



Forage preference of range sheep
by Mons L Teigen

A THESIS Submitted to the Graduate Committee in partial fulfillment of the requirements for the degree of Master of Science in Range Management
Montana State University
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Abstract:

This study was conducted on two adjoining sheep allotments in the Bridget Range of the Gallatin Rational Forest. A comparison of forage preference was made between a ewe and lamb band and a yearling or "dry" band.

By use of a modification of the line interception method various grazed areas were sampled to determine what the animals had been eating. All species of plants encountered on the transects were recorded and a notation was made as to whether grazed or not. If grazed, the portions removed by grazing were noted. Vegetational composition was also indicated by recording all species encountered.

The study has shown that a certain amount of preference is exercised by sheep in grazing. It has been shown also that this preference is not necessarily in favor of the most abundant plants. Species composition, as determined from the transects, ranked the types of forage according to abundance as follows: grasses and grass-like plants, forbs, and then browse*. Preference according to the type of forage, however, was led by forbs followed by grass and then browse. This held true for both bands.

The most abundant plant encountered was California brome followed by elk sedge, sheep fescue, slender wheatgrass, and pinegrass, respectively. Of these, slender wheatgrass was the first preference of the ewe and lamb band, California brome and sheep fescue following. For the yearling band, sheep fescue led with slender wheatgrass second and California brome thirds. The four most abundant palatable forbs for the yearling band were common dandelion, pale agoseris, northwest cinquefoil, and lupine. Their order of preference for the ewe and lamb band was common dandelion, pale agoseris, northwest cinquefoil, and heartleaf arnica. Although encountered less frequently the preference for thickstem aster was high for both bands.

Browse preference was difficult to determine as the area had few shrubs on it. Snowberry appeared to be one of the more preferred plants, especially for the ewe and lamb band. Douglas fir was preferred to some extent by the ewe and lamb band also.

The average use by lines together with its standard deviation has been computed for some of the more preferred or abundant plants. The standard deviations were so large as to render the average use figure of little value as an exact measurement of preference. This was the extent of the statistical analysis made of the study. However, it was sufficient to show the extreme variability of utilization of the same plant on different transects.

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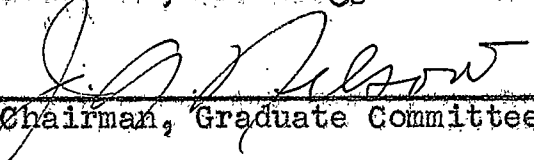
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ABSTRACT

This study was conducted on two adjoining sheep allotments in the Bridger Range of the Gallatin National Forest. A comparison of forage preference was made between a ewe and lamb band and a yearling or "dry" band.

By use of a modification of the line interception method various grazed areas were sampled to determine what the animals had been eating. All species of plants encountered on the transects were recorded and a notation was made as to whether grazed or not. If grazed, the portions removed by grazing were noted. Vegetational composition was also indicated by recording all species encountered.

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The most abundant plant encountered was California brome followed by elk sedge, sheep fescue, slender wheatgrass, and pinegrass, respectively. Of these, slender wheatgrass was the first preference of the ewe and lamb band, California brome

and sheep fescue following. For the yearling band, sheep fescue led with slender wheatgrass second and California brome third.

The four most abundant palatable forbs for the yearling band were common dandelion, pale agoseris, northwest cinquefoil, and lupine. Their order of preference for the ewe and lamb band was common dandelion, pale agoseris, northwest cinquefoil, and heartleaf arnica. Although encountered less frequently the preference for thickstem aster was high for both bands.

Browse preference was difficult to determine as the area had few shrubs on it. Snowberry appeared to be one of the more preferred plants, especially for the ewe and lamb band. Douglas fir was preferred to some extent by the ewe and lamb band also.

The average use by lines together with its standard deviation has been computed for some of the more preferred or abundant plants. The standard deviations were so large as to render the average use figure of little value as an exact measurement of preference. This was the extent of the statistical analysis made of the study. However, it was sufficient to show the extreme variability of utilization of the same plant on different transects.

INTRODUCTION

Many thousands of acres of range land in the West are grazed by sheep. This practice contributes greatly to the income of the region. The importance of these animals to the economy of the West has caused much investigational work to be done in an effort to determine which feeds, feeding practices, and systems of management can produce the most successful long-term range operation. Most of these studies have had one fundamental problem to cope with, the problem of what the animals obtain from the native range forage. A factor of primary importance in this determination, therefore, is a knowledge of the forage preference of the animal. The aim of this project was, consequently, to determine what this preference might be on summer forest range.

Previous research (5, 12, 16) has indicated that as sheep graze over the range they do not forage indiscriminantly, but display a rather definite choice as to both species and portions consumed? This characteristic of consciously selecting certain plants over others indirectly creates one of the livestock industry's greatest problems--the proper degree of forage utilization? It can readily be seen that as the more palatable plants are grazed, modifying in some respects their physiological functions, the less palatable ones are thereby benefited by having the degree of competition decreased. If the grazing use does not become too intense on the preferred plants, no

harm is done, and the plants will continue to reproduce and thrive. If on the other hand, the plants become too intensely grazed, they will fail to reproduce in sufficient numbers to maintain their position in the plant community and will eventually be replaced by less palatable plants. This generally constitutes a decrease in the carrying capacity of the range, which is a situation that stockmen can ill afford.

Forage preference has been determined largely from observations by persons closely connected with grazing management. There is relatively little information on forage preference based upon detailed and accurate measurements, due primarily to the lack of an adequate sampling method which can take into account all of the various interrelationships that exist between the environment, the vegetation, and the animals themselves. Another factor of importance is that information obtained in one locality will not necessarily hold true for another locality.

PREVIOUS WORK

Jardine and Anderson (12) have mentioned that sheep prefer forbs while horses and cattle prefer grasses. This has been borne out by Stoddart and Smith (16) in a more recent publication. Doran (10), while studying the grazing habits of ewes and lambs on summer forest range found that the ewes spent more time grazing grasses and forbs than did their lambs, however, the lambs spent more than an hour more time each day grazing browse plants than did their mothers.

Several methods have been devised that readily make themselves useful in preference determination. Stapledon and Jones (15) used a "before and after" method to check utilization wherein plots were clipped and weighed both before and after grazing, and the difference attributed to grazing. Beruldsen and Morgan (2) using a similar method found it possible to estimate the amount removed by a single determination if a good growth of herbage was present. This procedure was modified by Cassady (4) when he clipped a number of plant portions of the principal forage species and obtained an average weight both before and after grazing. The difference in the weight was attributed to utilization by the sheep. Cook, Harris, and Stoddart (6) have elaborated upon Cassady's work by devising a method whereby randomly encountered plants have portions clipped and chemically analyzed before and after grazing to determine the nutritive content of the range forage. With this

method it could be assumed that on a properly grazed range the degree of utilization of the various plants indicated preference.

Cory (7) suggested a method of determining forage preference by establishing permanent quadrats over the range and noting any changes in the vegetation over a period of years. While apparently giving reliable results, the length of time involved usually precludes its use.

Yound, et al (18) made determinations of utilization by counting leaves and measuring current livestem before and after grazing on sheep range in the cut-over western white pine areas of Idaho. The utilization values obtained were fairly consistent from year to year, showing that certain species were definitely preferred by the sheep. Although various browse plants appeared to make up most of their diet, mountain brome and elk sedge were also quite heavily utilized by the animals.

A botanical analysis of stomach contents was attempted by Norris (13) to determine its feasibility in preference studies. Differences in the digestibility of the forage and in the digestive abilities of the various sheep created wide variability between the ration consumed and the material found upon examining the contents of the stomachs. To calculate the mean grass consumption per day for sheep on pasture, Woodman, Evans, and Eden (17) used a system whereby the weight of feces voided each day was determined by independent digestion trials on

other similar sheep the digestibility of the herbage was obtained. This made it possible for the weight of dry matter consumed each day to be computed. In most instances this method would be too expensive and time consuming for use with range sheep. Esplin, Greaves, and Stoddart (11) working with winter range plants developed a system wherein they multiplied species composition by the percentages of each species consumed at the end of the season. This method is obviously too general for most scientific study, although it does give an indication of the amount of forage consumed.

Certain portions of plants are more highly preferred by sheep than others according to Cook, Cook, and Harris (5). Throughout their study, leaves averaged a greater percentage utilization by weight than stems. Although grass made up a larger percentage of forage produced, it ranked second in the diet of sheep, forbs making up the largest percentage of diet. Davies (9) found that the stage of growth has an effect upon palatability of pasture plants for sheep. The younger more succulent plants were preferred over mature plants and in young plants leaves were preferred to stems. Beaumont, et al (1) working with dairy cattle found that there is little discrimination shown between various kinds of pasture grasses when two to four inches in height, however, stage of growth became a factor when grass becomes taller. In a study of grazing habits of cattle, Culley (8), found that some southwestern

range plants were grazed rather uniformly throughout the year, while others were subject to seasonal differences.

In a trial of cool and warm season pasture grasses, Rogler (14) found that cattle displayed a definite taste preference for certain grasses rather than a preference due to the mechanical condition of the plants.

DESCRIPTION OF AREA

The experiment was performed in an area which is located for the most part on two adjoining sheep allotments on the Bridger Range of the Gallatin National Forest. Approximately fifteen sections of land make up these two allotments which are referred to by name as the Jackson Creek and the Spring Creek allotments.

The range is rather rough and has a general southern exposure with fairly steep slopes. The elevation ranges from approximately 5,200 feet at the south edge where Jackson Creek leaves the forest to approximately 7,400 feet south of the Bangtail Ranger Station on the northern edge of the allotments. The area makes up the headwaters of several streams. Fleshman Creek is a small stream that heads on the eastern watershed and flows southeast into the Yellowstone River at Livingston. Jackson Creek heads on the area and flows southwest and then west until it forms the East Gallatin River. Spring Creek and Stone Creek make up the western watershed and eventually flow into Bridger Creek which in turn flows into the East Gallatin River. A portion of the allotments, largely unavailable for grazing, lies on the upper headwaters of Willow Creek which flows eastward into the Shields River a short distance north of where that river flows into the Yellowstone. From this description, one can see that the area forms a divide from which part of the water flows westerly into the East Gallatin

River and the remainder flows eastward to the Yellowstone River.

The soil of the area is, for the most part, of a sandy texture with sandstone outcrops forming rather rugged escarpments at the extreme head of Jackson Creek. Above these one finds gravel-capped ridges. There are many slide-rock slopes in the area. The stream bottoms are composed of a well drained, fairly deep silt loam.

The area is predominantly a timber type, but produces very little merchantable saw timber. The predominant species being Douglas fir, Pseudotsuga taxifolia* and lodgepole pine, Pinus contorta. The open parks and meadows at the medium elevations are composed of a grass-weed type with grasses dominating. This type is mainly a brome-grass-bluegrass-cinquefoil community. On the higher untimbered portions of the range, the type is predominantly grass, principally a sheep fescue-brome-grass community. The valley bottoms are mainly a timothy-brome community. There is very little shrubby vegetation on either allotment. Big sagebrush, Artemisia tridentata, is present in scattered stands and is probably the most abundant shrub. A few scattered clumps of mountain balm, Ceanothus velutinus are occasionally encountered, but compose only a

* Both technical and common names will be given the first time encountered, thereafter only the common name will be used. See Appendix A.

very small percentage of the total vegetation.



Figure 1
Open park, typical of the area, before grazing.

Several transects were studied soon after leaving the forest allotments. These transects have been included with the others in the study because of the close similarity between these areas and the adjacent forest lands.

Climatological data is not available for the specific area. Data from Bozeman, approximately sixteen air miles southwest gives the mean annual precipitation as 17.39 inches with 36.5 percent of the total falling in the winter months of October, November, December, January, February, and March. The mean frost-free period is 115 days for the Bozeman station. The weather for 1948 as recorded at Bozeman does not appear to differ greatly from previous years. It was generally believed by people well acquainted with the study area, that the first thirty days on the allotments were considerably cooler than

the average, and also that there was a greater frequency of rainfall during that period. The weather records at Bozeman do not bear this out, but variations such as this are common in the mountain areas due to elevational and topographical influences.

Approximately eleven air miles southeast of the allotments is Livingston, the only other station in the vicinity where weather records are taken. Livingston has a mean frost-free period of 127 days. The mean annual precipitation is 14.67 inches with 31.3 percent of it falling in the winter months of October, November, December, January, February, and March. Although somewhat nearer the experimental area, the Livingston station, because of its location on the plains east of the mountains, does not give as accurate a picture of the climate of the study area as does Bozeman.

EXPERIMENTAL PROCEDURE

The forage preferences of two different bands of sheep were studied. One band was composed of 1,030 ewes with lambs at side, and the other was made up of 745 yearling ewes plus 165 older "dry"* ewes, making a total of 910 head for the band. Each band was under the control of a herder and the "one-night bed-ground" system of management as described by Stoddart and Smith (16) was used during the time spent on the forest. Since it was not possible for the investigator to exert any form of control over either band, sampling was done wherever the animals had previously grazed. The sheep were never directed to any special location for the purpose of this study.

Before sampling, it was necessary for the investigator to confer with the herder to determine what areas had been grazed previously. In most instances areas to be sampled were selected from those which had been exposed to grazing animals twice. It was difficult to determine the length of time the sheep spent grazing an area, however, it was generally less than half a day, due to the fact that during the middle of the day they would "shade-up" and generally move onto another area in late afternoon. If this was not done and the sheep grazed

* "Dry" ewes are ewes that are not raising lambs this year.

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the same area in the afternoon as in the morning, the area was considered grazed twice. It was necessary, in some cases, for the investigator to make a preliminary reconnaissance of the area and by visual appraisal of the number of plants grazed decide whether sufficient grazing intensity had been attained to justify sampling. In selecting these sampling areas an effort was made to avoid areas where considerable grazing or trampling damage had occurred, as it was believed that in these instances some plants might be taken that ordinarily would not be preferred. The limitations of this study did not permit the study of special conditions such as preference near bedgrounds, trampled areas, or overgrazed areas.



Figure 2
Mountain meadow, used as bedground.

The method originally planned for use in this study was a modification of that described by Cook, Harris, and Stoddart (6). Upon field trial, however, it was discarded in favor of

the line transect. There were several reasons for this. First, there is difficulty in knowing which plant to select at the point of the toe in vegetation of high density such as that on much of the allotments. Second, equipment and facilities for work of this nature were not available. A transportation problem was also involved as all supplies had to be packed in on horseback. Third, the fact that no chemical analysis was to be made of the collected material made the method appear quite elaborate for use in this study.

A modification of the line interception method as described by Canfield (3) was the method employed in sampling. The line used was composed of one hundred feet of cotton sashcord with a steel pin attached at each end. This line was extended a number of times over each area studied. Data was recorded from twenty transects with this length of line during the first part of the study. Then the line was broken into eight sections, each marked by a knot at twelve and one-half feet intervals. The remainder of the transects were taken by sampling alternate sections. This shortened the length of time necessary to sample a line transect and made possible more replications per area without too great loss in sampling adequacy. The lines were run in such a manner as it was thought would best sample vegetational heterogeneity. In most cases this meant that the lines were run up hill. It was also desired to use a set pattern in locating lines on each area in order

to eliminate personal bias. Therefore, for each study area a base line was established, generally running up hill and additional lines were run parallel to this base line. The sampling areas were of various sizes and shapes and, therefore, each area had a different pattern of lines. It was discovered quite early in the study that locating transects under dense timber was of little value, due to the fact that very few grazed plants were encountered and in some cases, none at all. This made it necessary for the transects to be located in the more open portions of the range, such as parks, meadows, open ridges, and other timberless or moderately timbered areas.

Data recorded for each transect involved was first, a topographic description of the sample area; second, frequency and abundance of each species of plant on the transect; third, whether the plant was grazed or not; fourth, what portions of the plant were taken, if grazed; and fifth, any pertinent remarks as to characteristics that could affect its palatability such as trampling damage, the presence of ergot, stage of growth, or other characteristics. No measurements were made of stubble height or length of intercept. Whether or not a plant was grazed was determined by visual perception of stems, leaves, or flowers showing evidence of being grazed. Grazing was evident if plants had portions removed recently. This was easily determined except in certain cases such as elk sedge, Carex Geyeri, in which the terminal portions of

the leaves dry up and break off early in the season giving it a grazed appearance. This is also true of certain browse plants. Notable among these is snowberry, Symphoricarpos spp., and Oregon grape, Mahonia repens. Minute observation with the aid of hand lens, however, would in all cases be sufficient to determine whether or not a plant had been grazed. The freshness of the scar was the criterion used in these cases.

Data concerning portions of plant removed by grazing was recorded in several categories, namely: all parts grazed, flower or seeds (in the case of grasses), flower stalk or seed stalk, leaves, and leaf tip. A plant recorded as "all parts" grazed does not necessarily mean that the entire plant was cropped off, but rather that all of the various above-ground portions of the plant have been grazed to some degree. This category was most often used with grasses, as in many instances "all parts" were cropped down to a certain height. "Flower or seeds" recorded as grazed meant that these portions were completely utilized. The category "flower stalk" was used primarily for grasses to indicate that the seed or flower stalk had been taken in preference to some other portion. A distinction has been made in this study between the leaf and leaf tip because this differentiation could give an indication of the quality of the animal's diet (6). In order to determine into which category the plant should be placed it was

necessary to compare the grazed leaves to other adjacent ungrazed leaves and in some cases estimate the amount removed. Data of this sort is available for fifty-two lines but was omitted from the first nine lines taken.

In most cases only one area was sampled daily. This was primarily due to the length of time required to analyze each transect and to the distance between the areas. The number of transects within each area varied from one to six. The instances in which only one line transect was studied per day were not discarded, however, as the investigator believed that they were still a measurement of the animal's preference.

RESULTS

Rangemen have known for some time that a foraging sheep prefers a rather varied diet (12, 16). The present study confirms this fact.

Although depicting the varied nature of a sheep's diet on summer forest range this study, unfortunately, does not determine the actual amounts consumed. The method of Cook, Harris and Stoddart (6), the only practicable method for such a determination, was largely unsuitable due to the reasons given in the previous section.

The relative preference for individual species was determined by comparing, for each species, the total number encountered with the number grazed. These preferences are tabulated for each band in Table I (a. and b.). Where there is a wide range in numbers of plants encountered, it is believed that the most logical comparison can be made when the plants are grouped in classes according to their abundance. The plants have therefore been grouped in this manner. In most cases these groups have a spread of nineteen. For example, all plants encountered between twenty-one and forty times are placed in a group.

Of the thirty nine transects sampled on the yearling band allotment, grasses and grass-line plants were the dominant class of vegetation. Weeds were dominant on only five lines. Browse was never so abundant as to be dominant on any transect

TABLE Ia

Percentage Preference by Classes
Yearling Band

Class	Plant	Number encountered	Percent use
311-630	<i>Bromus marginatus</i>	627	22.8
291-310	<i>Carex Geyeri</i>	292	11.3
211-230	<i>Festuca ovina</i>	226	32.3
191-210	<i>Agropyron trachycaulum</i>	200	28.0
151-170	<i>Potentilla gracilis</i>	159	53.5
131-150	<i>Achillea lanulosa</i>	145	0.7
	<i>Poa Canbyi</i>	139	34.5
	<i>Poa pratensis</i>	132	39.3
111-130	<i>Agoseris glauca</i>	115	60.0
	<i>Antennaria</i> spp.	119	4.2
91-110	<i>Calamagrostis rubescens</i>	99	6.1
71-90	<i>Arenaria congesta</i>	84	9.5
51-70	<i>Agropyron Smithii</i>	61	27.9
	<i>Artemisia ludoviciana</i>	65	1.5
	<i>Lupinus flexuosus</i>	58	53.4
	<i>Phleum alpinum</i>	55	21.8
	<i>Stipa columbiana</i>	69	21.7
31-50	<i>Agropyron spicatum</i>	34	11.7
	<i>Aster integrifolius</i>	38	63.2
	<i>Geranium viscosissimum</i>	38	21.1
	<i>Poa compressa</i>	43	13.9
	<i>Sedum stenopetalum</i>	42	0
	<i>Taraxacum officinalis</i>	50	70.0
11-30	<i>Anaphalis subalpinum</i>	27	0
	<i>Arnica cordifolia</i>	14	50.0
	<i>Carex</i> spp.	27	3.7
	<i>Cirsium</i> spp.	16	50.0
	<i>Helianthus scaberrimus</i>	12	58.3
	<i>Koeleria cristata</i>	17	5.9
	<i>Melica spectabilis</i>	13	38.5
	<i>Phleum pratense</i>	12	58.3
	<i>Potentilla</i> spp.	16	37.5
	<i>Symphoricarpos</i> spp.	17	11.8
2-10	<i>Agropyron</i> spp.	6	83.3
	<i>Agrostis hiemalis</i>	6	16.7
	<i>Arnica</i> spp.	4	25.0
	<i>Artemisia tridentata</i>	8	0
	<i>Astragalus</i> spp.	9	66.7
	<i>Balsamorhiza sagitata</i>	3	33.3
	<i>Cerastium arvense</i>	3	0

TABLE Ia Continued

Class	Plant	Number encountered	Percent use
2-10	<i>Cirsium undulatum</i>	4	25.0
	<i>Danthonia intermedia</i>	9	33.3
	<i>Delphinium scopulorum</i>	2	50.0
2-10	<i>Elymus condensatus</i>	7	14.3
	<i>Erythronium</i> spp.	4	50.0
	<i>Festuca idahoensis</i>	2	0
	<i>Hieracium Scouleri</i>	7	42.9
	<i>Juniperus communis</i>	4	0
	<i>Mahonia repens</i>	3	0
	<i>Melica bulbosa</i>	6	0
	<i>Mertensia ciliata</i>	6	83.3
	<i>Monarda</i> spp.	4	75.0
	<i>Muhlenbergia squarrosa</i>	3	0
	<i>Perideridia Gairdneri</i>	3	66.7
	<i>Phlox canescens</i>	7	0
	<i>Pseudotsuga taxifolia</i>	2	0
	<i>Rudbeckia occidentalis</i>	6	16.7
	<i>Senecio triangularis</i>	2	50.0
	<i>Tragopogon pratensis</i>	4	50.0
	<i>Urtica</i> spp.	3	100.0
0-1	<i>Arctium</i> spp.	1	100.0
	<i>Bromus</i> spp.	1	---
	Cruciferae	1	---
	<i>Pinus contorta</i>	1	---
	<i>Poa</i> spp.	1	---
	<i>Trifolium hybridum</i>	1	100.0

TABLE Ib

Percentage Preference by Classes
Ewe and Lamb Band

Class	Plant	Number encountered	Percent use
251-270	Carex Geyeri	270	10.3
211-230	Bromus marginatus	211	36.5
171-190	Calamagrostis rubescens	184	7.6
91-110	Agropyron trachycaulum	94	50.0
	Antennaria spp.	92	16.3
	Festuca ovina	102	25.5
71-90	Poa compressa	73	79.5
	Potentilla gracilis	72	59.7
51-70	Achillea lanulosa	55	3.6
	Arenaria congesta	53	11.3
	Phleum pratense	70	78.6
31-50	Agoseris glauca	39	69.2
	Poa pratensis	37	32.4
	Taraxacum officinalis	34	70.6
11-30	Arnica cordifolia	28	35.7
	Aster integrifolius	11	90.9
	Astragalus spp.	19	63.2
	Geranium viscosissimum	11	36.3
	Lupinus flexuosus	14	64.3
	Poa Canbyi	13	38.5
	Sedum stenopetalum	17	0
	Stipa columbiana	24	29.2
	Symphoricarpos spp.	27	44.4
	Trisetum spicatum	28	35.7
	Viola spp.	27	18.5
2-10	Agrostis hiemalis	3	0
	Anaphalis subalpinum	2	100.0
	Arnica sororia	4	75.0
	Artemisia ludoviciana	10	0
	Artemisia tridentata	4	0
	Balsamorhiza sagitata	8	100.0
	Ceanothus velutinus	3	0
	Delphinium scopulorum	2	50.0
	Erythronium spp.	2	0
	Fragaria spp.	2	50.0
	Helianthus scaberrimus	4	100.0
	Hieracium albiflorum	2	0
	Lactuca pulchella	2	100.0
	Lonicera spp.	3	0
	Melica spectabilis	6	16.7

TABLE Ib Continued

Class	Plant	Number encountered	Percent use	
2-10	<i>Mahonia repens</i>	10	10.0	
	<i>Monarda</i> spp.	6	50.0	
	<i>Muhlenbergia squarrosa</i>	6	66.7	
	<i>Phleum alpinum</i>	10	50.0	
	<i>Pseudotsuga taxifolia</i>	4	100.0	
	<i>Rudbeckia occidentalis</i>	2	50.0	
	<i>Rosa</i> spp.	2	100.0	
	<i>Rubus</i> spp.	8	12.5	
	<i>Smilacina</i> spp.	4	100.0	
	<i>Tragopogon pratensis</i>	2	100.0	
	<i>Trifolium hybridum</i>	8	37.5	
	<i>Vaccinium</i> spp.	6	33.3	
	0-1	<i>Agropyron Smithii</i>	1	100.0
		<i>Agropyron spicatum</i>	1	---
<i>Festuca idahoensis</i>		1	---	
<i>Hieracium Scouleri</i>		1	---	
<i>Perideridia Gairdneri</i>		1	100.0	
	<i>Physocarpus</i> spp.	1	---	
	<i>Senecio triangularis</i>	1	100.0	

for either band. It occurred on thirteen line transects of the yearling band, but was utilized on two of them only. Eighteen of the ewe band transects were dominated by grass while forbs dominated the other four. Browse occurred on fourteen line transects for this band and was utilized on eleven of them.

It is of interest to note the preference for each class of forage in comparison to the total composition. Table II shows the preference for each class in a percentage figure comparing the number of grazed plants of each class to the total number of plants of that class encountered for each band. Percentage composition was determined by comparing the total number of plants to the total number in each class of forage for each band. It would lead one to expect that the animals did practice a certain degree of selection in their choice of forage, inasmuch as forbs, while not being the dominant type of vegetation, were considerably more preferred as a class than grasses or browse.

TABLE II

TOTAL PREFERENCE AND COMPOSITION BY CLASS OF FORAGE

	<u>Yearlings</u>		<u>Ewes and Lambs</u>	
	<u>Percent Composition</u>	<u>Percent Preference</u>	<u>Percent Composition</u>	<u>Percent Preference</u>
Grass	65.7	23.3	65.3	30.9
Forbs	33.2	30.9	30.8	37.9
Browse	1.1	5.7	3.9	32.3

TABLE III

A Comparison of Plant Portions Preferred for the Last Fifty-two Line Transects. (In Percent)

Note: "(1)" indicates that only one plant was recorded.

Plant	Band	No. Lines totaled	All parts	Flower	Flower stalk	Leaf tip	Leaves
Forbs							
Achillea	Y	1					100.0(1)
lanulosa	E	1					100.0(1)
Agoseris	Y	16	13.5	1.9		21.2	65.5
glauca	E	3	22.2			44.4	33.3
Anaphalis	Y	0					
subalpinum	E	1	100.0				
Antennaria	Y	4	20.0			20.0	60.0
spp.	E	1				100.0(1)	
Arctium	Y	1		100.0(1)			
spp.	E	0					
Arenaria	Y	3		16.6		66.7	16.6
congesta	E	3			20.0	80.0	
Arnica	Y	1					100.0(1)
spp.	E	0					
Arnica	Y	1					100.0(1)
cordifolia	E	5	28.6				71.4
Artemisia	Y	1					100.0(1)
ladoviciana	E	0					
Aster	Y	10	21.7			8.7	69.6
integrifolius	E	2	33.3				66.7
Astragalus	Y	4				58.3	66.7
spp.	E	2				100.0	
Balsamorhiza	Y	1					100.0(1)
sagittata	E	1	100.0				
Cirsium	Y	1				100.0(1)	
undulatum	E	0					
Cirsium	Y	2	12.5			50.0	37.5
spp.	E	0					
Delphinium	Y	1					100.0(1)
scopulorum	E	0					
Erythronium	Y	2					100.0
spp.	E	0					
Geranium	Y	3	40.0	20.0			40.0
viscosissimum	E	3	55.5				66.7
Helianthus	Y	3	14.3			14.3	71.4
scaberrimus	E	1					100.0(1)

TABLE III Continued

Plant	Band	No. lines totalled	All parts	Flower stalk	Flower stalk	Leaf tip	Leaves
Forbs							
Hieracium	Y	1	100.0				
Scouleri	E	0					
Lupinus	Y	8	27.5	9.1		18.2	45.5
flexuosus	E	3	25.0				75.0
Monarda	Y	1	66.7			33.3	
spp.	E	0					
Mertensia	Y	1	20.0				80.0
ciliata	E	0					
Perideridia	Y	2	100.0				
Gairdneri	E	0					
Potentilla	Y	15	10.3	2.5		5.7	81.6
gracilis	E	5	77.3				22.7
Rudbeckia	Y	1					100.0(1)
occidentalis	E	0					
Senecio	Y	1					100.0(1)
triangularis	E	1	100.0(1)				
Tragopogon	Y	2			50.0		50.0
pratensis	E	1	50.0				50.0
Trifolium	Y	1	100.0(1)				
hybridum	E	1	33.3	33.3			33.3
Taraxacum	Y	9	31.6			15.8	52.6
officinale	E	4	55.6			44.4	
Urtica	Y	1					100.0
spp.	E	0					
Viola	Y	0					
spp.	E	1					100.0
Grasses and Grasslike Plants							
Agropyron	Y	5	47.1	5.9		17.6	29.4
Smithii	E	0					
Agropyron	Y	3	50.0			25.0	25.0
spicatum	E	0					
Agropyron	Y	18	57.5	1.8	3.6	28.6	28.6
trachycaulum	E	7	62.9	2.9	2.2	14.3	17.1
Agropyron	Y	3			40.0	60.0	
spp.	E	0					
Agrostis	Y	1					100.0(1)
hiemalis	E	0					
Bromus	Y	29	30.1	0.8	5.3	18.6	45.1
marginatus	E	12	42.3	5.8	5.8	19.2	28.8

TABLE III CONTINUED

Plant	Band	No. lines totaled	All parts	Flower stalk	Flower tip	Leaves
Forbs						
<i>Calamagrostis rubescens</i>	Y	4	20.0		40.0	40.0
<i>Carex Geyeri</i>	Y	5				100.0
<i>Carex</i>	Y	11	3.1	3.1	51.3	62.5
<i>Carex</i> spp.	E	8			25.0	75.0
<i>Carex</i> spp.	Y	1				100.0(1)
<i>Danthonia intermedia</i>	E	0	33.3			66.7
<i>Elymus condensatus</i>	Y	2	100.0(1)			
<i>Elymus</i> spp.	E	0				
<i>Festuca ovina</i>	Y	12	29.2	4.2	37.5	29.2
<i>Festuca</i> spp.	E	7	34.6	3.8	34.6	26.9
<i>Koeleria cristata</i>	Y	1				100.0(1)
<i>Koeleria</i> spp.	E	0				
<i>Melica spectabilis</i>	Y	4		20.0	40.0	40.0
<i>Melica</i> spp.	E	0				
<i>Phleum alpinum</i>	Y	7	41.7		16.7	41.7
<i>Phleum</i> spp.	E	2	100.0			
<i>Phleum pratense</i>	Y	3	100.0			
<i>Phleum</i> spp.	E	5	61.8	14.5	3.6	1.8
<i>Poa pratensis</i>	Y	6	50.0		8.0	4.0
<i>Poa</i> spp.	E	4				45.6
<i>Poa Canbyi</i>	Y	13	26.1		10.9	63.0
<i>Poa</i> spp.	E	2	80.0		20.0	
<i>Poa compressa</i>	Y	2	66.7	16.6		16.6
<i>Poa</i> spp.	E	3	57.9			31.6
<i>Stipa columbiana</i>	Y	7	13.6	6.7	6.7	73.3
<i>Stipa</i> spp.	E	2	66.7			33.3
<i>Trisetum spicatum</i>	Y	3	50.0		25.0	25.0
<i>Trisetum</i> spp.	E	2	100.0			
Browse						
<i>Mahonia repens</i>	Y	0				
<i>Mahonia</i> spp.	E	1				100.0(1)
<i>Pseudotsuga taxifolia</i>	Y	0				
<i>Pseudotsuga</i> spp.	E	2	100.0			
<i>Rosa</i> spp.	Y	9				
<i>Rosa</i> spp.	E	2			50.0	50.0
<i>Symphoricarpos</i> spp.	Y	2			50.0	50.0
<i>Symphoricarpos</i> spp.	E	3		14.3	42.9	42.8
<i>Vaccinium</i> spp.	Y	0				
<i>Vaccinium</i> spp.	E	1				100.0

Table III shows preference accorded certain portions of plants in terms of the categories previously described. These data show that in the case of forbs it was most common to have only the leaves utilized. In the case of grasses, however, it was most common to have all parts utilized to some degree; although, it should be noted that leaves were also the most preferred single portion. With both grasses and forbs sheep appear to have a low preference for flowers and flower stalks. Apparently a number of grasses do not have the entire leaf taken but have a portion removed instead. This is not as evident in forbs. With the browse plants leaves were the preferred portions.

A few of the more abundant grasses, weeds and browse merit special discussion.

California brome, Bromus marginatus, was the most frequently occurring plant of the entire study. It was encountered a great many more times on yearling band transects than on ewe band transects. Leaves were preferred by both bands.

Elk sedge ranked first in number for the ewe band and second for the yearling band. The percentage preference was nearly the same for both bands. Either leaves or leaf tips were the portions grazed.

Sheep fescue, Festuca ovina, was more highly preferred by the yearling band than by the ewe band. It must be remembered, however, that this plant was encountered considerably

more often on these lines. Leaves were the portion most often removed by both bands.

Slender wheatgrass, Agropyron trachycaulum, was encountered a good many more times on yearling band transects than on transects for the ewe band. The preference of the ewe band appears to be nearly twice that of the yearling band for this grass. In portions preferred by the yearlings the choice was about the same for "all parts", "leaf tip", and "leaves" while for the ewe band "all parts" led by a considerable margin.

Pinegrass, Calamagrostis rubescens, although encountered more often on ewe band transects, had nearly the same preference for both groups of sheep. Leaves were the only parts taken by the ewe band while with the yearlings leaves and leaf tips were the predominant portions removed.

The most abundant forb on the yearling band transects was northwest cinquefoil, Potentilla gracilis. This plant being the second most numerous forb, was also fairly abundant on ewe band transects. Along with its relative abundance northwest cinquefoil was highly preferred having a preference rating of over fifty percent for either band. The most plants were found in "leaves" category for the yearling band, however, "all parts" led for the ewe band. The difference in portions preferred is quite large with this plant. It is possible that some of the difference is due to the fact that

on the ewe band allotment five lines were evaluated as to portions preferred; whereas, there were fifteen lines evaluated in this respect for the yearling band.

Western yarrow, Achillea lanulosa, and pussytoes, Antennaria spp., were two forbs of high abundance and of low preference. It is interesting to note that western yarrow is generally given a fairly good proper use factor rating.

Pale agoseris, Agoseris glauca, was a plant of high preference, as was also common dandelion, Taraxacum officinale, and thickstem aster, Aster intergrifolius. Lupine, Lupinus flexuosus, had a moderately high preference, with leaves chosen over other portions. Sticky geranium, Geranium viscosissimum, was only moderately preferred by either band. Some flowers were taken by the ewe and lamb band; however, leaves were the portion most preferred by either band. Blackhead sunflower, Helianthus scaberrimus, was well preferred although few were encountered. Leaves were the predominant portion grazed by both bands.

At this point it might be well to explain that the preference rating for Douglas fir may be higher than shown in Table I. This is a result of the fact that in the early stages of the study, observations were not made of the trees over the line; the thought being that the sheep would not utilize any of the leaves. Subsequently several animals were observed browsing Douglas fir. After this careful attention

was paid to all trees encountered above the lines. A problem in checking the preference for this tree was that some of the leaves were continually falling, a fact which made it difficult to decide whether or not there had been grazing. The standard used in this case was that the tree was considered grazed if a number of adjacent leaves were absent, since it would seem to be highly coincidental if several adjacent leaves fell at the same time.

The mean use and standard deviation by transects for certain of the more abundant plants has been determined and arranged in Table IV. The mean is the average preference for each line transect upon which the plant was encountered. It can be seen that the standard deviations are extremely large. This becomes even more pronounced if the standard deviation is doubled to place it at the .05 level. From this analysis, it is definitely shown that extreme variability exists between lines as to preference. It should be explained that such high standard deviations as presented here are possible, due in part to the numbers of unused plants recorded and in part to the wide range of use percentages that were used in computing them. This is the extent of the statistical method used in this study.

TABLE IV

Mean Use and Standard Deviations for Lines of
Some of the More Preferred Plants

Plant	Yearlings		Ewes and Lambs	
	X use for lines	Standard deviation	X use for lines	Standard deviation
<i>Agoseris glauca</i>	52.99	25.72	63.31	38.02
<i>Agropyron</i> <i>trachycaulum</i>	23.04	18.89	33.52	30.30
<i>Arenaria congesta</i>	5.30	4.45	18.94	24.77
<i>Arnica cordifolia</i>	20.83	21.34	43.94	34.21
<i>Aster integrifolius</i>	63.25	36.85	88.90	12.07
<i>Astragalus spp.</i>	63.34	36.74	72.50	15.92
<i>Bromus marginatus</i>	26.19	9.42	33.43	12.81
<i>Calamagrostis</i> <i>rubescens</i>	11.52	16.55	9.81	7.04
<i>Carex Geyeri</i>	16.27	16.23	15.24	10.39
<i>Festuca ovina</i>	45.35	17.80	26.92	14.65
<i>Lupinus flexuosus</i>	49.56	38.17	70.84	29.59
<i>Poa Canbyi</i>	33.85	23.29	31.68	25.76
<i>Poa compressa</i>	7.38	5.09	61.23	30.16
<i>Poa pratensis</i>	37.93	31.71	26.39	35.59
<i>Potentilla gracilis</i>	53.74	21.30	57.62	40.63
<i>Symphoricarpos spp.</i>	33.33	52.57	43.34	41.36
<i>Taraxacum officinalis</i>	60.00	24.98	68.75	32.42

In Table V will be found a tabulation of mean use by transects, total preference, and established proper use factors for some of the more preferred and/or abundant plants. The percentage figure in the first column for each band represents a comparison between the number of plants on each transect and the number of ungrazed plants of that species there. The figure in the second column is the total percent preference for each band and is based on total numbers of each species encountered throughout the study for each allotment.

This is just a comparison, however, because the use factor has a somewhat different connotation placed upon it from the other two figures. The definition of the use factor as given in Stoddart and Smith (16) is as follows:

"The use factor is an index to the grazing use that is made of a forage species, based upon a system of range management that will maintain the more economically important forage species for an indefinite time. It is expressed as the percentage of current year's weight production, within reach of stock, that is consumed."

According to this definition, the use factor involves a certain percentage of the current year's weight production while the preference figures in this study do not involve weight. The fact that the proper use factor is based upon the range being properly used also eliminates this mean from comparison since the transects were sampled in some instances before the sheep had fully utilized the area.

TABLE V

Comparison of Data to Proper Use Factors

Plant	Yearlings		P.U.F.	Ewes and Lambs	
	X use by lines	% preference		X use by lines	% preference
Agropyron Smithii	22	28	50		100
Agropyron trachycaulum	23	28	50	34	50
Bromus marginatus	26	23	50	33	37
Calamagrostis rubescens	12	6	20	10	8
Carex Geyeri	16	11	50	15	10
Festuca ovina	45	32	50	27	26
Koeleria cristata		6	60		
Melica spectabilis		39	60		17
Phleum pratense		58	60		79
Poa Canbyi	34	35	70	32	39
Poa pratensis	38	39	80	26	32
Trisetum spicatum			40		38
Achillea lanulosa		1	40		4
Agoseris glauca	53	60	80	63	69
Antennaria spp.		4	0		16
Arenaria congesta	5	10	10	19	11
Arnica cordifolia		50	0		38
Aster integrifolius	63	63	20	89	91
Potentilla gracilis	54	54	30	58	60
Rudbeckia occidentalis		17	20		50
Senecio triangularis		50	70		100
Taraxacum officinalis	60	70	70	69	71
Trifolium hybridum		100	80		38
Viola spp.			30		19
Symphoricarpos spp.		12	20		44

SUMMARY AND CONCLUSIONS

This study was conducted on two adjoining sheep allotments in the Bridger Range of the Gallatin National Forest. A comparison was made between a ewe and lamb band and a yearling or "dry" band as to forage preferred.

The method employed in the study was a modification of the line interception method. Lines 100 feet in length were located in the various grazed areas in such a manner as to sample what the animals had been grazing. All species of plants encountered on the line were recorded, and a notation was made as to whether grazed or not, and if so, what portion had been removed. Five categories were employed to record this data: "all parts", "flower", "flower stalk", "leaves", and "leaf tip". By recording all species encountered on a line, it was possible to obtain an indication of the vegetational composition.

The study has shown that there is a certain amount of preference exercised by sheep in obtaining their forage. It has also shown that this preference is not necessarily in favor of the more abundant plants. In this study, species composition, as determined from the transects, ranked the types of forage according to abundance as follows: grasses and grasslike plants, forbs, and browse. Types of forage preferred, however, were forbs, graze, and brose respectively. This roughly indicates that preference is more a matter of

choice than of relative abundance of dominant types of forage.

The most abundant plant encountered was California brome, followed in order by elk sedge, sheep fescue, slender wheatgrass, and pinegrass. Of these grasses, slender wheatgrass had the highest preference for the ewe and lamb band followed by California brome and sheep fescue. For the yearling band, sheep fescue led with slender wheatgrass second and California brome third.

The four most abundant palatable forbs for the yearling band were common dandelion, pale agoseris, northwest cinquefoil, and lupine. The order of preference for the ewe and lamb band was common dandelion, pale agoseris, northwest cinquefoil, and heartleaf arnica. Thickstem aster, although encountered less frequently, was highly preferred by both bands.

Browse preference is difficult to determine since the area, not being predominantly a browse range, had few shrubs upon it. Preference ratings of infrequently occurring plants have been considered unreliable in this work; therefore, few browse plants are considered. Snowberry appears to be one of the more preferred browse plants, this is especially true for the ewe and lamb band. Douglas fir received some use by the ewe and lamb band, as explained previously.

Standard deviations have been computed for the mean use by lines of some of the more preferred plants. These in most cases, have been so large as to render the mean of little value as a measurement of preference. This was the extent of the statistical analysis made in the study. It was sufficient to show the extreme variability of utilization of the same plant on different transects.

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APPENDIX A

Plants encountered in study

<u>Technical name</u>	<u>Common name</u>
Grasses and grasslike plants*	
Agropyron spp. Gaertn.	Wheatgrass
Agropyron Smithii Rydb.	Western wheatgrass
Agropyron spicatum (Pursh) Scribn. and Sm.	Bluebunch wheatgrass
Agropyron trachycaulum (Link) Malte	Slender wheatgrass
Agrostis hiemalis (Walt) B.S.P.	Ticklegrass
Bromus spp. L.	Brome
Bromus marginatus Nees.	California brome
Calamagrostis rubescens Buckl.	Pinegrass
Carex spp. (Rupp) L.	Sedge
Carex Geyeri Boott.	Elk sedge
Danthomia intermedia Vas.	Timber oatgrass
Elymus condensatus Presl.	Giant wild-rye
Festuca idahoensis Elm	Bluebunch fescue
Festuca ovina L.	Sheep fescue
Koeleria cristata (L) Pers.	Junegrass
Melica bulbosa Geyer.	Oniongrass
Melica spectabilis Scribn.	Purple oniongrass
Muhlenbergia squarrosa (Trin) Rydb.	Mat muhly
Phleum alpinum L.	Alpine timothy
Phleum pratense L.	Timothy
Poa spp. L.	Bluegrass
Poa canbyi (Scribn) Piper	Canby's bluegrass
Poa compressa L.	Canada bluegrass
Poa pratensis L.	Kentucky bluegrass
Stipa columbiana Macoun.	Columbia needlegrass
Trisetum spicatum (L) Richt.	Spike trisetum

Forbs**

Achillea lanulosa Nutt.	Western yarrow
Agoseris glauca (Nutt) Greene	Pale agoseris
Anaphalis subalpina (Gray) Rydb.	Pearleverlasting
Antennaria spp. Gaertn.	Pussytoes

* Authority: Hitchcock, A. S., Manual of the Grasses of the United States, U.S.D.A. Misc. Pub. 200, 1935.

** Authority: American Joint Committee on Horticultural Nomenclature, Standardized Plant Names, 2d. Ed. 1942.

APPENDIX A Continued

<u>Technical name</u>	<u>Common name</u>
Arctium spp. L.	Burdock
Arenaria congesta Nutt.	Ballhead sandwort
Arnica spp. L.	Arnica
Arnica cordifolia Hook.	Heartleaf arnica
Arnica sororia Greene	Arnica
Artemisia ludoviciana Nutt.	Louisiana sagebrush
Aster integrifolius Nutt.	Thickstem aster
Astragalus spp. (Tourn) L.	Loco
Balsamorhiza sagitata (Pursh) Nutt.	Arrowleaf balsamroot
Cerastium arvense L.	Starry cerastium
Cirsium spp. (Tourn) Hill.	Thistle
Cirsium undulatum (Nutt) Spreng.	Wavyleaf thistle
Delphinium scopularum Gray.	Tallmountain larkspur
Erythronium spp. L.	Fawn lilly (Dog tooth violet)
Fragaria spp. (Tourn) L.	Strawberry
Geranium viscosissimum F. & M.	Sticky geranium
Helianthus scaberrimus Ell.	Blackhead sunflower
Hieracium albiflorum Hook.	White hawkweed
Hieracium Scouleri Hook.	Woollyweed
Lactuca pulchella (Pursh) D.C.	Chicory lettuce
Lupinus flexuosus Lindl.	Lupine
Mertensia ciliata (James) Don.	Mountain bluebell
Monarda spp. L.	Beebalm
Phlox canescens T. & G.	Hoary phlox
Potentilla spp. L.	Cinquefoil
Potentilla gracilis Dougl.	Northwest cinquefoil
Rudbeckia occidentalis Nutt.	Niggerhead
Sedum stenopetalum (Pursh)	Wormleaf stonecrop
Senecio triangularis Hook.	Arrowleaf groundsel
Smilacina spp. Desf.	False solomonseal
Taraxacum officinale L.	Common dandelion
Tragopogon pratensis L.	Meadow salsify
Trifolium hybridum L.	Alsike clover
Urtica spp. (Tourn) L.	Nettle
Viola spp. (Tourn) L.	Violet

Browse*

Artemisia tridentata Nutt.	Big sagebrush
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* Authority: American Joint Committee on Horticultural Nomenclature, Standardized Plant Names, 2d. Ed. 1942.



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Teigen, M.L.	
Forage preference of range sheep.	

NAME AND ADDRESS	
L. B.	M. B. NIMIR
2 weeks use	INTERLIBRARY LOAN
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