata						
AGSP/FEID	11.95	4.2	20	65	2.70	270
PUTR/AGSP	11.00	3.5	20	55	3.43	343
PUTR/ARTR	9.75	2.4	20	60	3.85	385
ARTR/FEID	9.88	3.7	20	45	2.03	203
Tragopogon dubius						
AGSP/FEID	0.40	0.3	20	15	0.09	9
PUTR/AGSP	1.13	0.7	20	15	0.13	13
PUTR/ARTR	0.75	0.5	20	15	0.08	8
ARTR/FEID	0.88	0.8	20	10	0.04	4
Festuca idahoensis						
AGSP/FEID	21.65	3.9	20	90	2.72	272
PUTR/AGSP	2.98	1.6	20	20	0.45	45
PUTR/ARTR	6.88	1.9	20	50	1.22	122
ARTR/FEID	5.00	1.8	20	40	0.58	58
Bromus tectorum						
AGSP/FEID*	0	0	20	0	0	0
PUTR/AGSP	7.25	2.4	20	70	0.69	69
PUTR/ARTR	7.78	3.8	20	50	0.58	58
ARTR/FEID	0.13	0.1	20	5	0.004	0.4

+Estimates are based on 5 2X5 dm plots set in 4 locations within each habitat type.

*Although this species did not occur in any of the sample plots, it is sparsely represented within this habitat type. The total figures should, therefore, be considered minimal estimates.

PUTR/ARTR habitat type, and 4 kilograms/hectare (3 pounds/acre) or 337 kilograms total in the ARTR/FEID habitat type.

Idaho fescue was the most abundant species in the AGSP/FEID habitat type, providing 272 kilograms/hectare (243 pounds/acre) or 15,531 total kilograms within the entire area. Production and standing crop estimates of Idaho fescue on other types were 45 kilograms/hectare (40 pounds/acre) and 1,638 kilograms total within the PUTR/AGSP habitat type; 122 kilograms/hectare (109 pounds/acre) or 7,064 kilograms within the PUTR/ARTR habitat type; and 58 kilograms/hectare (52 pounds/acre), totaling 4,884 kilograms within the ARTR/FEID habitat type.

Downy chess brome was not encountered in the sample plots in the AGSP/FEID habitat type. The standing crop estimate for this species within the PUTR/AGSP habitat type, where it was most abundant, was 69 kilograms/hectare (62 pounds/acre) or 2,512 kilograms total for the type on the winter range. Downy chess brome provided 58 kilograms/hectare (52 pounds/acre) or 3,358 kilograms within the area of the PUTR/ARTR habitat type and 0.4 kilograms/hectare (0.3 pounds/acre), for a total of 34 kilograms within the ARTR/FEID type.

The four herbaceous species provided an estimated 104,095 kilograms (229,488 pounds) within the area of the four major-use habitat types combined.

Since deer utilize only portions of the plant material as opposed to all plant material available, production and standing crop estimates should be considered maximal from the standpoint of forage production for deer. Also, the availability of these plants to deer varies greatly through the winter due to accumulation of snow at certain locations and/or utilization by other animals. At the same time, they should be considered minimal estimates of actual production because the data were collected in late fall after some deterioration and utilization by insects, cattle and other animals during summer and fall had occurred.

DISCUSSION AND CONCLUSIONS

Protein

Browse species, particularly big sagebrush, chokecherry, bitterbrush and Rocky Mountain juniper, generally contained the highest protein contents of all plants collected on Armstrong Winter Range (Figure 6). Arrowleaf balsamroot had the highest protein level among herbaceous species, however, common salsify was about equal to balsamroot during the winter of 1975-76. Idaho fescue, which remains at least partially green during the dormant period, was consistently higher in protein content than downy chess brome, which contained the least protein of any species sampled.

Protein values for big sagebrush on the Armstrong Range were similar to those reported by Hickman (1975) in Oregon. Percentages determined by Dietz *et al.* (1962) for this species in Colorado were slightly higher and those reported by Trout and Thiessen (1973) in Idaho were lower during early winter but similar in mid-winter. The high protein content of big sagebrush throughout the year is due, in part, to its retention of green leafy foliage (Dietz *et al.* 1958). Overall protein levels of big sagebrush for the PUTR/ARTR habitat type were significantly higher than those for the ARTR/FEID type. The larger, more vigorous plants of the ARTR/FEID type may have higher volatile oil content and less palatability than the shorter, less

vigorous plants of the PUTR/ARTR habitat type as was suggested by Powell 1970.

Protein contents of bitterbrush on the study area were generally similar to those determined by Hickman (1975), Dietz *et al.* (1962) and Trout and Thiessen (1973) for other western ranges. Lassen *et al.* (1952) discussed a decrease in the use of this browse plant from fall to winter and related it to a potential decrease in palatability or nutritional value. Protein levels of bitterbrush decreased as winter progressed, especially in 1974-75, though these differences were not significant.

Protein levels found in Rocky Mountain juniper during this study were similar to those reported by Dietz *et al.* (1962). This species contained significantly higher amounts of protein on the PUTR/AGSP and PUTR/ARTR habitat types as compared to the AGSP/FEID and ARTR/FEID types. Maruzella and Lichtenstein (1956) found that volatile oils in juniper tissue sometimes inhibit microbial activity of the rumen. In a study conducted by Smith (1959), this species and big sagebrush were reported to be about equal in preference by deer. He proposed a potential limit for consumption of these two plants which is little affected by the other forage available.

The high winter levels of protein determined for chokecherry on Armstrong Range have also been reported by Smith (1957). According to Buscis (1974), mule deer use of this species was high wherever it

occurred.

Protein contents of Idaho fescue on the study area in winter were similar to those reported by Hickman (1975) but levels during early spring were higher on Armstrong Winter Range. Early spring values for bluebunch wheatgrass were also similar. Early spring protein levels of downy chess brome were lower than those reported by Dietz *et al.* (1962). The significant increase in protein content of this species from 1974-75 to 1975-76 could be accounted for by inclusion of less dessicated material during 1975-76 when more green shoots were available for collection and presumably for deer consumption.

A high protein percentage for grass during winter, similar to that determined for the sample of green grass collected during February, 1976, was also reported by Trout and Thiessen (1973).

It has been reported that deer cannot survive long on a diet of less than 5 percent protein (Einarsen 1946), and Dietz (1965) stated that rumen function is seriously impaired if crude protein levels in deer forage fall below 6 to 7 percent. On this basis, most browse species on Armstrong Winter Range would be considered adequate whereas protein levels of herbaceous plants may be marginal or less than satisfactory (Table 8).

Crude Fiber

Browse plants, especially the evergreen species, contained the

least amounts of crude fiber while the herbaceous plants, particularly downy chess brome, yielded the highest levels (Figure 14).

Percentages for browse on Armstrong Winter Range were lower than those reported by Raleigh and Lesperance (1972). Crude fiber levels of big sagebrush were less during early winter than those determined by Trout and Thiessen (1973), equal to those reported by Dietz *et al.* (1962) and slightly higher than those found by Hickman (1975). Levels of this component in juniper were generally similar to the findings of Dietz *et al.* (1962). The crude fiber contents of chokecherry on Armstrong Winter Range were less than those reported by Smith (1957).

Levels of crude fiber in grass species were similar to those reported by Raleigh and Lesperance (1972) but percentages for Idaho fescue appeared to be greater than those determined by Hickman (1975).

Forbes *et al.* (1941) stated that low digestive coefficients for crude fiber suggest that deer do not digest this component especially well.

Ether Extract

The evergreen browse species on the study area yielded greatest amounts of crude fat whereas downy chess brome, chokecherry, nootka rose and balsamroot contained the least (Figure 15).

Values for big sagebrush were lower than those reported by both Dietz *et al.* (1962) and Trout and Thiessen (1973) but were somewhat

higher than levels determined by Hickman (1975). General similarities in ether extract contents of bitterbrush were reported by Dietz *et al.* (1962), Hickman (1975) and Trout and Thiessen (1973). High percentages of crude fat in juniper were also found by Dietz *et al.* (1962). Smith (1957) reported slightly lower content of this component for chokecherry. Ether extract levels of Idaho fescue on Armstrong Winter Range were somewhat higher than those determined by Hickman (1975) for this species.

Ash

There were similarities in ash contents for big sagebrush and bitterbrush on the study area to the findings of both Hickman (1975) and Dietz *et al.* (1962). Ash levels in juniper were similar to those found by the latter. Hickman (1975) reported values analogous to those of Idaho fescue collected on Armstrong Winter Range during 1974-75 but lower than those for 1975-76.

The high ash content of arrowleaf balsamroot (Figure 16) may, in part, be due to its high calcium content. Trout and Thiessen (1973) reported an ash content of 21.4 percent during March for *Phlox* spp. and a value of 29.41 percent during April for wild buckwheat *(Lomatium nudicaule)*. These species also contained relatively high calcium levels.

Calcium

Calcium values of big sagebrush, bitterbrush and juniper were similar to the findings of Dietz *et al.* (1962) for these same plants and were considered to be ample levels for this mineral (Table 13). Similar findings for big sagebrush were also reported by Hickman (1975) and Trout and Thiessen (1973). The latter found calcium values for bitterbrush similar to those on Armstrong Winter Range but lower than those reported by Hickman (1975). Percentages of calcium in Idaho fescue were greater than those found by Hickman (1975).

The level of calcium in the soil has few direct effects on nutritional quality of plants (U.S.D.A. 1965).

Phosphorus

Many animals require about 0.3 percent phosphorus in their diets for normal growth (U.S.D.A. 1965). Similar requirements for deer were reported by Short *et al.* (1969). Percentages of this element in big sagebrush were similar to those of Dietz *et al.* (1962) and Hickman (1975) but less than those of Trout and Thiessen (1973). Bitterbrush generally contained amounts analogous to the findings of Dietz *et al.* (1962) and Trout and Thiessen (1973) but lower than those reported by Hickman (1975). Phosphorus levels of juniper were lower than those determined by Dietz *et al.* (1962). According to the latter, phosphorus levels in all forage plants sampled on Armstrong Winter Range may be

deficient with the exception of big sagebrush and chokecherry (Table 13). Idaho fescue contained similar amounts of this element as compared to the findings of Hickman (1975).

Calcium/Phosphorus

The most desirable Ca/P ratio is 2:1 - 1:2 according to Dietz *et al.* (1962). Only big sagebrush approaches this optimum on Armstrong Winter Range. Other species, particularly balsamroot, had ratios which were fairly wide (Table 13).

Ratios for big sagebrush and bitterbrush were equatable to those obtained by Dietz *et al.* (1962) and Hickman (1975) for these species. Though Trout and Thiessen (1973) reported a similar ratio for bitterbrush, a lower ratio was determined for big sagebrush. The Ca/P ratio of juniper was higher than that reported by Dietz *et al.* (1962) as was the ratio for Idaho fescue as compared to the findings of Hickman (1975), who found this value to be highest for both grasses and shrubs when moisture content was low.

Other Minerals

The greatest amount of sodium was contained in juniper, while the least amount was yielded by Douglas fir. Potassium percentages were highest in big sagebrush and lowest in arrowleaf balsamroot (Table 13).

Though deer requirements for these two minerals have not been established, potassium deficiencies are usually not common in animals. Plants rarely contain sufficient sodium to meet the needs of animals. Soils which are very high in this element are very poor for plant growth (U.S.D.A. 1965).

References to positive correlations between palatability and protein, ether extract, individual minerals or total ash, and sugars and soluble carbohydrates of plants have been reported by Westoby (1974), as well as negative correlations between palatability and crude fiber. Crude fiber has been shown to be negatively correlated to crude protein in grasses by Vallentine and Young (1959). This would also appear to be the case on Armstrong Winter Range where, for example, big sagebrush contained the highest protein content and lowest crude fiber and the reverse was true of downy chess brome. Although general trends in ether extract content seem to show a positive relationship to levels of ash in several species collected on the study area (Tables 11 and 12) crude fat showed no relationship with other nutrients in the findings of Vallentine and Young (1959).

Digestibility of Forage Species

No attempt was made during the course of this study to determine cell wall and lignin components of crude fiber or to ascertain various digestibility differences between forage species sampled on the

Armstrong Winter Range. However, Snider and Asplund (1974) found that twigs ranked lower in digestibility than forbs. Thus, mature twigs are of less quality than is suggested by nutrient analysis and they are generally poorly digested (Short *et al.* 1974). According to the latter, mature browse twigs contained 20 percent lignin and 29 percent cellulose during January. It was suggested by Hickman (1975) that apparent digestibility of big sagebrush was higher than that of bitterbrush, especially during winter months. Based on comparisons with other research (Dietz *et al.* 1962, Trout and Thiessen 1973, Hickman 1975) big sagebrush apparently varies more from area to area in its nutritive composition than does bitterbrush.

Mature grasses do not reach maximum digestibility as rapidly as mature forbs. The former contained 8 percent lignin and 38 percent cellulose as compared to 12 percent lignin and 36 percent cellulose of mature forbs (Short *et al.* 1974). Forbs had the highest digestibilities in tests conducted by Snider and Asplund (1974.

Deer combine a high rate of digestion with a rapid rate of passage to supply their high energy needs (Snider and Asplund 1974). Though a species may have a lower net energy value, higher consumption rates can result in a better energy balance than exists with a species of higher net energy value (Mautz and Petrides 1971).

Forage Production

Browse produced and potentially available to mule deer was 71,069 kilograms (156,679 pounds) for the 189.4 hectares (468 acres) of shrubland habitat types on Armstrong Winter Range during the winter of 1973-74, 44 percent of which was big sagebrush, 49 percent juniper and 7 percent bitterbrush (Buscis 1974). Estimated production and standing crop of four herbaceous forage plants during the winter of 1975-76 was 104,095 kilograms (229,488 pounds) within the 235.6 hectares (582 acres) of the four major-use habitat types, 65 percent of which was arrowleaf balsamroot, 28 percent Idaho fescue, 6 percent downy chess brome and 2 percent common salsify (Table 15). Though the entire standing crop of these herbaceous species was not available for mule deer consumption it would appear that their potential contribution to the winter diet was sizeable and perhaps equal to or exceeding that of the three aforementioned browse species.

Smith (1949) correlated an increase in balsamroot and a decrease in big sagebrush to heavy deer use. Though Raleigh and Lesperance (1972) stated that balsamroot is not generally utilized by deer, other studies in addition to the present one have shown that this species is an important item in their diet (Wilkins 1957, Schwarzkoph 1973, Buscis 1974, Nellis 1969, Trout and Thiessen 1973). Common salsify appeared to be equal to balsamroot in nutritive value as a winter forage item but it did not occur in appreciable quantity as compared

to the latter. Due to its abundance on the study area, Idaho fescue appeared to be an important forage species though its nutritive value is generally lower than both balsamroot and common salsify. Downy chess brome may be questionable as an important winter forage plant due to its lower quality and quantity. Green shoots of this species contained high protein percentages during early spring and would presumably afford high nutritive value during a winter "green-up".

In general, the PUTR/AGSP and PUTR/ARTR habitat types appeared to produce forage plants of higher nutritional value than either the AGSP/FEID or ARTR/FEID types. The former two types were shown to be the most widely used on the winter range during late winter and early spring in 1975 (Mackie *et al.* 1976).

Winter browse may supply critically needed maintenance feed (Forbes *et al.* 1941) but it would appear that herbaceous winter forage plants, balsamroot in particular, also contribute considerably to the diet due to their general higher digestibility, rates of passage and abundance on the range.

Population levels are frequently determined by the condition of the game habitat used during the winter months (Smith 1959). Snider and Asplund (1974) concluded that scarcity of forage is a more important limiting factor in winter than low digestibility. This was apparently the case on Armstrong Winter Range during 1974-75 when accumulation of snow reduced availability of forage, herbaceous forage in particular.

However, good summer range may be critical to deer for sufficient fat deposits necessary to survive the winter in reasonably good condition (Julander *et al.* 1961).

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APPENDIX

TABLE 16. SNOW DEPTH AT ARMSTRONG RANCH, DECEMBER, 1974 THROUGH APRIL, 1975 AND OCTOBER, 1975 THROUGH FEBRUARY, 1976.

	Date	Snow Depth (inches)	Snow Depth (centimeters)
December 1974	19	3.2- 3.3	8.2- 8.4
	26	5.1- 5.5	13.0-14.0
January 1975	2	6.3- 6.7	16.0-17.0
	9	6.7- 8.3	17.0-21.0
	16	7.1- 9.8	18.0-25.0
	23	6.7- 7.1	17.0-18.0
	30	11.0-12.0	27.9-30.5
February 1975	6	12.0-13.0	30.5-33.0
	13	16.0-17.0	40.6-43.2
	20	18.0-20.0	45.7-50.8
	27	15.0-17.0	38.1-43.2
March 1975	6	15.0-17.0	38.1-43.2
	13	15.0-17.0	38.1-43.2
	20	18.0-20.0	45.7-50.8
	27	20.0-24.0	50.8-61.0
April 1975	3	16.0-17.0	40.6-43.2
	10	22.0-24.0	55.9-61.0
	17	15.0-17.0	38.1-43.2
October 1975	24	4.0- 5.0	10.2-14.0
	31	clear	
November 1975	21	3.0- 5.0	7.6-12.7
	28	12.0-14.0	30.5-35.6
December 1975	5	3.0- 7.0	7.6-17.8
	12	4.0- 6.0	10.2-15.2
	18	0.4- 0.5	1.0- 1.3
	25	0.4- 0.5	1.0- 1.3
January 1976	1	0.5- 0.6	1.3- 1.5
	9	7.5- 9.5	19.0-24.1
	15	5.0- 8.5	12.7-21.6
	22	0- 7.0	0-17.8
	29	0- 7.0	0-17.8
February 1976	5	1.0- 7.0	2.5-17.8
	13	0- 5.0	0-12.7
	21	clear	
	27	clear	

TABLE 17. MOISTURE CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING EARLY APRIL, 1975, AND FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within each habitat type)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridentata																						
1974-75	-	-	-	-	-	-	4.5	-	4.5	-	-	5.0	3.4	4.2	0.8	3.2	4.2	4.7	4.0	0.4	4.2	0.3
1975-76	-	-	-	-	-	-	6.1	-	6.1	-	6.8	4.9	4.0	5.2	0.8	3.5	4.4	4.0	4.0	0.3	4.8	0.4
Purshia tridentata																						
1974-75	-	-	-	-	-	3.8	1.6	3.0	2.8	0.6	4.3	3.3	-	3.8	0.5	-	-	-	-	-	3.2	0.5
1975-76	-	-	-	-	-	3.1	3.0	2.4	2.8	0.2	2.8	4.0	3.0	3.3	0.4	-	-	-	-	-	3.1	0.2
Juniperus scopulorum																						
1974-75	6.2	7.6	-	6.9	0.7	3.6	-	8.2	5.9	2.3	8.2	6.0	7.8	7.3	0.7	8.9	9.5	7.2	8.5	0.7	7.3	0.5
1975-76	-	-	-	9.5[1]	-	10.1	-	9.9	10.0	0.1	9.8	12.9	9.2	10.6	1.1	9.6	9.7	-	9.7	.05	10.1	0.4
Balsamorhiza sagittata																						
1974-75	5.6	-	5.6	5.6	0	4.6	5.9	4.3	4.9	0.5	4.4	-	-	4.4	-	5.4	-	-	5.4	-	5.1	0.2
1975-76	6.1	5.2	5.4	5.6	0.3	5.4	5.7	5.2	5.4	0.1	5.1	3.1	3.2	3.8	0.7	5.2	5.4	5.2	5.3	.07	5.0	0.3
Festuca idahoensis																						
1974-75	3.6	3.7	-	3.7	.05	-	-	-	-	-	-	2.2	-	2.2	-	-	-	-	-	-	3.2	0.5
1975-76	2.9	3.3	3.3	3.2	0.1	2.7	-	-	2.7	-	2.4	2.5	2.2	2.4	.09	-	-	3.1	3.1	-	2.8	0.1
Bromus tectorum																						
1974-75	-	-	6.1	6.1	-	3.9	3.7	3.6	3.7	.09	3.6	2.5	-	3.1	0.6	-	-	-	-	-	3.9	0.5
1975-76	-	-	-	-	-	2.9	3.1	2.6	2.9	0.1	2.5	2.3	-	2.4	0.1	-	-	-	-	-	2.7	0.1
Tragopogon dubius																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.7[1]	-
Prunus virginiana																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.2[1]	-
1975-76	-	-	-	2.9[1]	-	-	4.1	-	4.1	-	2.8	-	-	2.8	-	-	-	-	-	-	3.3	0.4
Rosa nutkana																						
1974-75	-	-	-	-	-	-	-	-	4.5[1]	-	-	-	-	-	-	-	-	-	-	-	4.5	-
1975-76	-	-	-	2.5[1]	-	-	3.5	-	3.5	-	-	-	-	-	-	-	-	-	-	-	3.0	0.5
Pseudotsuga menziesii																						
1974-75	-	-	-	5.7[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.5[1]	-	5.3[2]	0.3
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.2[1]	-
Green Grass[3]	-	-	-	-	-	2.8	-	-	2.8	-	-	-	-	-	-	-	-	-	-	-	2.8	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure includes a sample collected from habitat type 13, *Pseudotsuga menziesii/Festuca idahoensis*, containing 4.7% moisture.

[3]This sample was collected in 1975-76 only and consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 18. PROTEIN CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING DECEMBER (COLLECTION PERIOD I), 1974 AND 1975. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.						PUTR/ARTR h.t.					ARTR/FEID h.t.						Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	T35	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	T10	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridentata																								
1974-75	-	-	10.1	10.1	-	-	12.3	-	-	12.3	-	9.2	10.5	9.2	9.6	0.4	-	7.8	8.9	9.0	8.6	0.4	9.6	0.5
1975-76	-	-	-	-	-	-	9.4	-	-	9.4	-	11.1	10.3	8.0	9.8	0.9	9.0	8.1	9.5	-	8.9	0.4	9.3	0.4
Purshia tridentata																								
1974-75	-	-	-	-	-	-	9.3	8.2	8.7	8.7	0.3	8.7	9.4	7.9	8.7	0.4	-	-	-	-	-	-	8.7	0.2
1975-76	-	-	-	-	-	8.1	10.3	8.7	-	9.0	0.7	9.1	9.2	9.7	9.3	0.2	-	-	-	-	-	-	9.2	0.3
Juniperus scopulorum																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	6.7[1]	-	7.6	-	-	-	7.6	-	8.7	7.7	7.8	8.1	0.3	7.3	7.3	-	-	7.3	0	7.6	0.2
Balsamorhiza sagittata																								
1974-75	6.6	4.9	7.4	6.3	0.7	-	5.9	7.6	8.6	7.4	0.8	8.4	5.7	7.7	7.3	0.8	-	5.2	4.4	7.5	5.7	0.9	6.7	0.4
1975-76	5.3	5.6	5.4	5.4	0.1	6.2	8.0	5.6	-	6.6	0.7	6.0	4.9	6.1	5.7	0.4	6.0	4.0	5.0	-	5.0	0.6	5.7	0.3
Festuca idahoensis																								
1974-75	2.9	4.1	4.9	4.0	0.6	-	-	-	3.7	3.7	-	4.0	3.7	3.6	3.8	0.1	-	3.1	-	-	3.1	-	3.8	0.2
1975-76	4.3	4.3	3.4	4.0	0.3	-	-	-	-	-	-	5.1	5.3	5.1	5.2	0.1	-	5.4	3.1	-	4.3	1.2	4.5	0.3
Bromus tectorum																								
1974-75	-	3.3	3.1	3.2	0.1	-	3.3	2.2	-	2.8	0.6	3.2	2.8	-	3.0	0.2	-	3.3	-	-	3.3	-	3.0	0.2
1975-76	-	-	5.1	5.1	-	4.1	5.4	2.1	-	3.9	1.0	4.3	4.4	-	4.4	0.1	5.5	-	-	-	5.5	-	4.4	0.4
Tragopogon dubius																								
1974-75	3.4	3.9	2.9	3.4	0.3	-	2.9	2.5	3.8	3.1	0.4	3.0	4.0	4.4	3.8	0.4	-	-	3.5	4.8	4.2	0.7	3.6	0.2
1975-76	-	-	-	4.7[1]	-	-	-	-	-	5.8[1]	-	-	-	-	5.6[1]	-	-	-	-	-	-	-	5.4	0.3
Prunus virginiana																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	8.3[1]	-	-	-	10.4	-	9.5[2]	0.9	9.5	-	-	9.5	-	-	-	-	-	-	-	9.2	0.5
Rosa nutkana																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	4.8[1]	-	-	5.6	-	-	5.6	-	-	-	-	-	-	4.9	-	-	-	4.9	-	5.1	0.3
Pseudotsuga menziesii																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure includes a composite sample from the PUTR/AGSP h.t. in addition to the figure from transect 28. The composite sample contained 8.6% protein, air dry weight.

TABLE 19. PROTEIN CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING FEBRUARY (COLLECTION PERIOD II), 1975 AND 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.						PUTR/ARTR h.t.					ARTR/FEID h.t.						Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	T35	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	T10	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridenta																								
1974-75	-	-	-	-	-	-	10.1	-	-	10.1	-	13.1	11.9	8.4	11.1	1.4	11.0	6.8	8.7	-	8.8	1.2	10.0	0.8
1975-76	-	-	-	-	-	-	9.4	-	-	9.4	-	10.6	10.2	8.2	9.7	0.8	9.1	8.8	10.4	-	9.4	0.5	9.5	0.3
Purshia tridentata																								
1974-75	-	-	-	-	-	7.7	8.6	8.4	-	8.2	0.3	7.6	7.9	7.8	7.8	0.1	-	-	-	-	-	-	8.0	0.2
1975-76	-	-	-	-	-	8.7	9.6	8.7	-	9.0	0.3	8.7	10.0	8.9	9.1	0.5	-	-	-	-	-	-	9.1	0.2
Juniperus scopulorum																								
1974-75	-	6.3	-	6.3	-	10.4	-	-	-	10.4	-	7.8	7.5	8.3	7.9	0.2	9.1	7.6	-	-	8.4	0.8	8.1	0.5
1975-76	-	-	-	7.1[1]	-	7.5	-	9.1	-	8.3	0.8	7.4	7.8	7.8	7.7	0.1	7.7	7.9	-	-	7.8	0.1	7.8	0.2
Balsamorhiza sagittata																								
1974-75	5.2	4.4	7.1	5.6	0.8	6.6	6.3	9.1	-	7.3	0.9	6.9	6.2	5.3	6.1	0.5	-	-	5.1	-	5.1	-	6.2	0.4
1975-76	6.0	4.8	5.4	5.4	0.4	6.5	4.8	6.9	-	6.1	0.7	5.9	7.9	5.2	6.3	0.8	5.5	-	5.0	-	5.3	0.3	5.8	0.3
Festuca idahoensis																								
1974-75	5.6	3.7	7.3	5.5	1.0	-	-	-	-	-	-	-	4.6	5.1	4.9	0.3	-	-	-	-	-	-	5.3	0.6
1975-76	4.6	4.1	3.2	4.0	0.4	7.6	-	-	-	7.6	-	5.8	8.0	4.7	6.2	1.0	-	-	5.0	-	5.0	-	5.4	0.6
Bromus tectorum																								
1974-75	-	-	2.1	2.1	-	1.5	3.1	1.7	-	2.1	0.5	3.4	2.3	-	2.9	0.6	-	-	-	-	-	-	2.4	0.3
1975-76	-	-	-	-	-	3.7	3.7	2.1	-	3.2	0.5	3.8	4.7	-	4.3	0.5	-	-	-	-	-	-	3.6	0.4
Tragopogon dubius																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.1[1]	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.1[1]	-
Prunus virginiana																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	10.5[1]	-	-	10.9	-	-	10.9	-	8.7	-	-	8.7	-	-	-	-	-	-	-	10.0	0.7
Rosa nutkana																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	6.5[1]	-	-	6.0	-	-	6.0	-	-	-	-	-	-	5.0	5.0	-	-	5.0	0	5.6	0.4
Pseudotsuga menziesii																								
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.9[2]	-
Green Grass[3]	-	-	-	-	-	18.9	-	-	-	18.9	-	-	-	-	-	-	-	-	-	-	-	-	18.9	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure represents a sample collected from habitat type 13, *Pseudotsuga menziesii/Festuca idahoensis*.

[3]This sample was collected during 1975-76 only and consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 20. PROTEIN CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING EARLY APRIL (COLLECTION PERIOD III), 1975. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.						PUTR/ARTR h.t.					ARTR/FEID h.t.						Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	T35	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	T10	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridentata 1974-75	-	-	-	-	-	-	10.8	-	-	10.8	-	-	10.6	9.0	9.8	0.8	9.4	9.4	9.0	-	9.3	0.1	9.7	0.3
Purshia tridentata 1974-75	-	-	-	-	-	8.1	9.0	7.8	-	8.3	0.4	7.9	7.6	-	7.8	0.2	-	-	-	-	-	-	8.1	0.2
Juniperus scopulorum 1974-75	7.0	6.1	-	6.6	0.5	7.7	-	9.0	-	8.4	0.7	8.4	8.7	8.5	8.5	0.1	7.0	6.7	6.4	-	6.7	0.2	7.6	0.3
Balsamorhiza sagittata 1974-75	6.2	-	5.9	6.1	0.2	5.5	5.7	5.5	-	5.6	0.1	7.5	-	-	7.5	-	5.4	-	-	-	5.4	-	6.0	0.3
Festuca idahoensis 1974-75	3.8	4.5	-	4.2	0.4	-	-	-	-	-	-	-	6.0	-	6.0	-	-	-	-	-	-	-	4.8	0.6
Bromus tectorum 1974-75	-	-	3.0	3.0	-	2.1	2.6	1.9	-	2.2	0.2	2.4	2.5	-	2.5	0.1	-	-	-	-	-	-	2.4	0.2
Tragopogon dubius 1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.4[1]	-
Prunus virginiana 1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.8[1]	-
Rosa nutkana 1974-75	-	-	-	-	-	-	-	-	-	5.6[1]	-	-	-	-	-	-	4.8	-	-	-	4.8	-	5.2	0.4
Pseudotsuga menziesii 1974-75	-	-	-	7.4[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	8.2[1]	-	7.0[2]	0.8

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure includes a sample collected from habitat type 13, *Pseudotsuga menziesii/Festuca idahoensis*, containing 5.5% protein.

TABLE 21. CRUDE FIBER CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING EARLY APRIL, 1975, AND FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridentata																						
1974-75	-	-	-	-	-	-	17.3	-	17.3	-	-	18.3	18.7	18.5	0.2	18.1	16.9	15.5	16.8	0.8	17.5	0.5
1975-76	-	-	-	-	-	-	16.0	-	16.0	-	17.7	17.9	15.5	17.0	0.8	17.4	17.8	16.9	17.4	0.3	17.0	0.4
Purshia tridentata																						
1974-75	-	-	-	-	-	25.3	23.0	24.9	24.4	0.7	25.4	26.0	-	25.7	0.3	-	-	-	-	-	24.9	0.5
1975-76	-	-	-	-	-	22.6	23.2	22.9	22.9	0.2	23.7	34.8	25.1	27.9	3.5	-	-	-	-	-	25.4	1.9
Juniperus scopulorum																						
1974-75	23.6	23.6	-	23.6	0	21.1	-	19.9	20.5	0.6	21.2	20.9	20.1	20.7	0.3	21.1	19.0	23.9	21.3	1.4	21.4	0.5
1975-76	-	-	-	20.0[1]	-	21.6	-	21.1	21.4	0.2	22.8	26.5	22.0	23.8	1.4	22.8	24.8	-	23.8	1.0	22.7	0.7
Balsamorhiza sagittata																						
1974-75	30.0	-	32.5	31.3	1.3	37.6	24.5	21.2	27.8	5.0	32.1	-	-	32.1	-	23.9	-	-	23.9	-	28.8	2.2
1975-76	34.5	20.5	29.4	28.1	4.1	29.3	26.6	28.3	28.1	0.8	29.4	34.3	27.0	30.2	2.1	27.1	25.3	27.1	26.5	0.6	28.2	1.1
Festuca idahoensis																						
1974-75	34.1	39.3	-	36.7	2.6	-	-	-	-	-	-	36.0	-	36.0	-	-	-	-	-	-	36.5	1.5
1975-76	26.0	27.9	37.1	30.3	3.4	31.6	-	-	31.6	-	35.5	31.4	34.2	33.7	1.2	-	-	22.0	22.0	-	30.7	1.8
Bromus tectorum																						
1974-75	-	-	42.1	42.1	-	41.4	41.0	38.6	40.3	0.9	40.9	43.8	-	42.4	1.4	-	-	-	-	-	41.3	0.7
1975-76	-	-	-	-	-	40.2	41.9	43.0	41.7	0.8	40.7	35.3	-	38.0	2.7	-	-	-	-	-	40.2	1.3
Tragopogon dubius																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.8[1]	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32.1[1]	-
Prunus virginiana																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	22.9[1]	-
1975-76	-	-	-	23.4[1]	-	-	24.3	-	24.3	-	20.8	-	-	20.8	-	-	-	-	-	-	22.8	1.1
Rosa nutkana																						
1974-75	-	-	-	-	-	-	-	-	28.4[1]	-	-	-	-	-	-	31.7	-	-	31.7	-	30.1	1.6
1975-76	-	-	-	30.2[1]	-	-	28.3	-	28.3	-	-	-	-	-	-	29.8	-	-	29.8	-	29.4	0.6
Pseudotsuga menziesii																						
1974-75	-	-	-	20.5[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	19.6[1]	-	20.6[2]	0.6
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20.2[1]	-
Green Grass[3]	-	-	-	-	-	17.3	-	-	17.3	-	-	-	-	-	-	-	-	-	-	-	17.3	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure includes a sample collected from habitat type 13, *Pseudotsuga menziesii/Festuca idahoensis*, containing 21.8% crude fiber in 1974-75.

[3]This sample was collected in 1975-76 only and consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 22. ETHER EXTRACT CONTENT OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING EARLY APRIL, 1975, AND FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridentata																						
1974-75	-	-	-	-	-	-	9.7	-	9.7	-	-	10.6	9.6	10.1	0.5	11.6	11.7	10.8	11.4	0.3	10.7	0.4
1975-76	-	-	-	-	-	-	8.3	-	8.3	-	9.4	9.7	11.6	10.2	0.7	7.2	9.1	8.3	8.2	0.5	9.1	0.5
Purshia tridentata																						
1974-75	-	-	-	-	-	5.1	6.1	5.0	5.4	0.4	4.8	6.3	-	5.6	0.7	-	-	-	-	-	5.5	0.3
1975-76	-	-	-	-	-	7.5	5.1	6.3	6.3	0.7	6.2	6.6	6.6	6.5	0.1	-	-	-	-	-	6.4	0.3
Juniperus scopulorum																						
1974-75	15.2	15.4	-	15.3	0.1	18.4	-	18.3	18.4	0.05	17.9	17.3	17.9	17.7	0.2	17.0	20.1	15.0	17.4	1.5	17.3	0.5
1975-76	-	-	-	15.7[1]	-	17.3	-	15.4	16.4	0.9	15.3	17.4	13.7	15.5	1.1	14.8	13.8	-	14.3	0.5	15.4	0.5
Balsamorhiza sagittata																						
1974-75	2.5	-	2.5	2.5	0	2.4	2.5	2.0	2.3	0.2	2.8	-	-	2.8	-	2.4	-	-	2.4	-	2.4	0.1
1975-76	3.2	3.2	3.5	3.3	0.1	3.7	2.8	3.1	3.2	0.3	3.3	4.3	4.0	3.9	0.3	2.5	5.4	2.9	3.6	0.9	3.5	0.2
Festuca idahoensis																						
1974-75	4.2	2.2	-	3.2	1.0	-	-	-	-	-	-	2.8	-	2.8	-	-	-	-	-	-	3.1	0.6
1975-76	6.1	5.3	6.5	6.0	0.4	5.3	-	-	5.3	-	5.3	7.0	6.1	6.1	0.5	-	-	5.9	5.9	-	5.9	0.2
Bromus tectorum																						
1974-75	-	-	0.9	0.9	-	0.9	1.3	0.8	1.0	0.2	1.1	1.2	-	1.2	0.05	-	-	-	-	-	1.0	0.1
1975-76	-	-	-	-	-	2.8	1.5	0.9	1.7	0.6	1.8	2.6	-	2.2	0.4	-	-	-	-	-	1.9	0.4
Tragopogon dubius																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	6.8[1]	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.2[1]	-
Prunus virginiana																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.1[1]	-
1975-76	-	-	-	3.3[1]	-	-	2.9	-	2.9	-	2.3	-	-	2.3	-	-	-	-	-	-	2.8	0.3
Rosa nutkana																						
1974-75	-	-	-	-	-	-	-	-	2.9[1]	-	-	-	-	-	-	2.9	-	-	2.9	-	2.9	0
1975-76	-	-	-	2.6[1]	-	-	2.9	-	2.9	-	-	-	-	-	-	3.2	-	-	3.2	-	2.9	0.2
Pseudotsuga menziesii																						
1974-75	-	-	-	8.4[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9.4[1]	-	9.5[2]	0.6
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11.1[1]	-
Green Grass[3]	-	-	-	-	-	4.8	-	-	4.8	-	-	-	-	-	-	-	-	-	-	-	4.8	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure includes a sample collected from habitat type 13, *Pseudotsuga menziesii/Festuca idahoensis*, containing 10.6% ether extract in 1974-75.

[3]This sample was collected in 1975-76 only and consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 23. ASH CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING EARLY APRIL, 1975, AND FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
Artemisia tridentata																						
1974-75	-	-	-	-	-	-	3.4	-	3.4	-	-	2.6	3.0	2.8	0.2	2.9	2.8	3.0	2.9	0.06	3.0	0.1
1975-76	-	-	-	-	-	-	2.7	-	2.7	-	2.5	3.1	2.4	2.7	0.1	2.6	2.5	2.8	2.6	0.09	2.7	0.3
Purshia tridentata																						
1974-75	-	-	-	-	-	2.1	3.1	2.4	2.5	0.3	2.4	1.9	-	2.2	0.2	-	-	-	-	-	2.4	0.2
1975-76	-	-	-	-	-	2.3	2.5	1.9	2.2	0.2	1.8	2.0	1.9	1.9	0.06	-	-	-	-	-	2.1	0.1
Juniperus scopulorum																						
1974-75	5.4	5.0	-	5.2	0.2	3.4	-	4.8	4.1	0.7	3.7	3.5	4.4	3.9	0.3	3.4	4.4	5.1	4.3	0.5	4.3	0.3
1975-76	-	-	-	4.4[1]	-	2.6	-	3.0	2.8	0.2	2.8	3.1	3.3	3.1	0.1	3.0	3.2	-	3.1	0.1	3.2	0.2
Balsamorhiza sagittata																						
1974-75	12.3	-	9.0	10.7	1.6	24.6	23.2	31.1	26.3	2.4	17.8	-	-	17.8	-	2.1	-	-	2.1	-	17.2	3.8
1975-76	10.0	10.7	8.2	9.6	0.7	8.0	11.2	9.8	9.7	0.9	9.5	8.3	12.4	10.1	1.2	11.9	9.9	11.0	10.9	0.6	10.1	0.4
Festuca idahoensis																						
1974-75	8.6	8.0	-	8.3	0.3	-	-	-	-	-	-	6.6	-	6.6	-	-	-	-	-	-	7.7	0.6
1975-76	9.8	11.8	9.1	10.2	0.8	13.0	-	-	13.0	-	7.4	8.2	9.4	8.3	0.6	-	-	11.2	11.2	-	10.0	0.7
Bromus tectorum																						
1974-75	-	-	4.6	4.6	-	3.0	4.6	3.1	3.6	0.5	2.9	3.7	-	3.3	0.4	-	-	-	-	-	3.7	0.3
1975-76	-	-	-	-	-	5.3	6.9	4.3	5.5	0.8	5.5	7.0	-	6.3	0.7	-	-	-	-	-	5.8	0.5
Tragopogon dubius																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	4.7[1]	-
Prunus virginiana																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5.1[1]	-
1975-76	-	-	-	5.0[1]	-	-	3.6	-	3.6	-	3.7	-	-	3.7	-	-	-	-	-	-	4.1	0.5
Rosa nutkana																						
1974-75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.4[1]	-
1975-76	-	-	-	3.3[1]	-	-	4.1	-	4.1	-	-	-	-	-	-	-	-	-	-	-	3.7	0.4
Pseudotsuga menziesii																						
1974-75	-	-	-	3.1[1]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.8[1]	-	2.6[2]	0.3
1975-76	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.3[1]	-
Green Grass[3]	-	-	-	-	-	11.6	-	-	11.6	-	-	-	-	-	-	-	-	-	-	-	11.6	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This figure includes a sample collected from habitat type 13, *Pseudotsuga menziesii/Festuca idahoensis*, containing 2.0% ash in 1974-75.

[3]This sample was collected in 1975-76 only and consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 24. NUTRITIVE COMPOSITION OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING EARLY APRIL, 1975, AND FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS.

	Moisture		Protein		Ether Extract		Ash		Crude Fiber		Calcium	Phosphorus	Ca/P*	Sodium	Potassium	Na/K*
	1974-75	1975-76	1974-75	1975-76	1974-75	1975-76	1974-75	1975-76	1974-75	1975-76	1975-76	1975-76	1975-76	1975-76	1975-76	1975-76
Artemisia tridentata																
AGSP/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUTR/AGSP h.t.	4.5	6.1	10.8	9.4	9.7	8.3	3.4	2.7	17.3	16.0	0.53	0.19	2.8	0.02	0.55	0.04
PUTR/ARTR h.t.	4.2	5.2	9.8	9.7	10.1	10.2	2.8	2.7	18.5	17.0	0.46	0.17	2.7	0.04	0.72	0.05
ARTR/FEID h.t.	4.0	4.0	9.3	9.4	11.4	8.2	2.9	2.6	16.8	17.4	0.48	0.18	2.7	0.03	0.80	0.04
Total[1]	4.2	4.8	9.7	9.5	10.7	9.1	3.0	2.7	17.5	17.0	0.48	0.18	2.7	0.03	0.73	0.04
Purshia tridentata																
AGSP/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUTR/AGSP h.t.	2.8	2.8	8.3	9.0	5.4	6.3	2.5	2.2	24.4	22.9	0.62	0.11	5.5	0.02	0.25	0.08
PUTR/ARTR h.t.	3.8	3.3	7.8	9.1	5.6	6.5	2.2	1.9	25.7	27.9	0.52	0.12	4.4	0.02	0.23	0.07
ARTR/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total[1]	3.2	3.1	8.1	9.1	5.5	6.4	2.4	2.1	24.9	25.4	0.58	0.12	5.0	0.02	0.24	0.07
Juniperus osteosperma																
AGSP/FEID h.t.	6.9	9.5	6.6	7.1	15.3	15.7	5.2	4.4	23.6	20.0	1.29	0.13	9.9	0.01	0.60	0.02
PUTR/AGSP h.t.	5.9	10.0	8.4	8.3	18.4	16.4	4.1	2.8	20.5	21.4	0.96	0.16	6.0	0.06	0.34	0.19
PUTR/ARTR h.t.	7.3	10.6	8.5	7.7	17.7	15.5	3.9	3.1	20.7	23.8	1.03	0.14	7.5	0.03	0.51	0.06
ARTR/FEID h.t.	8.5	9.7	6.7	7.8	17.4	14.3	4.3	3.1	21.3	23.8	1.03	0.14	7.6	0.06	0.53	0.13
Total[1]	7.3	10.1	7.6	7.8	17.3	15.4	4.3	3.2	21.4	22.7	1.04	0.14	7.5	0.04	0.48	0.11
Cercocarpus virginiana																
AGSP/FEID h.t.	-	2.9	-	10.5	-	3.3	-	5.0	-	23.4	1.43	0.18	7.9	0.006	0.59	0.01
PUTR/AGSP h.t.	-	4.1	-	10.9	-	2.9	-	3.6	-	24.3	1.47	0.20	7.4	0.03	0.44	0.07
PUTR/ARTR h.t.	-	2.8	-	8.7	-	2.3	-	3.7	-	20.8	1.70	0.15	11.3	0.03	0.34	0.09
ARTR/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total[1]	4.2[2]	3.0	8.8[2]	10.0	3.1[2]	2.8	5.1[2]	4.1	22.9[2]	22.8	1.53	0.18	8.9	0.02	0.46	0.06
Bouteloua gracilis																
AGSP/FEID h.t.	-	2.5	-	6.5	-	2.6	-	3.3	-	30.2	-	-	-	-	-	-
PUTR/AGSP h.t.	4.5	3.5	5.6	6.0	2.9	2.9	-	4.1	28.4	28.3	-	-	-	-	-	-
PUTR/ARTR h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARTR/FEID h.t.	-	-	4.8	5.0	2.9	3.2	-	-	31.7	29.8	-	-	-	-	-	-
Total[1]	4.5	3.0	5.2	5.6	2.9	2.9	3.4[2]	3.7	30.1	29.4	-	-	-	-	-	-
Leucelene ericoides																
AGSP/FEID h.t.	5.7	-	7.4	-	8.4	-	3.1	-	20.5	-	-	-	-	-	-	-
PUTR/AGSP h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUTR/ARTR h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARTR/FEID h.t.	5.5	-	8.2	-	9.4	-	2.8	-	19.6	-	-	-	-	-	-	-
Total[1]	5.3	5.2[2]	7.0	5.9[2]	9.5	11.1[2]	2.6	3.3[2]	20.6	20.2[2]	0.89[2]	0.12[2]	7.4[2]	0.005[2]	0.03[2]	0.01[2]
Leptodactylon pungens																
AGSP/FEID h.t.	5.6	5.6	6.1	5.4	2.5	3.3	10.7	9.6	31.3	28.1	2.66	.06	48.1	0.008	0.08	0.10
PUTR/AGSP h.t.	4.9	5.4	5.6	6.1	2.3	3.2	26.1	9.7	27.8	28.1	2.54	.07	34.7	0.008	0.08	0.11
PUTR/ARTR h.t.	4.4	3.8	7.5	6.3	2.8	3.9	17.8	10.1	32.1	30.2	2.35	.06	37.5	0.008	0.09	0.09
ARTR/FEID h.t.	5.4	5.3	5.4	5.3	2.4	3.6	2.1	10.9	23.9	26.5	2.91	.09	32.7	0.01	0.10	0.09
Total[1]	5.1	5.0	6.0	5.8	2.4	3.5	17.2	10.1	28.8	28.2	2.61	.07	38.3	0.009	0.09	0.10
Eriogonum ovalifolium																
AGSP/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUTR/AGSP h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
PUTR/ARTR h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
ARTR/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total[1]	-	2.7[2]	4.4[2]	6.1[2]	6.8[2]	9.2[2]	-	4.7[2]	32.8[2]	32.1[2]	-	-	-	-	-	-
Grayia spinosa																
AGSP/FEID h.t.	3.7	3.2	4.2	4.0	3.2	6.0	8.3	10.2	36.7	30.3	0.46	.05	8.7	0.007	0.29	0.03
PUTR/AGSP h.t.	-	2.7	-	7.6	-	5.3	-	13.0	-	31.6	0.40	.14	2.9	0.02	0.41	0.03
PUTR/ARTR h.t.	2.2	2.4	6.0	6.2	2.8	6.1	6.6	8.3	36.0	33.7	0.40	.10	4.3	0.01	0.44	0.05
ARTR/FEID h.t.	-	3.1	-	5.0	-	5.9	-	11.2	-	22.0	0.48	.11	4.4	0.008	0.32	0.03
Total[1]	3.2	2.8	4.8	5.4	3.1	5.9	7.7	10.0	36.5	30.7	0.43	.09	5.8	0.01	0.36	0.03
Poa secunda																
AGSP/FEID h.t.	6.1	-	3.0	-	0.9	-	4.6	-	42.1	-	-	-	-	-	-	-
PUTR/AGSP h.t.	3.7	2.9	2.2	3.2	1.0	1.7	3.6	5.5	40.3	41.7	0.26	.05	6.3	0.007	0.08	0.09
PUTR/ARTR h.t.	3.1	2.4	2.5	4.3	1.2	2.2	3.3	6.3	42.4	38.0	0.35	.06	5.8	0.01	0.16	0.06
ARTR/FEID h.t.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total[1]	3.9	2.7	2.4	3.6	1.0	1.9	3.7	5.8	41.3	40.2	0.29	.05	6.1	0.008	0.10	0.08
Green Grass[4]	-	2.8	-	18.9	-	4.8	-	11.6	-	17.3	0.59	0.25	2.4	0.03	1.20	0.03

*Ratios were calculated from original data figures which were not rounded to the nearest decimal.

[1]Totals represent averages of all samples collected during these periods and do not necessarily represent averages of habitat type values.

[2]Representative of a composite sample.

[4]Collected from PUTR/ARTR h.t., transect 15, during a "green-up". This sample consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 25. CALCIUM AND PHOSPHORUS CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
CALCIUM																						
Artemisia tridentata	-	-	-	-	-	-	0.53	-	0.53	-	0.48	0.44	0.46	0.46	.01	0.38	0.50	0.57	0.48	.06	0.48	.02
Purshia tridentata	-	-	-	-	-	0.64	0.69	0.52	0.62	.05	0.56	0.48	-	0.52	.04	-	-	-	-	-	0.58	.04
Juniperus scopulorum	-	-	-	1.29[1]	-	0.84	-	1.08	0.96	.12	0.98	1.19	0.92	1.03	.08	0.97	1.08	-	1.03	.06	1.04	.05
Balsamorhiza sagittata	2.65	2.96	2.36	2.66	.17	2.45	2.54	2.62	2.54	.05	2.56	2.09	2.40	2.35	.14	2.79	2.87	3.08	2.91	.09	2.61	.08
Festuca idahoensis	0.48	0.44	0.47	0.46	.01	0.40	-	-	0.40	-	0.40	0.38	0.42	0.40	.01	-	-	0.48	0.48	-	0.43	.01
Bromus tectorum	-	-	-	-	-	0.28	-	0.23	0.26	.03	0.35	-	-	0.35	-	-	-	-	-	-	0.29	.03
Tragopogon dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus virginiana	-	-	-	1.43[1]	-	-	1.47	-	1.47	-	1.70	-	-	1.70	-	-	-	-	-	-	1.53	.09
Rosa nutkana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.89[1]	-
Green Grass[2]	-	-	-	-	-	0.59	-	-	0.59	-	-	-	-	-	-	-	-	-	-	-	0.59	-
PHOSPHORUS																						
Artemisia tridentata	-	-	-	-	-	-	.19	-	.19	-	.18	.18	.15	.17	.01	.17	.17	.19	.18	.01	0.18	.004
Purshia tridentata	-	-	-	-	-	.10	.13	.11	.11	.01	.11	.13	-	.12	.01	-	-	-	-	-	0.12	.004
Juniperus scopulorum	-	-	-	.13[1]	-	.15	-	.17	.16	.01	.12	.14	.16	.14	.01	.13	.14	-	.14	.01	0.14	.007
Balsamorhiza sagittata	.07	.05	.05	.06	.01	.07	.07	.08	.07	.01	.06	.07	.06	.06	.01	.09	.10	.08	.09	.01	.07	.006
Festuca idahoensis	.06	.05	.05	.05	.01	.14	-	-	.14	-	.09	.12	.08	.10	.01	-	-	.11	.11	-	.09	.01
Bromus tectorum	-	-	-	-	-	.06	-	.03	.05	.01	.06	-	-	.06	-	-	-	-	-	-	.05	.01
Tragopogon dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus virginiana	-	-	-	.18[1]	-	-	.20	-	.20	-	.15	-	-	.15	-	-	-	-	-	-	.18	.02
Rosa nutkana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.12[1]	-
Green Grass[2]	-	-	-	-	-	.25	-	-	.25	-	-	-	-	-	-	-	-	-	-	-	0.25	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This sample consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 26. SODIUM AND POTASSIUM CONTENTS OF MAJOR MULE DEER FORAGE PLANTS ON FOUR HABITAT TYPES ON THE ARMSTRONG WINTER RANGE DURING FEBRUARY, 1976. DATA ARE PERCENTAGES OF AIR DRY WEIGHTS FOR INDIVIDUAL TRANSECTS WITHIN EACH TYPE AND MEANS ARE FOR ALL TRANSECTS COMBINED. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
SODIUM																						
Artemisia tridentata	-	-	-	-	-	-	.02	-	.02	-	.03	.04	.04	.04	.01	.02	.02	.05	.03	.01	0.03	.004
Purshia tridentata	-	-	-	-	-	.02	.02	.02	.02	0	.02	.01	-	.02	.01	-	-	-	-	-	0.02	0
Juniperus scopulorum	-	-	-	.01[1]	-	.06	-	.06	.06	0	.02	.05	.006	.03	.01	.03	.09	-	.06	.03	0.04	.01
Balsamorhiza sagittata	.009	.007	.007	.008	0	.009	.009	.007	.008	0	.007	.01	.008	.008	0	.009	.01	.01	.01	-	0.009	0
Festuca idahoensis	.007	.008	.007	.007	0	.02	-	-	.02	-	.01	.02	.01	.01	.006	-	-	.008	.008	-	0.01	0
Bromus tectorum	-	-	-	-	-	.009	-	.005	.007	0	.01	-	-	.01	-	-	-	-	-	-	0.008	0
Tragopogon dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus virginiana	-	-	-	.006[1]	-	-	.03	-	.03	-	.03	-	-	.03	-	-	-	-	-	-	0.02	.006
Rosa nutkana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.005[1]	-
Green Grass[2]	-	-	-	-	-	.03	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.03	-
POTASSIUM																						
Artemisia tridentata	-	-	-	-	-	-	.55	-	.55	-	.59	.92	.66	.72	.1	.88	.79	.73	.80	.05	0.73	.05
Purshia tridentata	-	-	-	-	-	.26	.27	.22	.25	.02	.22	.23	-	.23	.01	-	-	-	-	-	0.24	.009
Juniperus scopulorum	-	-	-	.60[1]	-	.40	-	.27	.34	.06	.42	.42	.70	.51	.09	.59	.46	-	.53	.06	0.48	.05
Balsamorhiza sagittata	.10	.07	.07	.08	.05	.06	.09	.08	.08	.01	.07	.10	.11	.09	.01	.09	.10	.11	.10	.01	0.09	.006
Festuca idahoensis	.35	.27	.24	.29	.03	.41	-	-	.41	-	.39	.54	.39	.44	.05	-	-	.32	.32	-	0.36	.03
Bromus tectorum	-	-	-	-	-	.08	-	.07	.08	.01	.16	-	-	.16	-	-	-	-	-	-	0.10	.03
Tragopogon dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus virginiana	-	-	-	.59[1]	-	-	.44	-	.44	-	.34	-	-	.34	-	-	-	-	-	-	0.46	.08
Rosa nutkana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.65[1]	-
Green Grass[2]	-	-	-	-	-	1.20	-	-	1.20	-	-	-	-	-	-	-	-	-	-	-	1.20	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This sample consisted primarily of *Agropyron spicatum* and *Poa* spp.

TABLE 27. CALCIUM/PHOSPHORUS (Ca/P) AND SODIUM/POTASSIUM (Na/K) RATIOS FOR MAJOR MULE DEER FORAGE PLANTS ON THE ARMSTRONG WINTER RANGE DURING FEBRUARY, 1976. (T = transects within habitat types)

	AGSP/FEID h.t.					PUTR/AGSP h.t.					PUTR/ARTR h.t.					ARTR/FEID h.t.					Totals	
	T14	T13	T32	$\bar{X}$	SE	T15	T6	T28	$\bar{X}$	SE	T5	T7	T33	$\bar{X}$	SE	T17	T31	T1	$\bar{X}$	SE	$\bar{X}$	SE
Ca/P																						
Artemisia tridentata	-	-	-	-	-	-	2.8	-	2.8	-	2.7	2.4	3.1	2.7	0.2	2.2	2.9	3.0	2.7	0.3	2.7	0.1
Purshia tridentata	-	-	-	-	-	6.4	5.3	4.7	5.5	0.6	5.1	3.7	-	4.4	0.7	-	-	-	-	-	5.0	0.4
Juniperus scopulorum	-	-	-	9.9[1]	-	5.6	-	6.4	6.0	0.4	8.2	8.5	5.8	7.5	0.9	7.5	7.7	-	7.6	0.1	7.5	0.5
Balsamorhiza sagittata	37.9	59.2	47.2	48.1	6.2	35.0	36.3	32.8	34.7	1.0	42.7	29.9	40.0	37.5	3.9	31.0	28.7	38.5	32.7	3.0	38.3	2.5
Festuca idahoensis	8.0	8.8	9.4	8.7	0.4	2.9	-	-	2.9	-	4.4	3.2	5.3	4.3	0.6	-	-	4.4	4.4	-	5.8	0.9
Bromus tectorum	-	-	-	-	-	4.7	-	7.8	6.3	1.5	5.8	-	-	5.8	-	-	-	-	-	-	6.1	0.9
Tragopogon dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus virginiana	-	-	-	7.9[1]	-	-	7.4	-	7.4	-	11.3	-	-	11.3	-	-	-	-	-	-	8.9	1.2
Rosa nutkana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.4[1]	-
Green Grass[2]	-	-	-	-	-	2.4	-	-	2.4	-	-	-	-	-	-	-	-	-	-	-	2.4	-
Na/K																						
Artemisia tridentata	-	-	-	-	-	-	.04	-	.04	-	.05	.04	.06	.05	.006	.02	.03	.07	.04	.02	0.04	.008
Purshia tridentata	-	-	-	-	-	.08	.07	.09	.08	.006	.09	.04	-	.07	.03	-	-	-	-	-	0.07	.009
Juniperus scopulorum	-	-	-	.02[1]	-	.15	-	.22	.19	.04	.05	.12	.01	.06	.03	.05	.20	-	.13	.08	0.11	.03
Balsamorhiza sagittata	.09	.10	.10	.10	.006	.15	.10	.09	.11	.02	.10	.10	.07	.09	.012	.10	.10	.09	.10	.006	0.10	.006
Festuca idahoensis	.02	.03	.03	.03	.006	.05	-	-	.05	-	.03	.04	.03	.03	.006	-	-	.03	.03	-	0.03	.004
Bromus tectorum	-	-	-	-	-	.11	-	.07	.09	.02	.06	-	-	.06	-	-	-	-	-	-	0.08	.02
Tragopogon dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Prunus virginiana	-	-	-	.01[1]	-	-	.07	-	.07	-	.09	-	-	.09	-	-	-	-	-	-	0.06	.02
Rosa nutkana	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pseudotsuga menziesii	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.01[1]	-
Green Grass[2]	-	-	-	-	-	.03	-	-	.03	-	-	-	-	-	-	-	-	-	-	-	0.03	-

[1]Where a figure appears under a total but not under individual transects, it is a composite sample from an individual habitat type or from all habitat types concerned, regardless of transects.

[2]This sample consisted primarily of *Agropyron spicatum* and *Poa* spp.

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