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A STUDY OF THE FOOD HABITS
OF THE
MOUNTAIN GOAT (Oreamnos americanus missoulae)
IN WESTERN MONTANA

.by

Robert L. Casebeer

B.S. in Forestry, Montana State University, 1947

Presented in partial fulfillment of the
requirement for the degree of
Master of Science in Forestry

Montana State University

1948

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INTRODUCTION

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In the United States the mountain goat occurs as native only in Montana, Idaho and Washington (Anthony, 1928). In 1924 it was accidentally introduced into the Black Hills of South Dakota (Swift, 1940). This big game species is characterized in these localities by the habitat which it generally frequents. Loftier heights of rugged mountain ranges, well developed cirques, and broken rocky ledges typify the summer ranges and many winter ranges of this animal. Such areas are usually found within the upper Hudsonian and the Arctic-Alpine life zones. (described by Bailey, 1918).

In Western Montana the Hudsonian zone commonly occurs as a narrow belt between 6,000 and 7,000 feet in altitude on the cooler and more moist north and east exposures and from 7,000 to 8,000 feet on the warmer and drier south and west exposures. Its borders are quite irregular. The upper edge is approximately at timber line, marked by the fingertips of dwarfed or prostrate trees, while below it merges into the solid Canadian zone forest. It has far more open than timbered areas.

The Arctic-Alpine zone caps the high peaks and extends down to 8,000 feet elevation on the warmer slopes, and on cold slopes down to about 7,000 feet elevation. Areas of live glaciers and large snow fields, great expanses of barren cliff and rock, and extensive areas of depauperate vegetation characterize this area which lies entirely

above the last trace of timber and dwarfed trees.

South and west exposures within the Hudsonian zone furnish most spring and early summer feeds for the mountain goat as they are the first bared by the sun and prevailing westerly winds. In these areas the more succulent species are predominant in spring and early summer. As the areas lose their moisture the summer aspect changes to one of more xerophytic plants.

Luxuriant summer and early fall feeds are usually found in high cirques having an easterly exposure. Prevailing westerly winds build up pronounced snow cornices on the leeward side of ridges, and within an easterly exposed cirque such a cornice furnishes a continual water supply to slopes below throughout the summer and into the fall.

Some goats remain on their high summer ranges all winter and take advantage of the exposed vegetation on the bald, windswept ridges. Other summer habitats do not offer this available winter food so the goats migrate to warm south facing cliffs and ledges at lower altitudes. Here they make use of the exposed vegetation as well as retain the protection granted by cliffs.

To manage this animal as a big game species it is necessary that these mountain goat habitats just described be measured, judged and appraised. To accomplish this a store of facts must be built up as background material. Many ecological facts are important, particularly those concerning the food and feeding habits of the animal.



PHOTOGRAPH 1.

HIGH GLACIATED CIRQUE ON THE CONTINENTAL DIVIDE NEAR RED BUTTE
(Elevation 8000-8500 feet)

Prevailing westerly winds build pronounced snow cornices at the top edge of these easterly exposed cirques and furnish a continual water supply to the slopes below throughout the summer and into the fall.

REVIEW OF LITERATURE

The literature relating to food habits of mountain goats is scanty, and is indicative of the limited amount of work that has been done on this animal as compared to other big game species. Limited distribution of mountain goats in the United States and the relatively inaccessible habitat of the animal partially accounts for this. Alpine and Hudsonian zones in Western United States are usually remote and hazardous to enter, definitely limiting the ease of study.

Anderson (1940) has worked intensively on the mountain goat in Washington and reports that the species is not restricted to a particular type of range. It uses timber, meadows, rocky ledges, and cliffs as best suited to the purpose and will feed for hours on open meadows. It relishes grasses and herbs the year around, but in general this animal browses more than it grazes. If bunch grasses are available in winter they may make up as much as 90 per cent of the goat's diet for that season. In the spring and through the summer, green grass is utilized quite heavily and furnishes a good part of the goat's diet. As important summer feeds he lists mountain laurel (Ceanothus velutinus), low bush huckleberry (Vaccinium sp.), and quaking aspen (Populus tremuloides) as the most important. Bunch grass (Agropyron sp.), eriogonum (Eriogonum heracleoides), tall Oregon grape (Berberis aquifolium), and pentstemon (Pentstemon sp.) are the most important winter forage species. Anderson's summary of mountain goat diets is given in detail in Table 16

This paper reports an investigation of the food habits of the mountain goat on two representative ranges in Western Montana. The amount of use made of forage species is considered as indicative of the food habit of the animal. Measurements were made of range forage use which would permit evaluations and comparisons of food habits of goats.

The possible relationships between food habits and season of use or vegetative composition is an important part of this study. Therefore, the work of this study is subdivided according to winter and summer use, and the vegetational differences within areas.

The following evaluations and comparisons of range forage use are made:

1. Use made of each species: Component parts of food habits may be obtained by considering four aspects of species utilization.

a. Number of plants grazed of each species. This is a tally by species of plants available and the plants showing utilization. It is expressed in per cent of total plants showing utilization.

b. Average utilization of grazed plants only. This is the use made of only the plants that were grazed of each species. It is the amount, expressed in per cent of total plant weight, of average current utilization.

c. Total use made of each species by seasons and areas, expressed in per cent of total available weight.

d. Preferred vegetative parts of each species.

2. Total forage use by areas: This is the per cent, by weight, of available forage of all species combined, utilized in an area.

3. Food habits of the mountain goat: This is the total diet of the animal as indicated by the per cent each species makes up of the total weight of forage utilized.

2. Total forage use by areas: This is the per cent, by weight, of available forage of all species combined, utilized in an area.

3. Food habits of the mountain goat: This is the total diet of the animal as indicated by the per cent each species makes up of the total weight of forage utilized.

in the appendix of this report.

Swift (1940) reports on the goats in the Black Hills which Harmon (1944) reported on again in more detail. Harmon indicates that the goats' choice of food in winter and spring is quite varied. Their diet is about 60 per cent mosses and lichens; 20 per cent bearberry (Arctostaphylos uva-ursi); 10 per cent pine twigs and needles (Pinus ponderosa); and 10 per cent miscellaneous, including ferns, grasses, currant (Ribes sp.), rose (Rosa sp.), willow (Salix sp.) and erigeron (Erigeron sp.). The report does not indicate how these figures were obtained. He says that in winter they seem to avoid aspen (Populus tremuloides), gooseberry (Ribes sp.), and mint (Monarda sp.). In deep snow the goats pawed away snow and ate the exposed parts of bearberry, but usually their food supply was above the snow level.

Reporting on mountain goats in Alberta, Canada, Cowan (1944) says that, based on five stomach content analyses, the summer food consists of grass and sedge (63 per cent), willow (23 per cent), and herbaceous vegetation (14 per cent). From field observation he lists such species as willow, green lily (Zygadenus elegans), purple milk vetch (Astragalus alpinus), bluegrasses (Poa sp.) and spike trisetum (Trisetum spicatum) as ranking high in palatability. Species ranking high on winter range are balsam fir (Abies lasiocarpa), aspen (Populus tremulocarpa), mountain maple (Acer glabrum), red osier dogwood (Cornus stolonifera), rose (Rosa macounii), willow (Salix sp.), bluegrasses

(Poa sp.) and june grass (Koeleria cristata).

Work on mountain goat food habits in Western Montana by Hemre (1947) indicates that heaviest winter use of browse (based on the average per cent of terminal parts taken) occurred on chokecherry (Prunus demissa), mountain maple (Acer glabrum), mountain lover (Pachystima myrsinites), bearberry (Arctostaphylos uva-ursi), rose (Rosa woodii) and serviceberry (Amelanchier alnifolia). Other species showing high utilization (based on per cent of plants showing utilization of each plant) were buffalo bunchgrass (Festuca scabrella), pine grass (Calamagrostis rubescens), bluebunch wheatgrass (Agropyron spicatum), elk sedge (Carex Geyeri), alumroot (Heuchra sp.) and sage (Artemisia discolor).

AREAS STUDIED

Studies of mountain goat food habits were made on two representative habitats in Western Montana and are described as follows:

Red Butte Area:

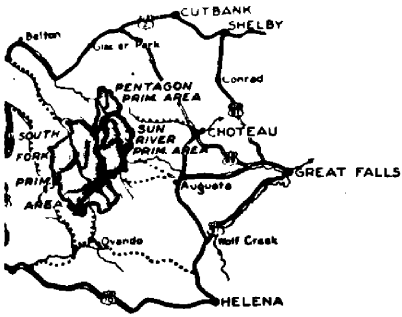
This area lies near the headwaters of the Sun River drainage west of Augusta, Montana (Figure 1), and is bounded on the east by the West Fork of Sun River, on the west by the continental divide, on the north by Red Butte Creek, and on the south by Indian Creek.

Red Butte and its immediate surroundings are within the typical upper-Hudsonian and lower Arctic-Alpine life zones. Timber at one time predominated the lower portions of the area, but it was burned by a 1916 fire, and is now covered by various associations of shrubs, grasses and weeds, with a scattering of dwarf alpine trees.

The entire area is underlain by a Proterozoic argillite and quartzite rock formation striking north and south and dipping steeply to the west. As a result of this dipping, the west slopes are steep and nearly uniform inclines, whereas the east exposure is broken into steep cliffs and ledges. Glaciated cirques on this east exposure give rise to the main streams which drain from the area into the West Fork of the Sun River.

This is a typical yearlong range for a herd of thirty to forty mountain goats, and both summer and winter studies were carried on here.

INDEX MAP



SCALE

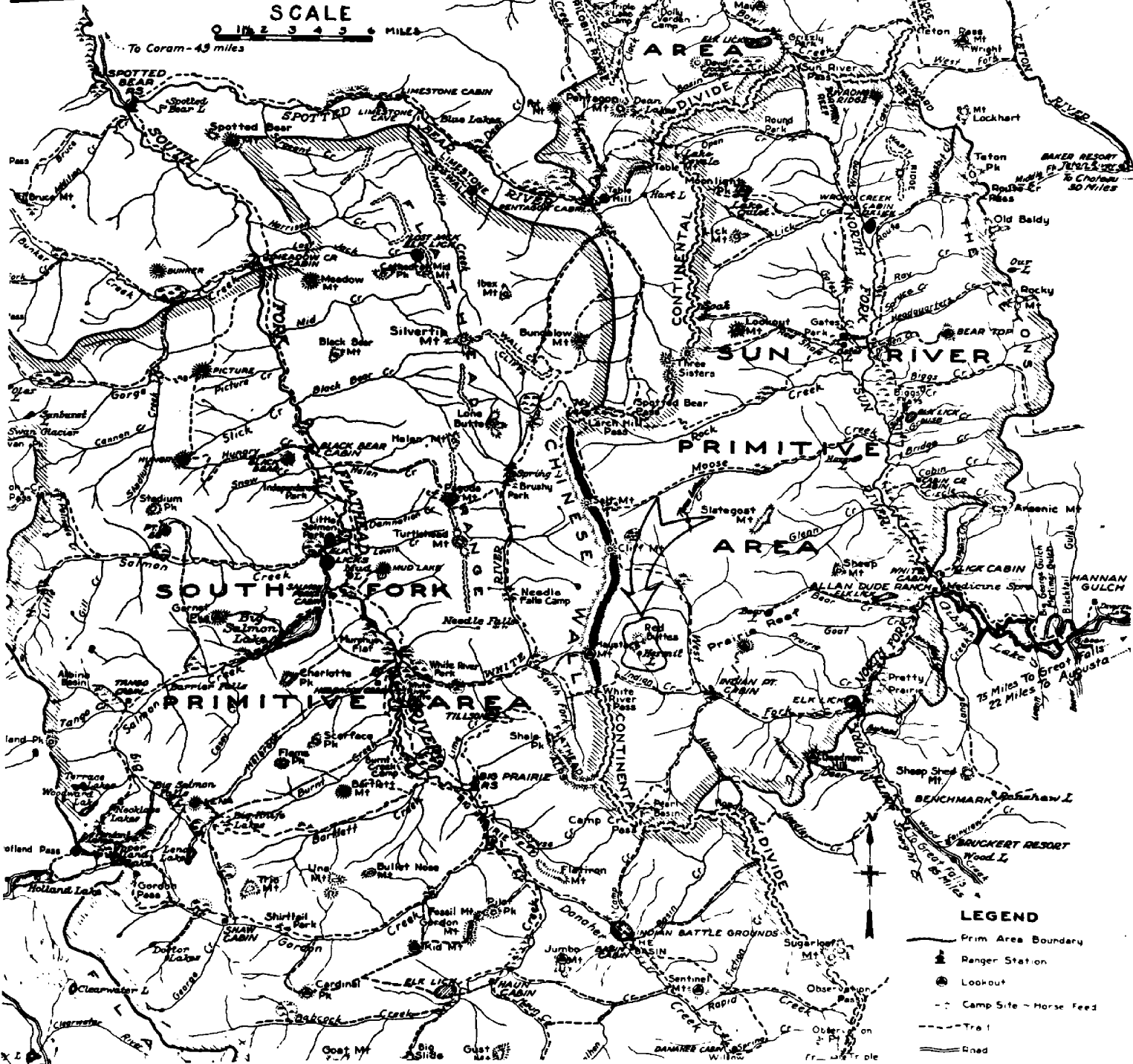
0 1 2 3 4 5 6 MILES

To Coram - 49 miles

FIGURE 1

RED BUTTE STUDY AREA

MOUNTAIN GOAT SUMMER RANGE





PHOTOGRAPH 2

SOME FAVORITE SUMMER RANGE FOR MOUNTAIN GOATS IN THE RED BUTTE AREA

Evidence of Arctic-Alpine life zone vegetation is found along this ridge which is just over 8000 feet elevation. Fingertips of dwarfed trees distinguish the upper edges of the Hudsonian zone.

The summer goat range lies above the mature timber and includes approximately 960 acres ranging in elevation from about 7,000 feet up to the highest peak of 8,600 feet (outlined in Figure 2). The summer phase of this entire study was conducted in this one area. Daily observations were made almost continuously from July 1, through August 30, 1947.

The winter range boundaries could not be definitely determined. It is known that during the severe part of winter goats use the west, south and east exposures, limited only by the most adverse snow conditions. Goats may be found at lower elevations on winter range than the normal summer range, but in general winter elements have no effect on their altitudinal distribution. Winter feeding data were collected from this area in December, 1947, and March, 1948, and both times goats were seen at various elevations from 8,500 feet to the highest points of over 8,000 feet.

Little to no competitive use of the range exists on either the summer or winter range. Elk and mule deer feed up to the lower limits of the goat summer range, but their movement on up into goat range is rare, and the effect is negligible. Elk migrating across and down from the continental divide late in the fall go along the lower limits of winter goat range on the south exposure of Red Butte. Wind blown, snow free ridges on that south exposure furnish a part of the winter feed for the goats, so limited dual use does exist at the lower edges of the winter range. Again the competitive effect is trivial.

FIGURE 2

VEGETATIVE TYPES OF MOUNTAIN GOAT RANGE OF THE RED BUTTE AREA

LEGEND:

12 Type number

19 Acreage of type

... Type boundaries

— Maximum summer range

Principal summer range
(Analysed in this report)

▨ Area sampled for winter studies

— Section line

Scale:

4 in. = approx. 1 mile

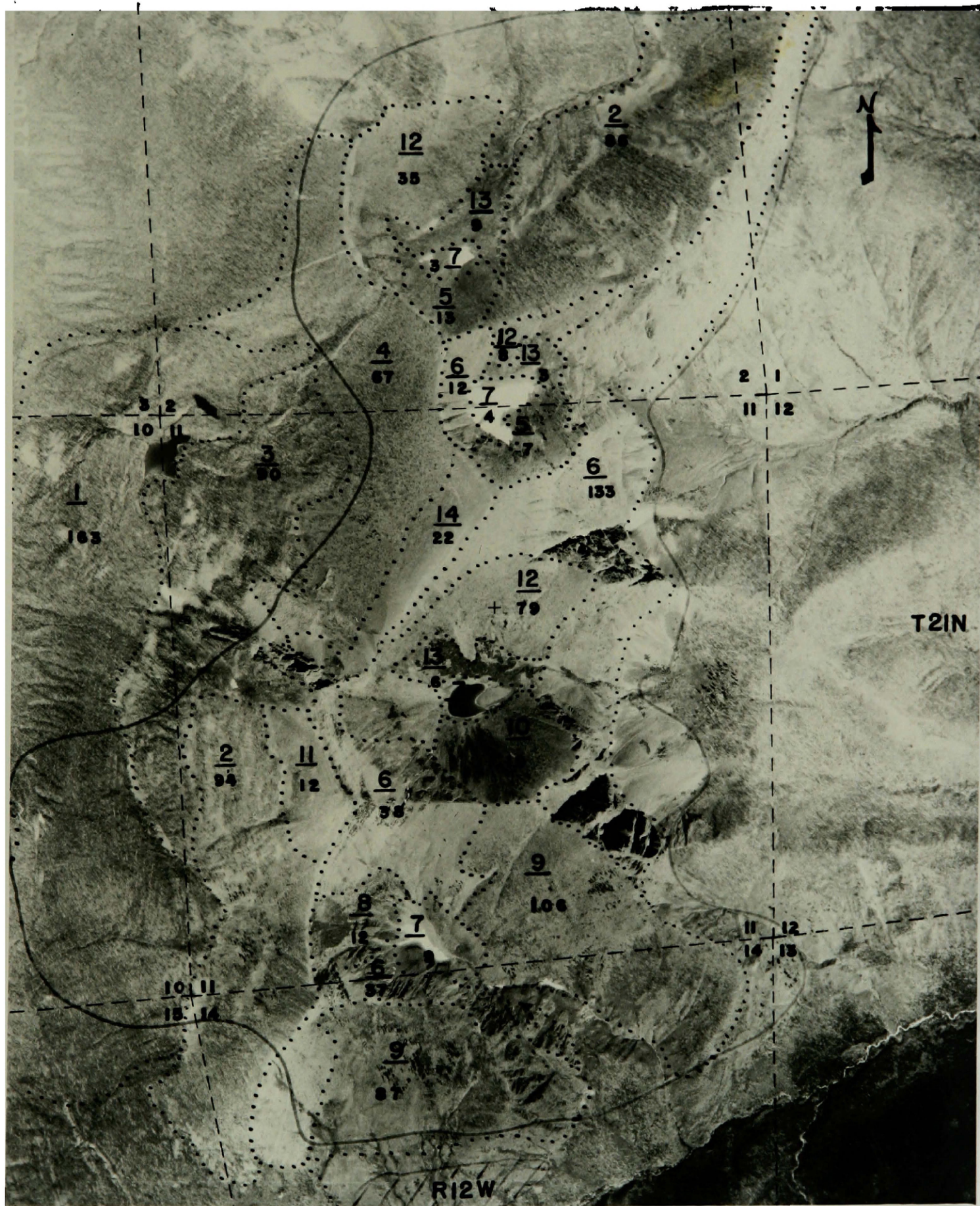


FIGURE 2

MOUNTAIN GOAT RANGE OF THE RED BUTTE AREA

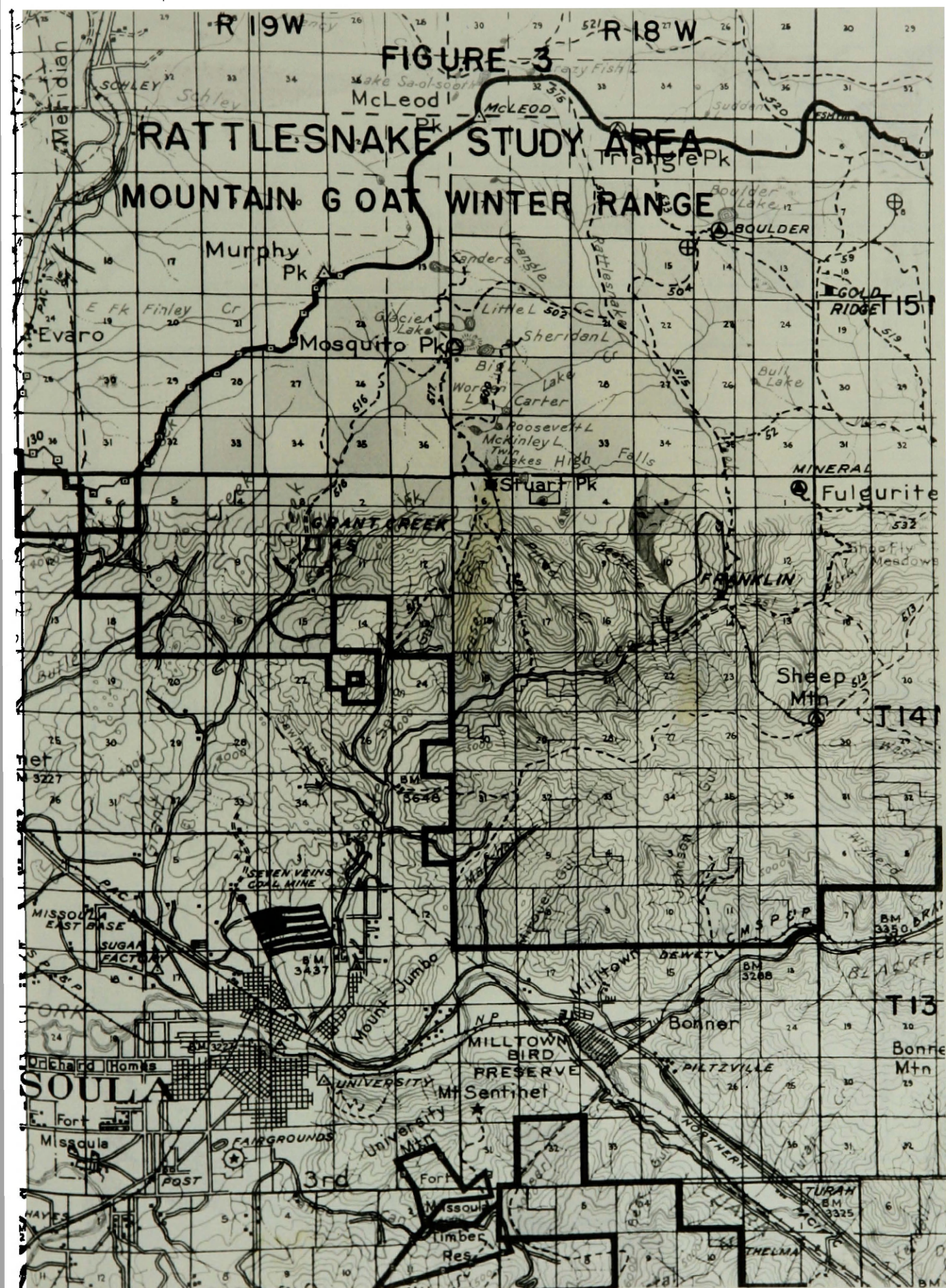
Rattlesnake Area:

The Rattlesnake study area is a narrow belt of cliffs extending from approximately thirteen miles above the mouth of Rattlesnake Creek, at Missoula, east and north one and one-half miles to the mouth of High Falls Creek. (Figure 3). A herd of fifteen to twenty mountain goats move down from higher country to these cliffs to winter each year.

Over 300 acres of cliff rock outcropping lying within the Canadian forest zone at an elevation of 4,000 to 5,000 feet make up this range. The cliffs and ledges of Proterozoic argillite and quartzite rock face south to southeast and form a part of the north side of Rattlesnake canyon.

Weekend trips were made into this study area between December 1, 1947, and April 18, 1948; to get data for an analysis of the progressive feeding on the winter range. The data is presented in this report according to the month in which they were collected, December, January, February or April.

Dual use on the Rattlesnake range is not significant. A few mule deer range in the area during the summer, but they are kept at a minimum by the human activity along the Rattlesnake road. By winter these deer have moved to lower country. Resident elk are rare in summer or winter.

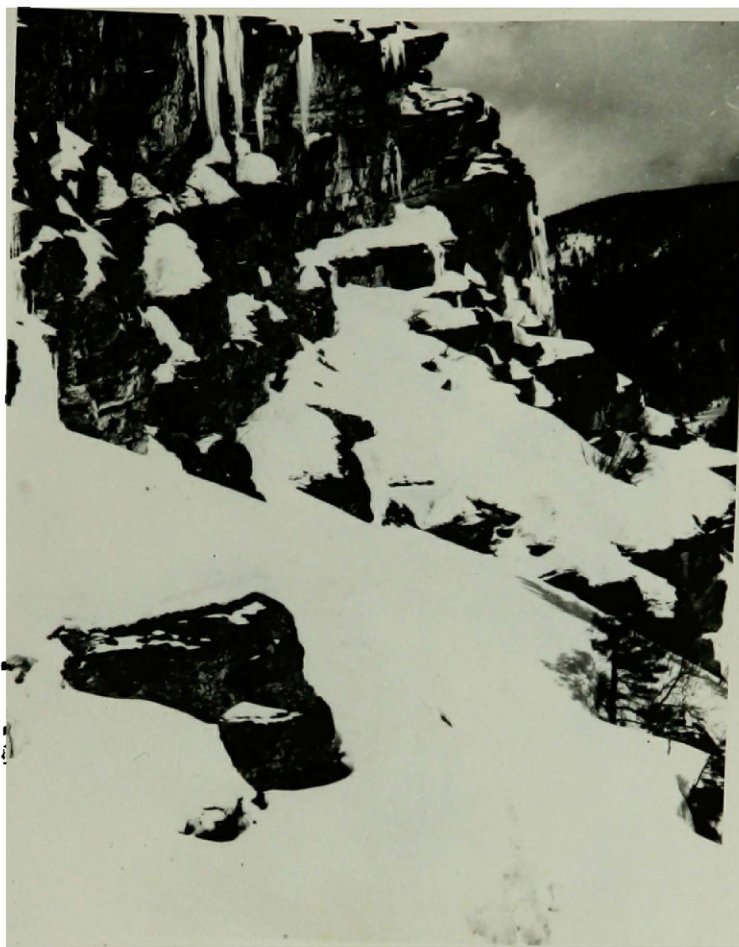




PHOTOGRAPH 3

**A PORTION OF THE WINTER GOAT RANGE DIRECTLY ABOVE FRANKLIN
RANGER STATION IN THE RATTLESNAKE**

This area is centrally located in the belt of south facing cliffs and ledges of the Rattlesnake drainage. Fifteen to twenty mountain goats come down to these cliffs from higher country to winter each year.



PHOTOGRAPH 4

INACCESSIBLE MOUNTAIN GOAT WINTER RANGE

A closer view of those cliffs immediately above Franklin Ranger Station in theattlesnake. Snow covered ledges such as these prohibit human activity, but mountain goats still maintain their fearless sense of equilibrium and show no reluctance for climbing around in such areas even though deep snow has covered much of the feed which they generally seek.

METHODS

The diet of the mountain goat is made up of a voluntary selection from the different forage species available at a given time. This animal is extremely difficult to observe on the range, and stomach analyses of normal animals are impracticable to obtain. Accordingly, the only practicable method for determining the normal selection of food made by goats is to observe and measure the forage utilization which has taken place in the absence of forced feeding. This was the method of study followed in this investigation. The assumption was made that measured utilization of forage on the range at various times would give at least a good indication of mountain goat food habits.

During each of the two study seasons the areas were analysed for available vegetation and utilization by species. By considering four aspects of species utilization, the use of areas and the food habits of the animal were obtained.

Summer Range

To study summer feeding, the Red Butte range was divided into fourteen different vegetative types. Type boundaries were identified from vegetative differences appearing on the aerial photograph (Figure 2). Density and per cent composition of these types were then obtained by a vegetative inventory similar to the "Range Reconnaissance Method" referred to by the Interagency Committee (1937) and used by Grimm (1939).

Field data were recorded on Range Survey Form 764a (Figure 8), commonly used by the United States Forest Service) and are summarized in Table 17.

Most of the goat feeding was concentrated on the types numbered 5, 8, 9, 10 and 12 (all shaded green in Figure 2). These five types were considered the most important in the area, and are the ones used as the basis for determining the summer food habits of goats. Throughout the remainder of this report each summer type is referred to by its assigned number.

Utilization data gathered on the summer range by the estimated per cent of volume method in no way accounts for the differential weight between species having like densities per unit area. When comparing different species, this differential weight must be accounted for. In lieu of comparative yield data so I have arbitrarily assigned a weight correction factor to each species on the summer range based on relative differences in yield between species per unit of density. These relative figures, listed in Table 18 are based on Carex Geyeri as the unit of "1". By applying these correction factors to the per cent composition figures of Table 17 the corrected composition figures, Table 1, for species on the five summer range types are expressed in per cent by weight. These are the composition figures used for computations in this report.

Utilization measurements were made on the five types between

CORRECTED COMPOSITION OF THE FIVE PRINCIPAL TYPES IN THE RED BUTTE SUMMER RANGE
(In Per Cent of Total Weight)

Species	Vegetative Types					Average
	5	8	9	10	12	
No						
X		81	15		33	29
A	3	1-				1-
S	1		1	2		1
A			1-		4	1-
V	1					1-
Chamaenerion angustifolium					1	1-
Pedicularis groenlandica		1-	1-	2	1	1-
Antennaria rosea	1	1-	1-	1-	1-	1-
Sedum stenopetalum		1-	1-	1-	1-	1-
Achillea lanulosa		1-	1-	1-	1	1-
Phacelia leucophylla					2-	1-
Penstemon ellipticus		1	2			1
Heuchera glabella		1-	1-		1-	1-
Eriogonum sp.		1	1		4	1
Arenaria formosa	1-	1-	1-	1	1-	1-
Gentiana calycosa	1-			1-		1-
Veronica wormskjoldii	1-	1-		1-		1-
Aster sp.	1-	1-			1-	1-
Potentilla sp.			1-			1-
Sieversia ciliata			1-		1-	1-
Agoseris villosa			1-			1-
Hypericum Scouleri		1-				1-
Hieracium Scouleri		1-	1-			1-
Drymoallis pseudorupestris			1-		1-	1-
Silene multicaulis			1-			1-
Others				5	1	1-
Sub Total for weeds	6	83	22	11	45	34
Grasses and Grasslike Plants						
Agropyron spicatum					1-	1-
Sitanion hystrix			1-		1-	1-
Festuca idahoensis			1-		1	1-
Agrostis hiemalis		1-	1-	1-		1-
Poa epilis	1-			3	1-	1-
Oryzopsis exigua			1-		1-	1-
Festuca ovina				5		1-
Poa alpina	1-	1-	1-	16	1	1
Koeleria cristata		1-	1-		1-	1-
Juncus Parryi	1	4	1-		4	1
Juncoides sp.	1-	1-		1-		1-
Carex Geyeri	1	1	6	10	8	4
Others	1					1-
Sub Total for grasses and grass-like plants	3	5	7	35	14	7

Species	Vegetative Types					Average
	5	8	9	10	12	
Shrubs						
Salix sp.			1-			1
Phyllodoce empetrifolia	49					7
Vaccinium scoparium	42	12	69	49	39	49
Vaccinium membranaceum				5		1-
Ribes sp.			1			1
Dasiphora fruticosa			1		2	1
Sub Total for shrubs	91	12	71	54	41	59
Total	100	100	100	100	100	100

August 1 and 15, 1947, at the time when utilization was judged to be about optimum.¹ From one to three 100-square-foot plots were selected in each of the five important types to sample the variety of species within the type. Every plant in the plot was tabulated as to species and whether utilized or unutilized; if utilized the estimated per cent of volume removed was recorded.

Winter Ranges

It was physically impossible to determine the extent, variation and use of the Red Butte winter range. The only accessible portion of the range was a narrow south exposed ridge above Indian Creek (marked in Figure 2) which had been swept clear of snow by the wind. This ridge is described as a single vegetative type composed mostly of grasses, and is called the Red Butte winter range in the rest of this report. Composition of this type (Table 2) was determined in March, 1948, by ocular estimation of the total weights of forage by species on sample areas (Pechanec and Pickford, 1937). These sample areas are the temporary plots selected for utilization analyses as described later on.

Mountain goat activities on the Rattlesnake range were limited mostly to the cliffs and ledges. Only two vegetative types were recognized in this area. They were identified from aerial photos in the

¹ "Optimum utilization" is the use of vegetation on a range to the point where the majority of species show utilization to varying degrees, but no one species shows use on all plants.

COMPOSITION OF THE RED BUTTE AND RATTLESNAKE WINTER RANGES OF MOUNTAIN COATS
(In Per Cent of Total Weight)

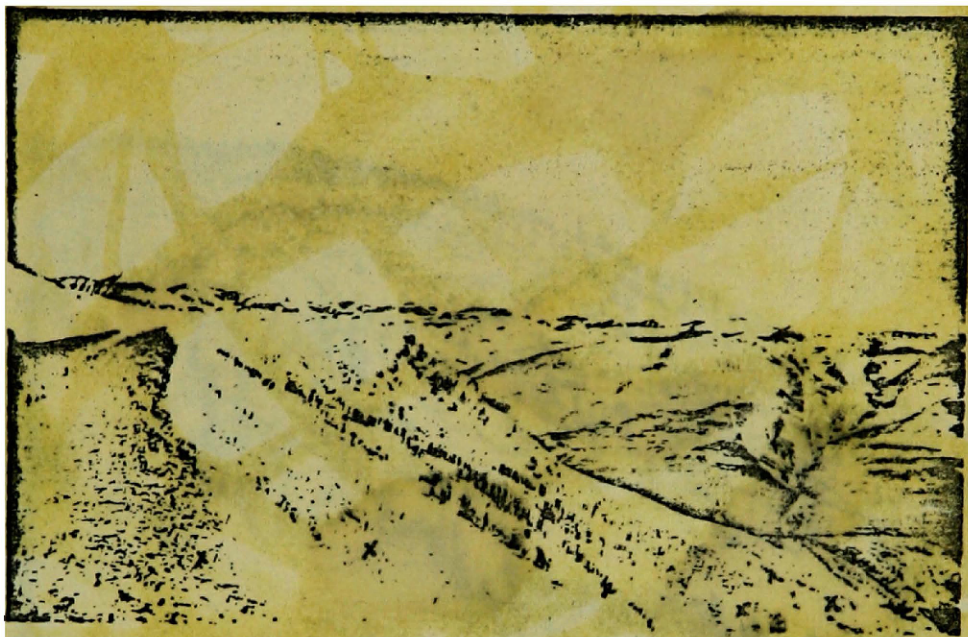
Species	Red Butte (March)	Rattlesnake		Average
		Type 1	Type 2	
Weeds:				
<i>Geranium</i>	1			
<i>Antennaria</i>	1-			
<i>Achillea</i>	1-	1-	1-	1-
<i>Pentstemon</i> sp.			1-	1-
<i>Eriogonum</i> sp.	1-			
<i>Potentilla</i> sp.	1		1-	1-
<i>Hoodsia</i> sp.			1-	1-
<i>Artemisia discolor</i>		1	1-	1-
Sub total for weeds:	2	1	1-	1-
Grasses and grasslike plants:				
<i>Agropyron spicatum</i>	14	11	2	4
<i>Festuca idahoensis</i>	1-			
<i>Psaleria cristata</i>	11	1	1	1
<i>Juncus Parryi</i>	1-			
<i>Carex Geyeri</i>	1-			
<i>Poa</i> sp.	5	1-	1-	1-
Sub total for grasses and grass- like plants:	30	12	3	5
Shrubs:				
<i>Vaccinium scoparium</i>	3			
<i>Salix</i> sp.	52			
<i>Ribes</i> sp.	1-	39		9
<i>Dasiphora fruticosa</i>	6			
<i>Amelanchier alnifolia</i>	2	3	23	18
<i>Acer glabrum</i>		4	3	4
<i>Philadelphus Lewisii</i>		17	24	23
<i>Holodiscus dumosus</i>		21	30	28
<i>Spiraea</i> sp.	5			
<i>Rosa</i> sp.		1-		1-
<i>Symphoricarpos albus</i>		3	1	1
<i>Juniperus scopulorum</i>			16	12
Sub total for shrubs:	68	87	97	95
Grand total:	100	100	100	100



PHOTOGRAPH 5

HIGH MOUNTAIN GOAT WINTER RANGE

Red Butte is just under the wing tip of the plane. This is looking at the east facing cliffs of the Red Butte area. Mountain goats were seen during December and March along the upper edge to the left side of these cliffs. These cliffs are very desirable summer goat range.



PHOTOGRAPH 6

SMALL WIND SWEEP RIDGES ON THE SOUTH EXPOSURE OF RED BUTTE

Strips of exposed vegetation running vertically on this south slope furnish much of the winter feed for the herd of approximately thirty mountain goats wintering in this Red Butte area.



PHOTOGRAPH 7

FAVORITE WINTERING GROUNDS FOR MOUNTAIN GOATS IN THE RATTLESNAKE

This area is just above the mouth of Beeskove Creek, and was one of the most popular concentration areas for goats throughout the winter. Type 1 can be distinguished as the cliff area. Type 2 is the talus slope below the cliffs and going up to the left. Also type 2 forms a narrow belt between the top of the cliffs and the timber. Type 3 is the heavier timbered areas above and below. The only use made of this type was restricted to a small area just into the edge of the timber above the cliffs.

same way as was done for the Red Butte summer range and the boundaries are mapped out as shown in Figure 4. These types are referred to in the rest of this paper as types 1 and 2.

A type numbered 3 is also shown in Figure 4, but it includes the mature timber stand which surrounds the cliffs and cuts through them in the draws. Its limits as goat range cannot be defined either by vegetative cover or by the use made of it, thus no boundaries are drawn in. Deep snow within this type severely reduced the available winter forage and limited the movement of goats for feeding and, therefore, was considered of minor importance to goats. Some midwinter observations were made in the type but were not analysed for food habits.

Composition of types 1 and 2 were determined in April, 1948, in the same way as for the Red Butte winter range. Table 2 gives these composition figures. Type 1 is found on the cliffs and ledges, and makes up approximately 140 acres of this winter range. It is a mixed type of 87 per cent browse, 12 per cent grasses, and 1 per cent weeds, with a larger percentage of grass than in either of the other types. Type 2, approximately 160 acres in area, is predominantly a browse type of 97 per cent browse, 3 per cent grasses, and less than one per cent weeds. It occupies the talus slopes bordering the sides and bottom of the cliff area, and is usually the transition belt between the ledge type and the timber below. In addition it may form a narrow belt at the top edge of the cliffs.

RIBW

FIGURE 4

Feeding observations were made by tracking or band trailing as described by Rush (1932), DeNio (1938), and Deen (1938), and by temporary plots, described by Deen (1938). Single trails accessible to the observer were very sparse in either of the winter ranges so feeding information obtained by tracking or band trailing was quite limited. Most trails merged into patches of concentrated feeding which were used as temporary plots. The greatest portion of winter feeding information was obtained from these plots.

No strict mechanical sampling method seems practicable under the conditions and terrain encountered in this study. The use of band trailing and temporary plots as employed here necessarily gave a variable intensity of sampling. However, guided by careful judgement, I believe that the observations obtained are representative of the forage and utilization exposed at the time.

When band trailing was used, all forage within normal reach of the animal was considered available¹, and on the temporary plots all vegetation within the area of goat activity was considered available forage.

¹ "Available browse" includes all accessible branches one quarter inch in diameter and less; "available grass and herbs", all exposed parts down to ground or snow line; and "available trees", all accessible foliage on fallen branches and trees. These criteria were set to include the maximum use that could be expected but limitations of what constitutes "available trees" were necessary. Green foliage from fallen limbs and trees is more readily taken by goats than foliage from standing trees. There is an unlimited supply of standing tree foliage within reach of these animals and to record it all as available would obscure the importance of other more desirable food species present.



PHOTOGRAPH 8

DOUGLAS FIR WINDFALL STRIPPED OF ITS FOLIAGE BY MOUNTAIN GOATS

All foliage within reach of the goats had been stripped clean by January. This type of feeding is exceptional to the normal feeding of these animals. Additional evidence of conifer feeding was scarce, and most of that was found to be on fallen limbs or windfall trees such as above.

It became apparent that the per cent estimate method of measuring available forage and utilization on the summer range was not entirely satisfactory for determining the food habits of game animals. Thus the weight estimate method for measuring vegetation devised by Pechanec and Pickford (1937) was adapted to use with band trailing and temporary plots and was used in this study. The weight in ounces and tenths of ounces of the available portion of each plant and the weight of the utilized portion were estimated¹ and tabulated according to species on the field form, Figure 9.

¹ As suggested by Pechanec and Pickford (1937), the estimator's conception of units of weight for all species present was continually checked by clipping and weighing. Simulated clipping and weighing furnished a close check on the estimates of utilized weights of forage.

RESULTS

Before presenting the results of this study some discussion is necessary concerning the number of observations and the snow conditions encountered as these factors have an important influence upon the results obtained.

The number of observations made on the summer range, by species, vegetative type, and total area, are recorded in Table 3. Those for the winter ranges are recorded in Table 4 by species, months and vegetative types.

Each individual observation for the summer range denotes a single plant or a compact clump typifying a single plant. In most instances each winter observation denotes the same, although variations from this do occur. In areas where the snow was three to five feet deep a clump of bushes could not be definitely distinguished as one or more plants. In this case the clump was measured and recorded as one observation. Another variation occurred where the use of ounces and tenths of ounces were not small enough units of measure for each individual plant of such species as Bromus tectorum, Poa sp., and Woodsia sp. A group of such plants making up the smallest convenient unit of weight was evaluated and recorded as a single observation.

The number of field observations indicates the amount of data collected and used for evaluating forage utilization. A small number of samples is indicative of the minor importance of that species on the

TABLE 3

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NUMBER OF OBSERVATIONS MADE ON THE RED BUTTE SUMMIT RANGE FOR
THE FOOD HABIT STUDY OF MOUNTAIN GOATS, 1947

Scientific Name	Vegetative Types					Total
	5	8	9	10	12	
Herbs:						
<i>Gerophyllum tenax</i>		50	8		4	62
<i>Arnica latifolia</i>	96	4				100
<i>Senecio triangularis</i>			16			16
<i>Astragalus</i> sp.			2		13	15
<i>Chamaenerion angustifolium</i>					2	2
<i>Pedicularis groenlandica</i>		13	15		8	36
<i>Antennaria rosea</i>	282	15		46		343
<i>Sedum stenopetalum</i>		4	12			16
<i>Achillea lanulosa</i>		25	13		20	58
<i>Pentstemon</i> sp.		4				4
<i>Heuchera glabella</i>		4				4
<i>Eriogonum subalpinum</i>		40	39		45	124
<i>Arenaria formosa</i>		43	68		33	144
<i>Veronica wormskjoldii</i>	27	8		20		55
<i>Aster</i> sp.		27			5	32
<i>Potentilla</i> sp.			2			2
<i>Hypericum Scouleri</i>		20				20
<i>Hieracium Scouleri</i>		1	1			2
<i>Dryocallis pseudorupestris</i>					4	4
<i>Silene multicaulis</i>			6			6
Sub Total for Herbs	405	238	182	66	134	1045
Grasses and Grasslike Plants:						
<i>Juncoides</i> sp.	164			8		172
<i>Festuca idahoensis</i>			46		3	49
<i>Agrostis hiemalis</i>		1				1
<i>Oryzopsis exigua</i>			3			3
<i>Festuca ovina</i>				66		66
<i>Poa alpina</i>	39	42	14	60	2	157
<i>Koeleria cristata</i>		3	4		3	10
<i>Juncus Parryi</i>	81	71	1		11	164
<i>Carex Geyeri</i>	47	43	276	54	58	478
Sub Total for Grasses and Grasslike Plants	331	160	344	188	77	1100
Shrubs:						
<i>Vaccinium scoparium</i>	218	80	176	82	110	636
<i>Phyllodoce empetrifolia</i>	60					60
<i>Vaccinium membranaceum</i>				3		3
Sub Total for Shrubs	278	80	176	85	110	699
Grand Total	1014	468	702	339	321	2844

TABLE 4

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NUMBER OF OBSERVATIONS MADE ON THE RED BUTTE AND RATTLESNAKE WINTER RANGES FOR THE FOOD HABIT STUDY OF MOUNTAIN GOATS (1947-48)

Scientific Name	Red Butte		Winter Range Rattlesnake Drainage												
	Dec.	March	Dec.	Jan.				Feb.				April			
			1	1	2	3	Total	1	2	3	Total	1	2	Total	
Erigeron sp.									1			1			
Xerophyllum tenax	3	3			1		1	2	3			3			
Antennaria rosea		2	1												
Sedum stenopetalum			1		1			1							
Achillea lamulosa	2	2			2	5		7					4		4
Phacelia leucophylla			1												
Pentstemon sp.					1	2	1	4	2		7	9		1	1
Heuchera glabella	2										1	1			
Eriogonum sp. alpinum	10	1			4	1	1	6		1		1			
Potentilla sp.	14	11			3	2	1	6		1		1		2	2
Angelica sp.	1														
Woodsia sp.			3			2		2	3	3		6		3	3
Artemisia discolor			2		1	11		12	2	4		6	9	6	15
Sub Total for Weeds	32	19	8		16	23	4	42	7	13	8	28	13	12	25
Grasses and Grasslike Plants:															
Agropyron spicatum	7	78	6		25	84	12	121	1	39	53	93	113	62	175
Festuca idahoensis		12													
Festuca sp.					1	1		2							
Koeleria crispata	43	54			3	13	4	20	1	17	3	21	16	20	36
Juncus Parryi		3													
Carex Geyeri	5	1													
Calamagrostis rubescens	5		1												
Bromus teo- torum			5			2		1	5	2		7			

TABLE 4 (Cont.)

Scientific Name	Red Butte		Winter Range Rattlesnake Drainage												
			Dec.	Jan.				Feb.				April			
	Dec.	March	1	1	2	3	Total	1	2	3	Total	1	2	Total	
Grasses and grass-like Plants (Cont.):															
<i>Bromus inermis</i>			1												
<i>Stipa</i> sp.					1		1								
<i>Poa</i> sp.	5	36	5	7	4	3	14		4	1	5	3	3	6	
Sub Total for Grasses and Grasslike Plants	65	184	20	36	104	19	159	7	62	57	126	132	85	217	
Shrubs:															
<i>Vaccinium scoparium</i>	6	10													
<i>Salix</i> sp.		19	1			3	3								
<i>Ribes</i> sp.		1			3	4	7	1	1	3	5	4		6	
<i>Dasiphora fruticosa</i>		5													
<i>Amelanchier alnifolia</i>	8	3	3		5	22	37	13	15		28	12	16	28	
<i>Acer glabrum</i>	5		4		3	29	32	8	9		17	1	5	6	
<i>Philadelphus Lewisii</i>			9	13	7	20	40	4	12		16	4*	12*	16	
<i>Holodiscus dumosus</i>			4		5	19	24	3	5		8	*	10*	10	
<i>Spiraea</i> sp.		6													
<i>Berberis repens</i>			1												
<i>Rosa</i> sp.			1	4	6		10	3	4		7	7		7	
<i>Ceanothus velutinus</i>			1			3	2			5	5				
<i>Prunus demissa</i>				3		10	13	1		1	2				
<i>Symphoricarpos albus</i>				3	9	6	18	1	5		6	7	5	12	
<i>Juniperus scopulorum</i>				2	2	4	8	1	4		5		2	2	
<i>Physocarpus malvaceus</i>				1	3	3	9		1		1				
Sub Total for Shrubs	17	44	29	26	43	124	205	35	58	9	100	33	50	83	
Grand Total	114	247	57	77	170	157	404	49	131	74	254	180	147	327	

* For those observations large clumps were evaluated with no attempt to distinguish individual plants.

range; therefore, a deficiency of samples in the case of scarce species does not affect the final results of food habits and is of little importance in this study. This will be brought out more fully by the final compilation of food habits.

There are decided limitations to the evaluations that can be made of the food habits on the winter ranges. This is due to the variation in snow depth encountered during the winter months of December, January and February. On the warm south exposure the snow depth varied from almost no snow to over 70 inches. The average snow depths on level ground in the Rattlesnake area for the winter months were:

	<u>On the canyon floor</u>	<u>At the upper limits of goat activity</u>
December	25 inches	32 inches
January	31 inches	48 inches
February	43 inches	60-70 inches

The increasing snow depth from one month to the next gradually covered a great deal of forage, previous utilization, and often entire species. Figure 5 illustrates the fallacious results that would be obtained from successive forage measurements taken with increasing snow depths when there was limited use only in the early part of the winter. Actually, however, additional utilization occurs all through the winter and confounds the results even more than illustrated.

For this reason none of the midwinter data can be used to determine a progressive feeding pattern nor can they be accepted as repre-

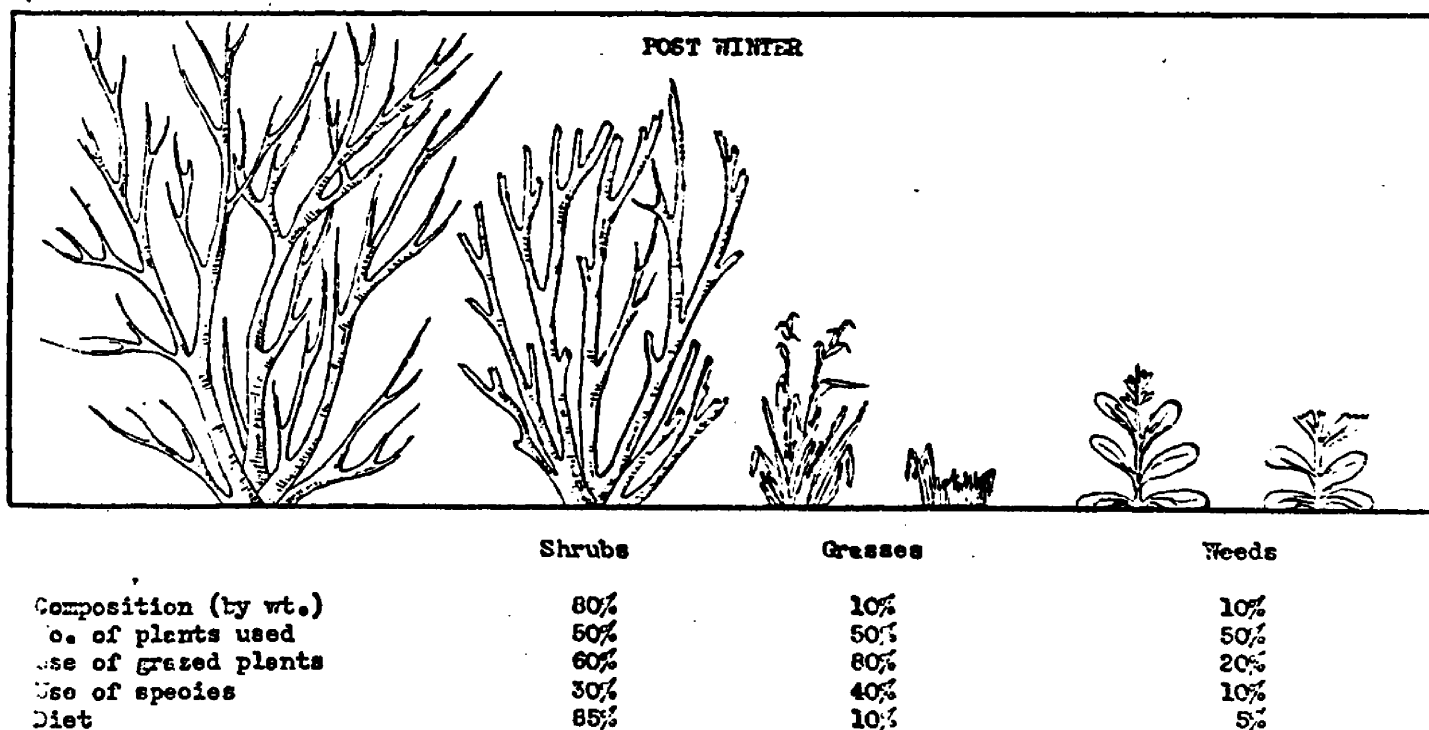
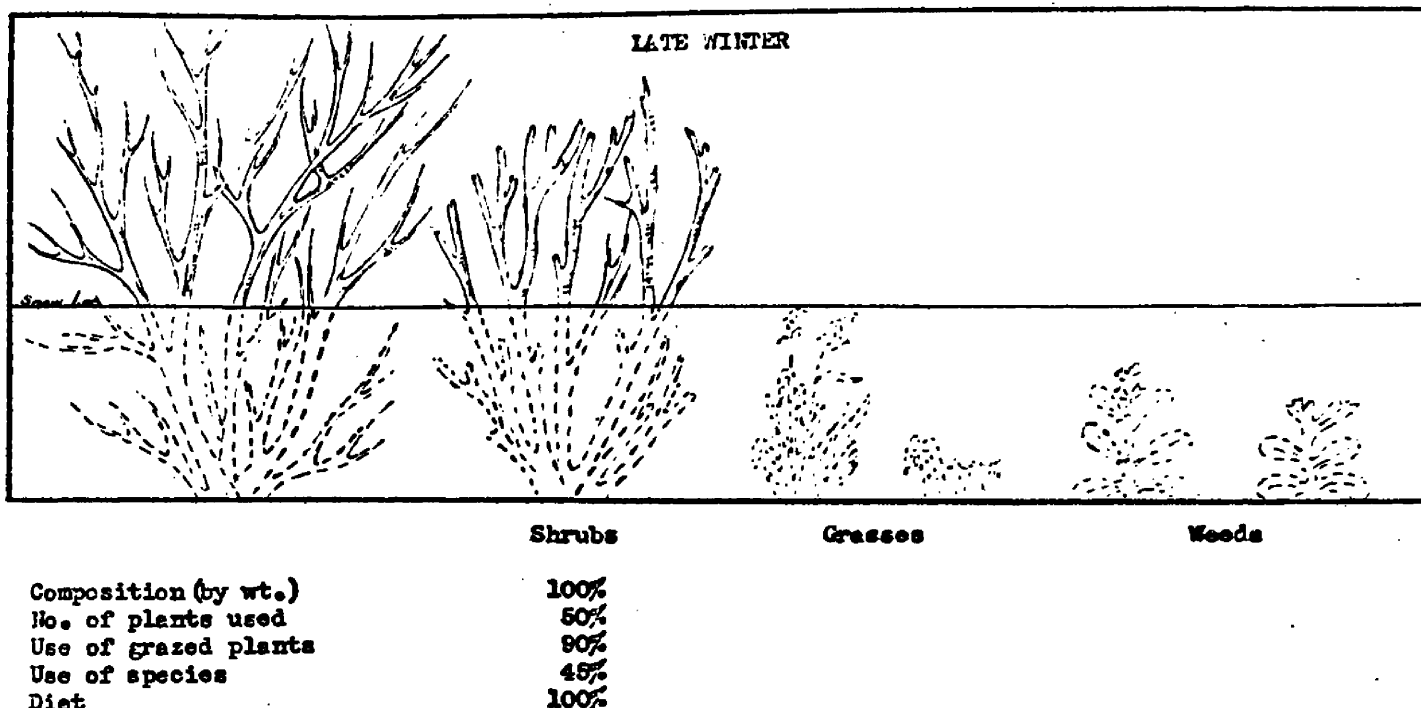


FIGURE 5 (Cont.)



PHOTOGRAPH 9

AN INCREASE IN SNOW DEPTH COVERS FORAGE, PREVIOUS UTILIZATION
AND OFTEN ENTIRE SPECIES

Four to five feet of snow in this area of the Rattlesnake
has covered up all the grass and weed species and a major
portion of the Amelanchier and Acer present. Much of the
evidence of earlier winter use is below the snow line.

senting accurately the use that has been made of the forage. Therefore, these data were not used to obtain the results presented in the body of this report. However, all the evaluations made of the data in this study were made of this midwinter information and the results are presented in the appendix of this report for examination by the reader. The results shown in Figure 5 are hypothetical, but are of the same type of evaluations as made in this report. They should be referred to following each set of results discussed later on and before examining the same type of results given for the midwinter data in the appendix.

The only valid information that was obtained from these midwinter data is a summary of those species which were used by goats sometime during the winter. The twenty six species showing utilization to some degree are tabulated in Table 5.

The last diagram in Figure 5 illustrates why utilization measured at the end of winter after the snow has disappeared indicates the accumulated food habit for the entire winter season. Measurements to correspond with this condition were made in April on types 1 and 2 in the Rattlesnake and the accumulated winter utilization is used in this report as the basis for the food habits of the mountain goat on the Rattlesnake winter range.¹

¹ Type 3 in the Rattlesnake area was not sampled in April because the use had been scanty and spotty. Good sampling was not feasible and was not justified by the minor importance of the type. Therefore, this type is excluded from final consideration of the food habits of goats on the Rattlesnake winter range.

SPECIES UTILIZED BY MOUNTAIN GOATS IN THE WINTER OF 1947-48

Ped Butte Range

Xerophyllum tenax
Eriogonum sp.
Agropyron spicatum
Festuca idahoensis
Koeleria cristata
Juncus Parryi
Carex Geyeri
Calamagrostis rubescens
Poa sp.
Amelanchier alnifolia
Salix sp.
Acer glabrum

Rattlesnake Range

Xerophyllum tenax
Achillea lanulosa
Pentstemon sp.
Heuchera glabella
Woodsia sp.
Artemisia discolor
Erigeron sp.
Agropyron spicatum
Festuca idahoensis
Koeleria cristata
Calamagrostis rubescens
Bromus tectorum
Poa sp.
Salix sp.
Ribes sp.
Amelanchier alnifolia
Acer glabrum
Philadelphus Lewisii
Rosa sp.
Ceanothus velutinus
Prunus demissa
Symphoricarpos albus
Juniperus scopulorum
Physocarpus malvaceus
Pseudotsuga taxifolia
Pinus ponderosa

March measurements in the Red Butte area, made in the absence of snow, are of the accumulated utilization up to the time of observation and are used to indicate the food habits of mountain goats on the Red Butte winter range.

With these considerations kept in mind, the results of evaluating species utilization and the comparison of food habits by the application of these results are presented below.

Use Made of Species

Number of Plants Grazed of Each Species

This is obtained from a tally of the plants available and of those showing utilization for each species. The latter divided by the former gives the per cent of available plants showing utilization. Columns numbered 1 in Table 6 give these results for the summer range, and columns numbered 1 of Table 7 the results for the winter range.

All figures in these tables based on less than five observations are marked (*) to indicate many of these results which may not be representative.

Average Utilization of Grazed Plants Only

The second aspect of species utilization is the use made of only those plants grazed. In the summer studies this was obtained by estimating the per cent utilization of each plant grazed and then average them by species. Results for the summer range are given in columns numbered 2 of Table 6 according to vegetative types.

The basis for per cent utilization is the entire aerial portion

Table 6 (cont.)

Species	Type No. 5			Type No. 8			Type No. 9			Type No. 10			Type No. 12			Total		
	Plants Ave. Total			Plants Ave. Total			Plants Ave. Total			Plants Ave. Total			Plants Ave. Total			Plants Ave. Total		
	Used	Use	Use	Used	Use	Use	Used	Use	Use	Used	Use	Use	Used	Use	Use	Used	Use	Use
	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/
Grasses and grasslike plants (cont.)																		
<i>Festuca ovina</i>										0	-	0				0	-	0
<i>Poa alpina</i> ¹	20	16	2	31	45	14	0	-	0	2	40	1	0	-	0	16	34	5
<i>Stelaria cristata</i>				0	-	0	0	-	0				0	-	0	0	-	0
<i>Ancus Parryi</i>	0	-	0	6	15	1	0	-	0				0	-	0	2	15	1
<i>Carex Geyeri</i>	4	10	1	14	17	2	29	36	10	0	-	0	0	-	0	18	21	4
Average for Grasses and Grasslike Plants:	6			14			28			1			0			11		
Shrubs:																		
<i>Scorodolopanax scoparium</i>	50	12	6	32	19	4	96	24	23	90	29	20	83	14	12	72	17	12
<i>Myrtodolopanax ampeliformis</i>	0	-	0													0	-	0
<i>Scorodolopanax membranaceum</i>										33	10	3				33	10	3
Average for Shrubs:	39			32			95			68			63			66		
For Types and Range:	19		3	18		2	36		17	22		10	32		5	22		11

Number of plants grazed of each species, in per cent of total number.

Average utilization of grazed plants only, in per cent of volume.

Total use made of species, in per cent by volume = column (1/ X column (2/.

These figures are based on less than 5 observations.

TABLE 6

NUMBER OF PLANTS GRAZED, AVERAGE USE OF GRAZED PLANTS ONLY, AND THE TOTAL USE MADE OF SPECIES ON THE RED BUTTE
MOUNTAIN GOAT SUMMER RANGE (AUGUST 1-15, 1947)
(In Per Cent of Number or Volume)

Species	Type No. 5			Type No. 8			Type No. 9			Type No. 10			Type No. 12			Total		
	Plants Ave. Total			Plants Ave. Total			Plants Ave. Total			Plants Ave. Total			Plants Ave. Total			Plants Ave. Total		
	Used	Use	Use	Used	Use	Use	Used	Use	Use	Used	Use	Use	Used	Use	Use	Used	Use	Use
	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/
Forbs:																		
Xerophyllum tenax				2	10	1	0	-	0				0*	-	0	2	10	1-
Arnica latifolia	9	12	1	25	10	3										10	11	1
Senecio triangularis							6	10	1							6	10	1
Astragalus sp.							0*	-	0				85	13	11	73	13	9
Chamaenerion angustifolium													0*	-	0	0*	-	0
Pedicularis greenlandica				38	12	5	67	17	11				13	20	3	44	16	7
Antennaria rosea	21	14	3	0	-	0				0	-	0				17	14	2
Sedum stenopetalum				0*	-	0	25	10	3							19	10	2
Achillea lanulosa				8	20	2	0	-	0				0	-	0	3	20	2
Pentstemon ellipticus				100*	12	12										100*	12	12
Heuchera glabella				75*	15	11										75*	15	11
Eriogonum umbellatum				10	9	1	8	10	1				0	-	0	6	9	1
Arenaria formosa				9	15	1	3	20	1				3	10	1-	6	15	1
Veronica wernskjoldii	4	10	1-	25	15	4				0	-	0				6	13	1
Aster sp.				59	15	9							0	-	0	50	15	8
Potentilla filipes							0*	-	0							0*	-	0
Hypericum Scouleri				15	17	3										15	17	3
Rhizacium Scouleri				100*	10	10	0*	-	0							50*	10	8
Dryas octopetala													0*	-	0	0*	-	0
Silene multicaulis							17	20	3							17	20	3
Average for Forbs:	17	1		18			11			0	-		10			14		
Grasses and Grasslike Plants:																		
Juncoidea sp.	4	14	1							0	-	0				4	14	1
Festuca idahoensis							2	40	1				0*	-	0	2	40	1
Agrostis hitchcockii				0*	-	0										0*	-	0
Oryzopsis exigua							0*	-	0							0*	-	0

**NUMBER OF PLANTS GRAZED, AVERAGE USE OF GRAZED PLANTS ONLY, AND THE TOTAL USE MADE OF SPECIES
FOR THE ENTIRE WINTER (1947-48) ON THE RED BUTTE AND RATTLESNAKE MOUNTAIN GOAT RANGES
(In Per Cent, of Number or Weight)**

SPECIES:	Red Butte (March)			Rattlesnake (April)								
				Type 1			Type 2			Total		
	Plants Ave.			Plants Ave.			Plants Ave.			Plants Ave.		
	Used	Use	Total	Used	Use	Total	Used	Use	Total	Used	Use	Total
	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	
Weeds:												
Xerophyllum tenax	100*	84	85									
Antennaria rosea	0*	-	0									
Achillea lanulosa	0*	-	0	50*	7	6				75*	17	0
Pentstemon sp.							0*	-	0	0*	-	0
Eriogonum sp.	0*	-	0									
Potentilla sp.	0	-	0				0*	-	0	0*	-	0
Woodсия sp.							0*	-	0	0*	-	0
Artemisia discolor				89	32	30	67	47	45	80	38	34
Average for weeds:	16	84	28	85	25	26	67	47	29	60	31	27
Grasses and grasslike plants:												
Agropyron spicatum	90	55	52	90	50	44	82	35	26	83	45	37
Festuca idahoensis	33	40	19									
Koeleria cristata	96	71	71	100	81	83	85	57	50	92	69	63
Juncus Parryi	67*	75	60									
Carex Geyeri	100*	60	60									
Poa sp.	56	40	26	100*	78	84	67*	68	39	83	73	51
Average for grasses and grasslike plants:	81	58	53	92	55	49	82	41	32	88	50	42
Shrubs:												
Vaccinium scoparium	0	-	0									
Salix sp.	74	26	18									
Ribes sp.	0	-	0	75*	1	1*				75	1	1*
Dasiphora fruticosa	0*	-	0									
Amelanchier alnifolia	0*	-	0	92	45	33	63	12	2	75	29	4
Acer glabrum				100*	13	13	20	20	1*	33	16	4

SPECIES:	Red Butte (March)			Rattlesnake (April)								
				Type 1			Type 2			Total		
	Plants	Ave.	Total	Plants	Ave.	Total	Plants	Ave.	Total	Plants	Ave.	Total
	Used 1/	Use 2/	Use 3/	Used 1/	Use 2/	Use 3/	Used 1/	Use 2/	Use 3/	Used 1/	Use 2/	Total
Shrubs (Cont.)												
Philadelphus Lewisii				25*	1	1	8	12	1-	13	7	
Holodiscus dumosus				0	-	0	0	-	0	0	-	
Spiraea sp.	0	-	0									
Rosa sp.				43	9	3				43	9	
Symphoricarpos albus				0	-	0	0	-	0	0	-	
Juniperus scopulorum							0*	-	0	0*	-	
Average for shrubs:	32	26	14	54	28	2	24	13	1	36	22	1
Total average	67	55	26	84	49	8	59	37	1	72	45	3

1/ Number of plants grazed of each species, in per cent of total number.

2/ Average utilization of grazed plants only, in per cent by weight.

3/ Total use made of species, in per cent by weight.

of the plant. This means the accumulated perennial growth of shrubby plants but only annual growth of weeds and grasses. Thus the 34 per cent use of Poa alpina plants is of the annual growth whereas the 17 per cent use of Vaccinium scoparium plants is of the total growth and may include most or all of the current annual growth.

Wide variations occur between vegetative types in the use of grass and grasslike plants, the greatest from 16 to 45 per cent in Poa alpina. This may be partially explained by the fact that most of these plants are small and slender and a very slight variation in the weight utilized is a larger variation in per cent utilization.

The use of weed species is less varied; the greatest variation being between 10 and 20 per cent for Arenaria formosa. Reference to Table 8 shows that the preferred vegetative parts of most weed species are usually the flowers with perhaps a little foliage. This type of use is quite consistent for each species and thus the variation remains low.

Though Vaccinium scoparium has a wide distribution on the range it has a small variation in average use between types, from 12 to 24 per cent. This is the only browse species that is abundant and apparently is the most highly preferred of the three browse species found.

On the entire summer range the average per cent utilization of grazed plants for twenty-four species varies from 9 per cent for Eriogonum sp. to 34 per cent for Poa alpina. In addition, seven species are recorded that show no utilization.

The use of individual plants on the winter ranges was obtained by dividing the weight of the plant by the weight of the utilized portion. These use figures are averaged by species and summarized in columns numbered 2 of Table 7 according to seasonal ranges. Outstanding is the consistently high winter use on the grasses, Agropyron spicatum, Koeleria cristata, and Poa sp. The 70 to 80 per cent use on Koeleria cristata plants on the winter ranges is in direct contrast to no use on the summer range. Other decided changes from low summer use to high winter use occurs on plants of Xerophyllum tenax, 10 to 84 per cent; Juncus Parryi, 15 to 75 per cent, and Carex Geyeri, 21 to 60 per cent. The reverse, a change from high summer use to low or no winter use occurs on plants of Vaccinium scoparium, 17 per cent to none; Achillea lanulosa, 20 per cent to none; and Antennaria rosea, from 14 per cent to none in winter.

Amelanchier alnifolia in type 1 of the Rattlesnake shows intense use on its plants. Within this type Amelanchier makes up only 3 per cent of the composition as compared to 23 per cent in type 2 (Table 2). Thus when the availability of this species is low, goats apparently utilize each of the available plants more intensely, probably to satisfy a seemingly high preference for the species.

Total Use Made of Species

The third aspect of species utilization is the use made of each species as a whole. For each species on the summer range, where the estimate of per cent utilization method was employed for determining

forage use, this figure was obtained by multiplying the per cent of plants showing utilization by the average utilization of the grazed plants as in the following formula:

$$\begin{array}{rcl} \text{Total use of} & & \text{Per cent of plants} \\ \text{a species} & = & \text{showing} \\ \text{(in per cent)} & & \text{utilization} \end{array} \times \begin{array}{l} \text{average per cent use} \\ \text{of the grazed} \\ \text{plants only} \end{array}$$

The use made of each species in each of the five summer range types and the weighted average for the entire range are represented by the figures in columns numbered 3 in Table 6. An average of 17 per cent utilization of 72 per cent of all Vaccinium scoparium plants on the range results in 12 per cent use of the entire volume of this species available on the range.

Of the thirty two species on the summer range, seventeen of the twenty weed species, five of the nine grass and grasslike species, and two of the three shrub species show utilization. Vaccinium scoparium and Pentstemon ellipticus were the heaviest utilized species on the summer range. Poa alpina and Festuca idahoensis are the only true grasses utilized on the summer range and very lightly at that. The other four grass species play no part in the summer feed of mountain goats.

Although the proper use of these forage species on this kind of a range is not known, the summer use of any one species for any type or for the entire Red Butte range was probably not heavy enough by the middle of August to endanger the survival of the species. There was most likely a margin of use left for the fall season.

The per cent, by weight, of total use made on each species in the winter ranges is computed from the field data of estimated weights by the following formula:

$$\text{Total use of a species (in per cent)} = \frac{\text{total weight of utilized portions}}{\text{total available weight}}$$

The results are presented for all species in columns numbered 3 of Table 7.

There is a conspicuous shift from a variety of weed species on the summer range to a variety of shrub species on the winter range, but grass species are few in number on both ranges. Of the twenty-seven species observed for these analyses, three of the eight weed species, all of the six grass and grasslike species, and six of the thirteen browse species show utilization. This number is supplemented by a list (Table 5) made up from the midwinter observations.

Only a third of the weed species on the winter range show utilization because most weed species do not cure well and in the non-growing season are inferior as forage to both grass and browse (Stoddart and Smith, 1943). The outstanding exception in this study is Xerophyllum tenax. Eighty-five per cent of the available weight was utilized, the highest use made of any species on the winter range. This is in contrast to the very low (less than 1 per cent) use of this species on the summer range.

Heavy winter use made on grass and grasslike species, varying

from 26 to 84 per cent, indicates that their importance in winter feeding is greater than in summer feeding. Agropyron spicatum, Koeleria cristata, and Poa sp. show wide distribution and consistently heavy use; Koeleria cristata generally heavier than the others. Koeleria cristata, Juncus Parryi and Carex Geyeri show a high winter use in the Red Butte area compared to low or no use in summer.

Amelanchier alnifolia on type 1 of Red Butte received the heaviest use, 33 per cent, of any browse species. The other species were used comparatively lighter, and some were avoided all winter, namely Holodiscus dumosus, Vaccinium scoparium, Dasiphora fruticosa, Symphoricarpos albus and Juniperus scopulorum.

Table 20 in the appendix shows the results obtained by measuring the use of species in midwinter when snow was present. The results do not show a progressive increase in utilization as should be expected. Instead the difference from one month to the next varies between an increase, a decrease, and no change at all.

Areas sampled for the midwinter data in Table 20 were not wholly included in the representative areas sampled for the total winter data in Table 7 although as much as was included as possible. This caused minor differences in the utilization pattern by indicating utilization on some species during midwinter, in Table 20, but no utilization at the end of the season, Table 7.

Preferred Vegetative Parts of Each Species

The selection made of vegetative parts of the various species

does not enter into the final computation of the food habits but is of interest. A knowledge of the vegetative parts generally selected increases the understanding of food and feeding habits of mountain goats. Information of preferences observed in the field during this study are recorded in Table 8.

Total Forage Use by Areas

The utilization of a vegetative type or seasonal range is the use made of all species combined and is expressed in per cent, by weight, of the total available forage.

As a part of food habits it is necessary to know the intensity of use on a type or range and what factors, if any, of the habitat are closely associated with this use and possibly have some influence on it.

From examination of the data I am unable to discern any correlation between the intensity of use of a vegetative type and the physiography of the area. However, correlations do exist between the use made of types and various features of the vegetative composition. Results obtained by evaluating utilization of types and the comparison of these results with the composition are presented below according to seasonal ranges.

Summer Range

Only per cent values of utilization were obtained in the field for each species on the summer range. To measure the use of a type the per cent utilization of each species must be weighted by its per cent

TABLE 8

VEGETATIVE PARTS OF FORAGE SPECIES PREFERRED BY MOUNTAIN GOATS
IN WESTERN MONTANA

Species	Parts taken
<i>Podicularia greenlandica</i>	Flower heads, little foliage
<i>Eriogonum umbellatum</i>	Flower heads
<i>Sedum stenopetalum</i>	Fleshy foliage
<i>Achillea lanulosa</i>	Flower heads, little green foliage, and dead flower stalks in winter
<i>Xerophyllum tenax</i>	Flower heads in summer, leaf foliage in winter
<i>Sonchello triangularis</i>	Flower heads
<i>Astragalus</i> sp.	Flowers and green foliage
<i>Hieracium Scouleri</i>	Flower heads, little foliage
<i>Antennaria rosea</i>	Flower heads, little foliage
<i>Arnica latifolia</i>	Flower heads, little foliage
<i>Aster</i> sp.	Flower heads
<i>Euchera glabella</i>	Flower heads
<i>Pentstemon ellipticus</i>	Flower heads
<i>Pentstemon</i> sp.	Dried stalks and foliage in winter
<i>Artemisia discolor</i>	Dried stalks and foliage in winter
<i>Woodia</i> sp.	Dried foliage
<i>Agropyron spicatum</i>	Cured culms and foliage
<i>Festuca idahoensis</i>	Culms in summer, cured culms and foliage in winter
<i>Poa alpina</i>	Green culms and little foliage
<i>Poa</i> sp.	Green culms, and cured culms and foliage
<i>Eoeleria cristata</i>	Cured culms and foliage
<i>Juncus Parryi</i>	Green and cured foliage
<i>Juncoides</i> sp.	Green foliage
<i>Carex Geyeri</i>	Green foliage and cured foliage
<i>Calamagrostis rubescens</i>	Cured culms and foliage
<i>Bromus tectorum</i>	Green foliage
<i>Vaccinium scoparium</i>	Green foliage and stems
<i>Vaccinium membranaceum</i>	Green foliage
<i>Salix</i> sp.	Green foliage and stem tips in summer, stems and buds in winter
<i>Ribes</i> sp.	Stem tips
<i>Amelanchier alnifolia</i>	Stems and buds
<i>Acer glabrum</i>	Stems and buds
<i>Philadelphus Lewisii</i>	Sucker shoots
<i>Rosa</i> sp.	Tips of sucker shoots
<i>Ceanothus velutinus</i>	Green foliage and stem tips in winter
<i>Prunus demissa</i>	Stems and buds
<i>Symphoricarpos albus</i>	Stem tips
<i>Juniperus scopulorum</i>	Low stem tips
<i>Physocarpus malvaceus</i>	Sucker shoots
<i>Pinus ponderosa</i>	Needles
<i>Pseudotsuga taxifolia</i>	Needles, buds and new stem tips

composition and the results of all species totaled. A summary of type use and composition is recorded in Table 9. Composition for each type is by vegetative classes plus the amount of Vaccinium scoparium.

The use made of these summer range types is mathematically proportionate to the relative amount of Vaccinium scoparium present, giving a correlation index of +.8664. A bar graph, Figure 6, illustrates this direct correlation. As the relative amount of Vaccinium scoparium increases from 12 per cent in type 8 to 68 per cent in type 9 the intensity of use increases from 2 to 17 per cent of the total available forage. The only variation of this increase occurs in type 8. Forty-nine per cent of the available forage is Phyllodoce empetri-formis, apparently an undesirable food species, and this may in some way influence the use made on the balance of available forage, of which 42 per cent is Vaccinium scoparium.

This one species, Vaccinium scoparium, is the most important summer food species and the evidence strongly indicates that the abundance of this species may be the controlling factor in the distribution of use on the summer range.

Winter Ranges

Determinations of the use made of types in the winter ranges are made simple by the use of forage weights. Results are obtained from direct use of field data in the following formula:

$$\begin{array}{l} \text{Use of a type} \\ \text{(in per cent)} \\ \text{of weight} \end{array} = \frac{\text{Sum of the utilized forage weights for all species}}{\text{Sum of the available forage weights for all species}}$$

COMPARISON BETWEEN USE MADE OF TYPES AND THE RELATIVE
AMOUNT OF Vaccinium scoparium AVAILABLE
(Red Butte Summer Range, 1947)

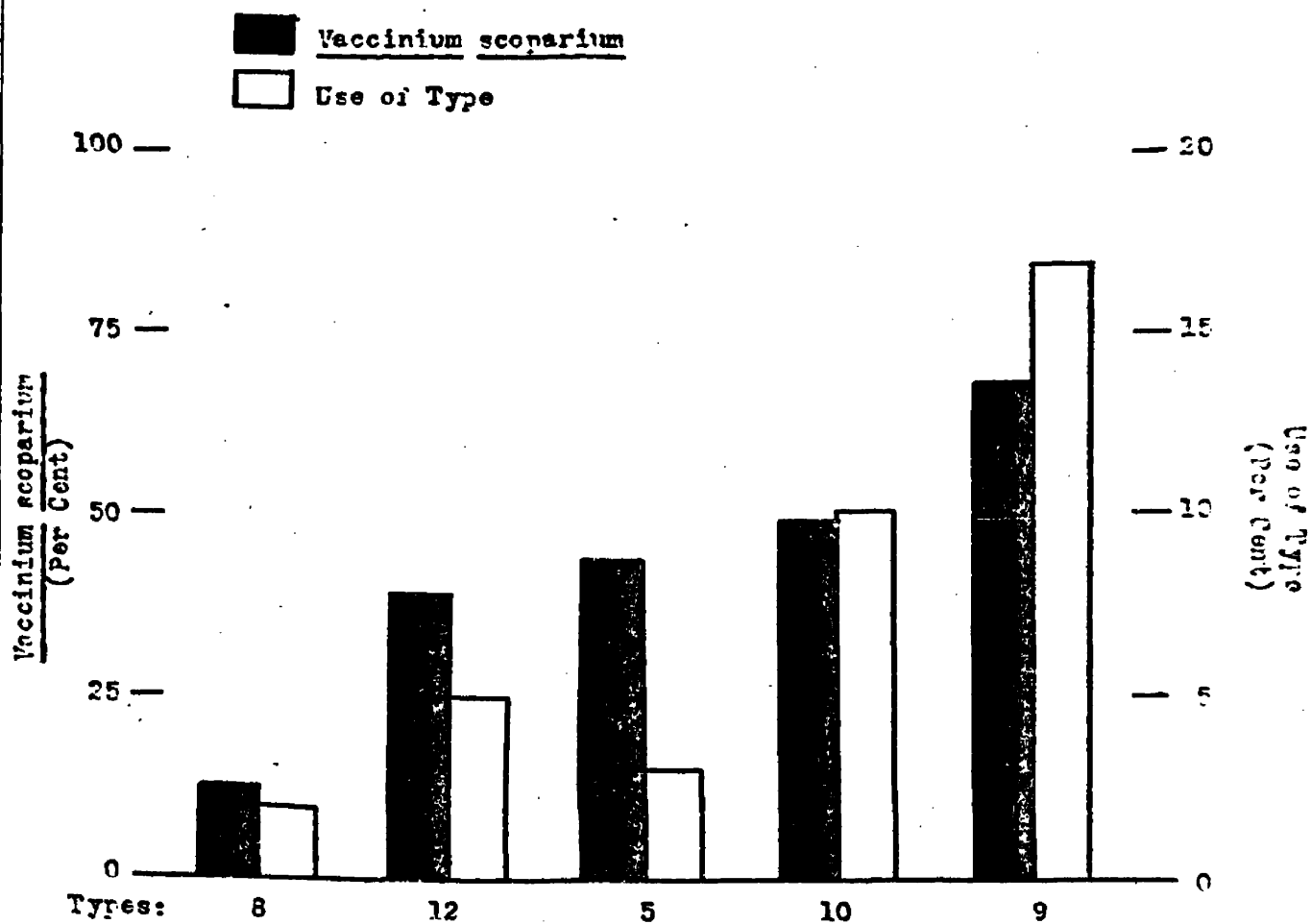


FIGURE 6

The results are shown as the last figure in columns numbered 3 of Table 7. These results are also summarized in Table 9 along with composition of the types.

Two features of range composition are related closely to the intensity of use of a type on the winter range. First is a direct correlation between the use made of a vegetative type and the relative amount of grasses available. With the presence of this first correlation and the fact that the amount of weeds is low in winter types it follows that a second relationship exists, an inverse correlation between intensity of use of a type and the relative amount of browse forage available. These correlations are illustrated by the bar graphs in Figure 7.

Accompanying an increase in available grasses from 2 to 31 per cent is the increase from 1 to 26 per cent in the use made of the type. Conversely, this increase in the use made of the type is associated with a decrease from 97 to 68 per cent in the relative amount of browse forage available.

These results are based only on the three vegetative types listed but the same evaluations have been made for the midwinter data collected in this study and the results are presented in Table 21 and illustrated by Figures 10 and 11 in the appendix. Although discrepancies in these midwinter results do exist as have been pointed out earlier, some of their implications cannot be wholly disregarded. The results shown in

COMPARISON BETWEEN USE MADE OF TYPES AND THE RELATIVE AMOUNT
OF GRASSES AND SHRUBS IN THE AVAILABLE FORAGE
(Red Butte and Rattlesnake Winter Ranges, 1947-48)

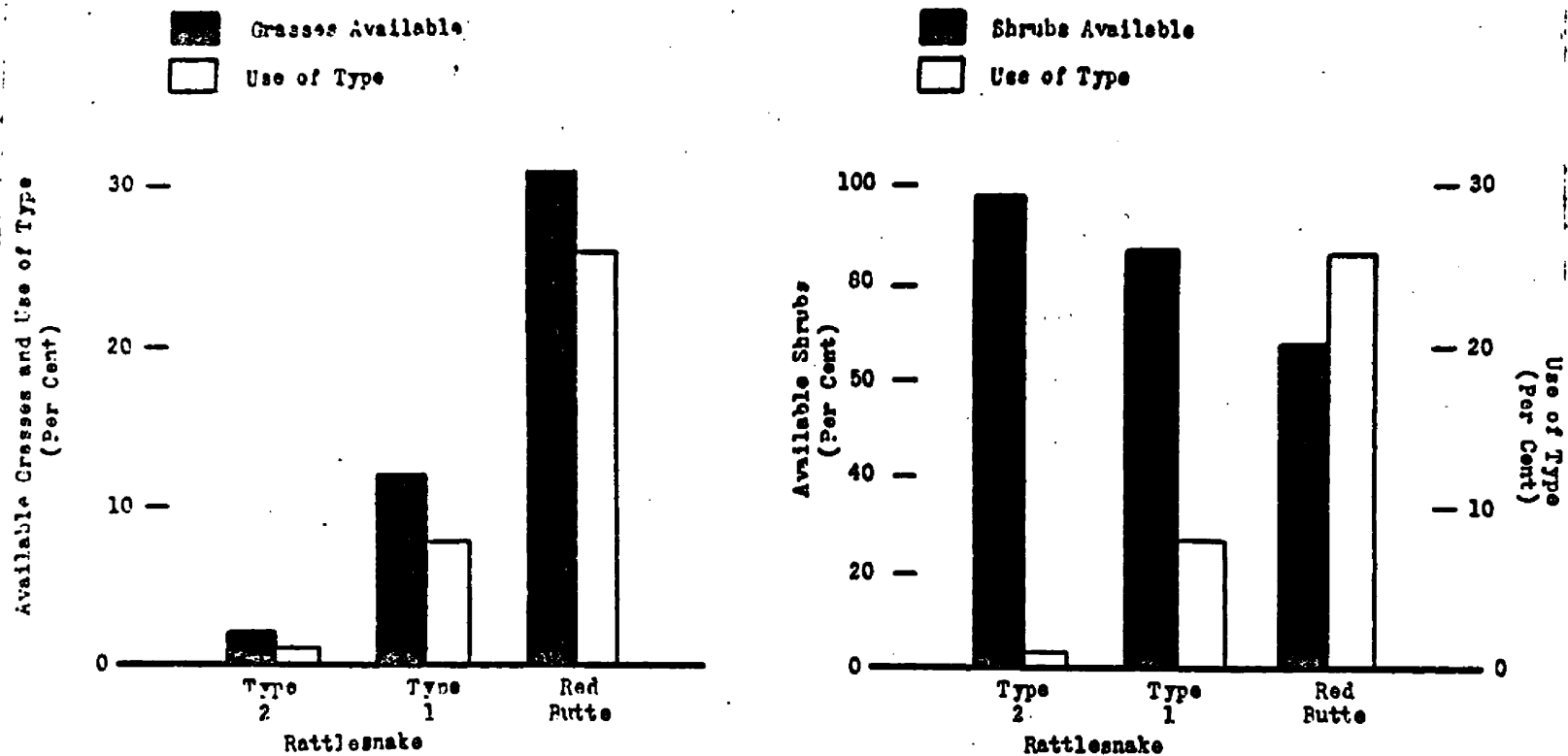


FIGURE 7

Figures 10 and 11 offer additional evidence in favor of conclusions derived from Figure 7.

The most intense winter use is usually on grasses and an increase in the relative amount of grasses in types accompanies and, according to this evidence, influences an increase in the intensity of use made of a type.

Food Habits of the Mountain Goat

The final consideration in this report is the measured relative choice of foodstuffs which mountain goats have made on each vegetative type or range. This choice in each case is indicative of the food habit of the animal within the conditions of time and area measured and is expressed as the per cent, by weight, each species makes up of the diet. Using the measured utilization of range forage to indicate the diet taken from the range the results are presented below as the food habits of this animal according to seasonal ranges.

Summer Range

The food habit for each vegetative type is a comparison of the actual amounts of utilization between species. Actual amounts can be expressed here only as units of feed and compared as a per cent of the total units of feed in the type.

The formula for computing units of feed utilized by species is:

Units of feed used = per cent utilization X per cent composition.

The following formula gives the per cent for comparing relative amounts of each species in the diet from a vegetative type:

$$\text{Per cent of each species in the diet} = \frac{\text{Units of feed utilized from each species}}{\text{Units of feed utilized from the entire vegetative type}}$$

Diets indicated by the utilization of the five summer range types are given in Table 10; also the diet for the entire summer range as a total of the five types. To determine the per cent of each species in the diet taken from the total range, the utilization per cent of each species is weighted by its respective composition plus the area and density of the type in which it occurs. For each species the computation is:

$$\begin{aligned} &\text{Units of feed used from the entire range} = \left(\begin{array}{l} \text{units of feed} \\ \text{used from type X} \end{array} \times (\text{area X density}) \text{ of the type} \right) \\ &\text{plus a repeat for each type in which the species occurs.} \end{aligned}$$

Each species is changed to per cent the same as for each type.

That is:

$$\begin{aligned} &\text{Per cent of each species in the diet for the range} = \frac{\text{units of feed furnished by each species on the range}}{\text{total units of feed furnished by all species on the range}} \end{aligned}$$

Of twenty weed species available on the entire range eighteen were taken as a part of the feed, but altogether they made up only 1 per cent of the diet, yet weed species make up 34 per cent of the available forage. Xerophyllum tenax in type 5, Astragalus sp. in type 12 and Pentstemon ellipticus in type 8 are the only indications of any weed

FOOD HABIT OF THE MOUNTAIN COAT ON THE RED BUTTE SUMMER RANGE, 1947
(Diet in Per Cent, by Weight)

Species	Vegetative Types					Total
	6	8	9	10	12	
Weeds:						
<i>Geropogon sp.</i>		20	0		0	1-
<i>Arnica montana</i>	1-	1-				1-
<i>Senecio sp.</i>			1-			1-
<i>Astragalus sp.</i>			1-		8	1-
<i>Hamamelis sp.</i>					1-	1-
<i>Medicularia groenlandica</i>		1-	1-		1-	1-
<i>Antennaria rosea</i>	1	0		0		1-
<i>Edum stenopetalum</i>		0	1-			1-
<i>Chiliza lanulosa</i>		1	0		0	1-
<i>Antstemon ellipticus</i>		9				1-
<i>Leuchera glabella</i>		1-				1-
<i>Trigonum umbellatum</i>		1-	1-		0	1-
<i>Renaria formosa</i>		1-	1-		1-	1-
<i>Veronica wormskjoldii</i>	1-			0		1-
<i>Aster sp.</i>		1			0	1-
<i>Potentilla filipes</i>			0			0
<i>Hypericum Scouleri</i>		1-				1-
<i>Geranium Scouleri</i>		1-	0			1-
<i>Thymocallis pseudorupestris</i>					0	0
<i>Silene multicaulis</i>			1-			1-
Sub total for weeds:	1	32	1-	0	9	1
Grasses and grasslike plants:						
<i>Lunoides sp.</i>	1-					1-
<i>Festuca idahoensis</i>			1-		0	1-
<i>Poa biennis</i>		0				0
<i>Elymus exigua</i>			0			0
<i>Festuca ovina</i>				0		0
<i>Poa alpina</i>	1-	2	0	9	0	1-
<i>Polypodium cristata</i>		0	0		0	0
<i>Lunus Parryi</i>	0	4	0		0	1-
<i>Carex Geyeri</i>	1-	2	4	0	0	2
Sub total for grasses and grasslike plants:	1-	8	4	9	0	3
Shrubs:						
<i>Saxifraga scoparium</i>	99	60	96	78	91	96
<i>Phyllocladus empetrifolius</i>	0					0
<i>Saxifraga membranaceum</i>				13		1-
Sub total for shrubs:	99	60	96	91	91	96
Total	100	100	100	100	100	100

species making up more than 1 per cent of the diet from any one type. However, none of these species were extensive enough to gain importance for the entire range.

Festuca idahoensis and Poa alpina are the only grass species in the summer diet of six species available. Over the entire range they are of little importance. Carex Geyeri makes up 3 per cent on the range, being utilized in three of the five types.

The one outstanding species on the summer range is Vaccinium scoparium. It makes up 60 per cent or more of the diet from each type and 96 per cent from the total range, yet it makes up only 49 per cent of the available forage. This single species is far more important in the summer diet of the mountain goat than all the other species together.

Winter Ranges

Again, direct use of field data based on estimated forage weights may be used, this time to determine diets taken from the range. The formula for obtaining the per cent of each species in the diet from a vegetative type is:

$$\text{Per cent of each species in the diet} = \frac{\text{Utilized weight of each species}}{\text{Total utilized weight of all species within the type}}$$

To determine the diet from the entire range each species utilization per cent must be weighted by the area of its respective type and then totaled by species. The above formula is applied to these results to obtain the per cent of each species in the diet from the total range.



PHOTOGRAPH 10

WINTER USE OF WILLOW ON THE RED BUTTE RANGE

This plant shows the low matted effect of winter feeding on the most important browse species of the Red Butte winter range.

Table 11 gives the food habits of mountain goats on the Red Butte and Rattlesnake winter ranges. Weeds are of little importance in the diet on either range. Two grass species, Agropyron spicatum and Koeleria cristata, furnish 51 to 73 per cent of the winter feed for mountain goats even though they make up only 3 to 25 per cent of the available forage. Agropyron spicatum usually furnishes more feed than Koeleria cristata, but the latter has a higher preference as indicated by the amount of feed in the diet per unit of available forage on the range. This is a strong contrast to the absence of this species in the summer diet even though it was available.

Salix sp. on the Red Butte range and Amolanchier alnifolia on the Rattlesnake range are the principal shrub species of a variety of twelve species present. Vaccinium scoparium appears to be undesirable and forms no part of the diet in the winter ranges, a noticeable difference from its important part in the summer diet.

A large per centage of the available forage on these winter ranges consists of browse species which are used very little or not at all. Holodiscus dumosus makes up 21 to 30 per cent of the available forage on the Rattlesnake range, and yet is not included in the diet at all. Ribes sp., Philadelphus Lewisii, and Juniperus scopulorum are also large constituents of the available vegetation but contribute only a little or none of the feed to the diet of the mountain goats.

The diets, by vegetative classes, from the two winter ranges com-

FOOD HABIT OF THE MOUNTAIN GOAT ON THE RED BUTTE AND RATTLESNAKE
WINTER RANGES, 1947-48
(Diet In Per Cent, by Weight)

Species	Red Butte March	Rattlesnake		Total
		Type 1	Type 2	
weeds:				
Geranium	2			
Antennaria rosea	0			
Achillea	0	1-		1-
Polygonum			0	0
Eriogonum sp.	0			
Potentilla sp.	0		0	0
Woodсия sp.			0	0
Artemisia discolor		3	3	3
Sub total for weeds:	2	3	3	3
Grasses and grasslike plants:				
Agropyron spicatum	27	57	34	43
Festuca idahoensis	1			
Koeleria cristata	30	16	23	19
Juncus Parryi	1			
Carex Geyeri	1-			
Poa sp.	4	1	2	1
Sub total for grasses and grasslike plants:	63	74	59	68
Shrubs:				
Vaccinium scoparium	0			
Salix sp.	35			
Ribes sp.	0	2		1
Ceanothus fruticosa	0			
Amelanchier alnifolia	0	13	35	22
Acer glabrum		7	1	4
Philadelphus Lewisii		1	2	1
Holodiscus dumosus		0	0	0
Spiraea sp.	0			
Rosa sp.		1-		1-
Erythricarpus albus		0	0	0
Juniperus scopulorum			0	0
Sub total for shrubs:	35	23	38	29
Total	100	100	100	100



PHOTOGRAPH 11

USE OF Amelanchier alnifolia BY MOUNTAIN GOATS ON THE RATTLESNAKE
WINTER RANGE

The most important browse species on the Rattlesnake goat range. It makes up about one-fourth of the diet of goats on this range.

pare very closely. Grasses and grasslike plants make up 63 per cent of the diet from the Red Butte range as compared to 68 per cent on the Rattlesnake range, shrubs 35 per cent on the former as to 29 per cent on the latter range, and weeds 2 per cent compared to 3 per cent.

SUMMARY

With the detailed results available from various evaluations made of available forage and forage utilization, it is now possible to summarize them by a discussion of the importance of each species to the food habit of the mountain goat.

The measure of utilization of a species in this study is an indication of the relative preference of use displayed by mountain goats. Thus 20 per cent use of one species indicates that the animal has shown less preference for it than for a species grazed 80 per cent. As a guide to rating use preference in this summary, reference is made to columns numbered 3 in Tables 6 and 7.

Petrides (1941), Hill (1946), and Aldous and Krefting (1946) have all pointed out that besides the preferences shown by animals in utilizing species, the amount of each food species on the range has a direct influence on the amount of that species taken in the diet. Therefore, availability has a direct bearing on the importance of the species to the food habit of the animal.

In the following summaries both the preference and the abundance of each species are considered as a measure of its importance. In each case adjectives are used instead of numerical values. The importance of each species is comparable to the comparative amounts making up the diet. In the following tables the diet from each range is presented as taken from Tables 10 and 11. The importance of each species is given as the last column of the tables.

7
(

The number of species included in the summer diet makes an extensive list, but the amount of many of them in the composition and the diet is very low with a correspondingly low importance to the goat. Table 12 summarizes the use preference, availability, diet and the importance of the species on the summer range.

Similar to all the evidence presented before, this table indicates the important part of one species, Vaccinium scoparium, in the food habit of goats on this particular range. If other species were more abundant on a range they might well be an important feed, especially Carex flaccida, Pentstemon ellipticus, Hesperis glabella, Astragalus sp., and Pedicularis groenlandica have higher use preferences but normally do not make up any sizeable part of the vegetative cover.

Tables 13 and 14 summarize the forage species of the Red Butte and Rattlesnake winter ranges respectively. The separate effects of use preference or availability on the importance of a species as food is shown by a comparison of Koeleria cristata, Agropyron spicatum and Amelanchier alnifolia on the Rattlesnake range.

The two species of grass, Koeleria cristata and Agropyron spicatum are the most important winter food species on both Red Butte and the Rattlesnake ranges. In addition, Salix sp. on the Red Butte range and Amelanchier alnifolia on the Rattlesnake range are the most important browse species.

SUMMARY OF FORAGE SPECIES ON THE RED BUTTE MOUNTAIN GOAT SUMMER RANGE

Species	Indicated 1/ Use Preference	Relative 2/ Availability	Diet 3/ (%)	Importance as Food
Vaccinium membranaceum	Moderate	High	98	Very high
Pentstemon ellipticus	Moderate	Very low	1-	Very low
Heuchera glabella	Moderate	Very low	1-	Very low
Astragalus sp.	Moderate	Very low	1-	Very low
Pedicularis groenlandica	Moderate	Very low	1-	Very low
Poa alpina	Low	Very low	1-	Very low
Hieracium Scouleri	Low	Very low	1-	Very low
Carex Geyeri	Low	Low	3	Moderate
Silene multicaulis	Low	Very low	1-	Very low
Vaccinium membranaceum	Low	Very low	1-	Very low
Hypericum Scouleri	Low	Very low	1-	Very low
Antennaria rosea	Low	Very low	1-	Very low
Sedum stenopetalum	Low	Very low	1-	Very low
Arnica latifolia	Very low	Very low	1-	Very low
Festuca idahoensis	Very low	Very low	1-	Very low
Aster sp.	Very low	Very low	1-	Very low
Arenaria formosa	Very low	Very low	1-	Very low
Veronica worms kjoldii	Very low	Very low	1-	Very low
Achillea lanulosa	Very low	Very low	1-	Very low
Senecio triangularis	Very low	Very low	1-	Very low
Juncoides sp.	Very low	Very low	1-	Very low
Eriogonum umbellatum	Very low	Very low	1-	Very low
Juncus Parryi	Very low	Very low	1-	Very low
Xerophyllum tenax	Very low	Very low	1-	Very low

TABLE 12 (Cont.)

71

Species	Indicated <u>1/</u> Use Preference	Relative <u>2/</u> Availability	Diet <u>3/</u> (%)	Importance as Food
<i>Dactyloctenium aegyptium</i>	0	Very low	0	None
<i>Chamaenerion angustifolium</i>	0	Very low	0	None
<i>Oryzopsis exigua</i>	0	Very low	0	None
<i>Koeleria cristata</i>	0	Very low	0	None
<i>Agrostis hiemalis</i>	0	Very low	0	None
<i>Festuca ovina</i>	0	Very low	0	None
<i>Phyllocoe empetriformis</i>	0	Moderate	0	None

1/ Based on column 3 or "Total" in Table 6.

2/ Based on "Total" column of Table 1.

3/ Taken from "Total" column of Table 10.

SUMMARY OF FORAGE SPECIES ON THE RED BUTTE MOUNTAIN GOAT WINTER RANGE

	Indicated 1/ Use Preference	Relative 2/ Availability	Diet 3/ (%)	Importance as Food
<i>Lepidolamium tenebrum</i>	Very high	Very low	2	Low
<i>Koeleria cristata</i>	Very high	Moderate	30	High
<i>Juncus Parryi</i>	Very high	Very low	1	Very low
<i>Carex Geyeri</i>	Very high	Very low	1-	Very low
<i>Agropyron spicatum</i>	High	Moderate	27	High
<i>Poa sp.</i>	Moderate	Low	4	Low
<i>Festuca idahoensis</i>	Moderate	Very low	1	Very low
<i>Salix sp.</i>	Moderate	High	35	High
<i>Antennaria rosea</i>	0	Very low	0	None
<i>Achillea lanulosa</i>	0	Very low	0	None
<i>Eriogonum sp.</i>	0	Very low	0	None
<i>Potentilla sp.</i>	0	Very low	0	None
<i>Vaccinium scoparium</i>	0	Low	0	None
<i>Ribes sp.</i>	0	Very low	0	None
<i>Dasiphora fruticosa</i>	0	Low	0	None
<i>Amelanchier alnifolia</i>	0	Low	0	None
<i>Spiraea sp.</i>	0	Low	0	None

1/ Based on column 3 of "Red Butte" in Table 7.

2/ Based on "Red Butte" data of Table 2.

3/ Taken from "Red Butte" data of Table 11.

TABLE 14

73

SUMMARY OF FORAGE SPECIES ON THE RATTLESNAKE MOUNTAIN GOAT WINTER RANGE

Species	Indicated 1/ Use Preference	Relative 2/ Availability	Diet 3/ (%)	Importance as Food
	Very high	Very low	19	Moderate
Poa sp.	High	Very low	1	Very low
Agropyron spicatum	High	Low	48	High
Artemisia discolor	High	Very low	3	Low
Achillea lanulosa	Low	Very low	1-	Very low
Amelanchier alnifolia	Low	Moderate	23	Moderate
Acer glabrum	Low	Low	4	Low
Rosa sp.	Low	Very low	1-	Very low
Ribes sp.	Very low	Moderate	1	Very low
Philadelphus Lewisii	Very low	High	1	Very low
Pentstemon sp.	0	Very low	0	None
Potentilla sp.	0	Very low	0	None
Woodsia sp.	0	Very low	0	None
Holodiscus dumosus	0	High	0	None
Symphoricarpos albus	0	Very low	0	None
Juniperus scopulorum	0	Moderate	0	None

1/ Based on column 3 of "Total Rattlesnake" data in Table 7.

2/ Based on "Total Rattlesnake" data in Table 2.

3/ Taken from "Total Rattlesnake" data in Table 11.

CONCLUSIONS

1. Indications of many aspects of food habits of mountain goats may be obtained by an evaluation of the range forage and its utilization which will assist in judging and appraising similar goat habits elsewhere.

2. Data for the evaluation of food habits of big game animals as indicated by forage utilization may be obtained better from the use of the weight estimate method than from the per cent estimate method. The weight estimate method will account for differences in volume within a species and among species as well as the total volume of forage for different types.

3. On the summer range mountain goats show a wide variety in the choice of food species, but utilization on most of them is very light, at least up to August. Vaccinium scoparium showed the most intense use and that was not excessive.

4. Vaccinium scoparium was the most abundant species on the summer range. Because of its high abundance and intensity of use, this species makes up 96 per cent of the summer diet and is by far the most important species in the Red Butte area.

5. Intensity of use of any vegetative type on the summer range is directly proportionate to the relative amount of Vaccinium scoparium in the available forage.

6. Snow conditions in western Montana make it impossible to accurately measure the progressive food habit pattern of the mountain goat through the winter season. A measure of accumulated winter utilization taken after the snow has disappeared does give the food habit picture for the entire winter based on the maximum possible amount of forage available.

7. Utilization is heavy on two grass species on the winter range, Agropyron spicatum and Koeleria cristata, and on two shrubs, Salix sp. on the Red Butte range and Amelanchier alnifolia on the Fattlesnake range. These four species make up most of the diets and are the most important species on winter ranges.

8. The intensity of use of a winter range is directly proportionate to the relative amount of available grasses and inversely proportionate to the relative amount of available browse.

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APPENDIX

CHECK LIST OF PLANTS FOUND IN AND NEAR MOUNTAIN GOAT HABITAT
IN WESTERN MONTANA

<u>Trees:</u>	<u>Scientific Name</u>	<u>Common Name</u>
	<i>Abies lasiocarpa</i> (Hook.) Nutt.	Alpine Fir
	<i>Larix lyallii</i> Parl.	Alpine Larch
	<i>Larix occidentalis</i> Nutt.	Western Larch
	<i>Picea Engelmannii</i> (Parry) Engelm.	Engelman Spruce
	<i>Pinus albicaulis</i> Engelm.	Whitebark Pine
	<i>Pinus contorta</i> Dougl.	Lodgepole Pine
	<i>Pinus ponderosa</i> Dougl.	Ponderosa Pine
	<i>Pseudotsuga taxifolia</i> (Lamb) Britt.	Douglas Fir
 <u>Shrubs:</u>		
	<i>Acer glabrum</i> Torr.	Mountain Maple
	<i>Amelanchier alnifolia</i> Nutt.	Serviceberry
	<i>Arctostaphylos uva-ursi</i> (L.) Spreng.	Bearberry or Kinnikiniok
	<i>Artemisia diversiflora</i> Rydb.	
	<i>Artemisia trichosperma</i> Besser.	
	<i>Azaleastrum albiflorum</i>	False Azalea
	<i>Berberis repens</i> Lindl.	Creeping Hollygrape
	<i>Ceanothus velutinus</i> Dougl.	Snowbrush
	<i>Dasiphora fruticosa</i> (L.) Rydb.	Shrubby Cinquefoil
	<i>Holodiscus dumosus</i> (Nutt.) Heller	Ocean Spray
	<i>Juniperus scopulorum</i> Sarg.	Rocky Mountain Juniper
	<i>Kalmia microphylla</i> (Hook.) Heller	Rocky Mountain Laurel
	<i>Ledum glandulosum</i> Nutt.	Smooth Labrador Tea
	<i>Menziesia glabella</i> Gray	Menziesia
	<i>Pachystima myrsinites</i> Raf.	Mountain Lover
	<i>Philadelphus Lewisii</i> Pursh	Mockorange
	<i>Phyllodoce empetrifolia</i> (Smith) Don	Mountain Heath
	<i>Physocarpus malvaceus</i> (Torr.) A. Nels.	Hinebark
	<i>Prunus demissa</i> (Nutt.) Walp.	Chokecherry
	<i>Ribes</i> sp.	Currant
	<i>Rosa</i> sp.	Wild Rose
	<i>Salix</i> sp.	Willow
	<i>Sambucus melanocarpa</i> Gray	Elderberry
	<i>Sorbus scopulina</i> Greene	Mountain Ash
	<i>Spiraea densiflora</i> Nutt.	Pink Meadowsweet
	<i>Spiraea lugida</i> Dougl.	White Meadowsweet
	<i>Symphoricarpos albus</i> (L.) Blake	Snowberry
	<i>Vaccinium membranaceum</i> Dougl.	Huckleberry
	<i>Vaccinium scoparium</i> Leiberg	Dwarf Huckleberry

TABLE 15 (Cont.)

Grasses and Grasslike plants:

Agropyron saxicola (Scribn. & Smith) Piper
Agropyron spicatum (Pursh) Scribn. & Smith
Agrostis hiemalis (Walt.) B.S.P.
Bromus inermis Leyss
Bromus tectorum L.
Calamagrostis rubescens Eucl.
Cerex festivela
Cerex Heyeri Nutt.
Cerex scopulorum Holm.
Festuca idahoensis Elmer.

Festuca ovina L.
Festuca scabrella Torr.
Juncoides sp.
Juncus Parryi Engelm.
Koeleria cristata (L.) Pers.
Crypsis exigua Thurb.
Phleum alpinum L.
Poa alpina L.
Poa opilis Scribn.
Poa secunda Presl.
Sitanion hystrix (Nutt.) J.C. Smith

Bluebunch Wheatgrass
 Ticklegrass
 Smooth Brome
 Cheatgrass
 Pinegrass
 Ovalhead Sedge
 Elk Sedge

Idaho Fescue or Bluebunch Fescue

Sheep Fescue
 Rough Fescue

Junegrass
 Little Ricegrass
 Alpine Timothy
 Alpine Bluegrass
 Skyline Bluegrass
 Sandberg Bluegrass
 Squirrel Tail

Herbs or Weeds:

Achillea lanulosa Nutt.
Agoseris villosa Rydb.
Allium cernuum Roth.
Anaphalis margaritacea (L.) Benth. & Hook.
Anemone tetonensis Porter
Angelica Lyallii Wats.
Antennaria rosea (Bat.) Greene
Arenaria formosa Fisch.
Arnica latifolia Bong.
Arnica longifolia Bat.
Artemisia discolor Dougl.
Aster sp.
Astragalus sp.
Campanula rotundifolia L.
Castilleja sp.
Chamaenerion angustifolium (L.) Scop.
Cirsium hookerianum Nutt.
Dryas octopetala L.
Dryocallis pseudorupestris Rydb.
Erigeron sp.
Eriogonum depressum (Blankinship) Rydb.

Yarrow
 False Dandelion
 Wild Onion
 Pearly Everlasting
 Alpine Anemone
 Lyals Angelica
 Pussy Toes
 Grass Sandwort
 Broadleaf Arnica

Herbaceous Sage

Harebell
 Indian Paint Brush
 Fireweed
 White Thistle
 White Dryad

Silver Plant

TABLE 15 (Cont.)

Herbs or Weeds:

Eriogonum subalpinum Greene
Eriogonum umbellatum Torr.
Eritrichium Howardii (Gray) Rydb.
Cayophytum racemosum Torr. & Gray
Contiana calycosa Criseb.
Heuchera glabella Torr. & Gray
Hieracium Scouleri Hook.
Hypericum Scouleri Hook.
Minulus Lewisii Pursh.
Parnassia fimbriata Banks
Pedicularis contorta
Pedicularis groenlandica Retz.
Pentstemon ellipticus Coult. & Fish
Pentstemon sp.
Phacelia leucophylla Torr.
Phacelia sericea (Craham) Gray
Potentilla filipes Rydb.
Potentilla glaucophylla Lehm.
Sedum stenopetalum Pursh.
Senecio pseud aureus Rydb.
Senecio purshianus Nutt.
Senecio triangularis Hook.
Sieversia oiliata G.
Silene multicaulis Nutt.
Valeriana scouleri Rydb.
Veratrum viride Ait.
Veronica wormskjoldii Roem. & Schult
Xerophyllum tenax (Pursh.) Nutt.

Umbrella Plant
 Sulphur Plant

Blue Centian
 Alumroot
 Hawkweed
 Scouler's St. Johnswort
 Red Monkey Flower
 Fringed Parnassia
 Alpine Lousewort
 Elephanthead

White Phacelia
 Silky Phacelia
 Showy Cinquefoil
 Blueleaf Cinquefoil
 Yellow Stonecrop

Arrowhead Ragwort
 Old Mans Whiskers
 White Catchfly
 Scouler Valerian
 False Hellebore
 Alpine Speedwell
 Beargrass

Lichens, Mosses, and Ferns:

Lycopodium sp.
Polytricum sp.
Woodsia sp.

Club Moss
 Moss
 Rock Fern

TABLE 16.

FOOD HABITS OF MOUNTAIN GOATS IN WASHINGTON

Spring and Summer, 1959		
Common Name	Scientific Name	Per Cent in Goat Diet
	<i>Lothus velutinus</i>	40
	<i>Linum</i> sp.	10
	<i>Salix tremuloides</i>	10
	<i>Agropyron</i> sp.)	
	<i>Cirsium tectorum</i>)	10
	sp.)	
Pentstemon	<i>Pentstemon</i> sp.	5
Manzanita	<i>Arctostaphylos uva-ursi</i>	1
Waterleaf	<i>Hydrophyllum capitatum</i>	2
Raspberry	<i>Ribes</i> sp.	2
Arnica	<i>Arnica</i> sp.	2
Lupin	<i>Lupinus</i> sp.	2
False Box	<i>Pachystima myrsinites</i>	1
Willow	<i>Salix</i> sp.	1
Sedges	<i>Carex</i> sp.	2
Wind Flower	<i>Anemone multifida</i>	1
Maple	<i>Acer</i> sp.	1
Thimbleberry	<i>Rubus parviflorus</i>	1
Solomon's Seal	<i>Smilacina</i> sp.	inci.
Black Moss	<i>Unsea</i> sp.	inci.
Elderberry	<i>Sambucus glauca</i>	inci.
Red Twin Berry	<i>Lonicera utahensis</i>	inci.
Black Twin Berry	<i>Lonicera involucratum</i>	inci.
Spiraea	<i>Spiraea</i> sp.	inci.
Service Berry	<i>Amelanchier florida</i>	inci.
Clematis	<i>Clematis columbiana</i>	inci.
Black Cottonwood	<i>Populus trichocarpa</i>	inci.
Red-Osier	<i>Cornus stolonifera</i>	inci.
Wild Rose	<i>Rosa</i> sp.	inci.
Wild Cherry	<i>Prunus</i> sp.	inci.

Winter (1939-1940)

Bunch grass	<i>Agropyron</i> sp.	75
Eriogonum	<i>Eriogonum heracleoides</i>	5
Tall Oregon Grape	<i>Berberis aquifolium</i>	5
Pentstemon	<i>Pentstemon</i> sp.	5
Manzanita	<i>Arctostaphylos nevadensis</i>	3
Choke Cherry	<i>Prunus demissa</i>	2
Sage Brush	<i>Artemisia</i> sp.	1
Bitterbrush	<i>Purshia tridentata</i>	1

TABLE 16(Cont.)

Winter (1939-1940)		
Common Name	Scientific Name	Per Cent in Goat Diet
Elderberry	Sambucus glauca	1
Fir	Abies sp.	1
Maple	Acer sp.	1
Willow	Salix sp.	inci.
Snowberry	Symphoricarpos alba	inci.

* As taken from Anderson (1940).

RANGE SURVEY WRITE-UP SHEET

RECONNAISSANCE METHOD

Project

No. _____

Examiner _____

Date _____

Type _____

Location
(Twp. and range—erial photo No.)

Total density

Timber
(Composition) (Condition)

Forage density % Pal.

 (Reproduction) (Density) (Age)

F. A. Factor _____ **For** _____

For
(C&H or S&G) (Injury) (Cause)

Utilization cuts ----- Slope -----%. Timber -----%. Rocks -----%. Lack of
water -----%. Erosion -----%. Unstable soils -----%. Total cut -----

Net forage factor C. and H. Net forage factor S. and G.

PRINCIPAL FORAGE SPECIES

[illegible]

*Proper use factor.

10-17840

FIGURE 8

FORM FOR RECORDING BULLER FIELD DATA (Front side)

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Plant vigor (check one): Poor—fair—good.

Relative productiveness of site (check one): Low—average—high.

(Kind—lake, spring, tank, etc.) (Distance) (Adequacy) (Permanent—temporary)

(Kinds)	(Recommendations)
1. <u>General</u>	
2. <u>Specific</u>	
3. <u>Other</u>	

goats.

iong.

(Game, predators, rodents—species and abundance)

;

(Under "Gully" check two. Check one in other columns. Under "Texture" check "Stony" also if applicable.)

PARENT MATERIAL	CLASS	TOP SOIL DEPTH INCHES	TEXTURE	SLOPE %	EROSION			
					WIND	WATER		
						Sheet	Gully	
Granitic	Residual	0-6	Light	0-5	Class I	Class I	Occasional	
Lavas				6-10				Frequent
Sandstones				11-20				
Shales	Transported	14-24	Heavy	21-40	Class II	Class II	Shallow	
Limestones				41-60				Deep
Glacial deposits				Over 60			Class III	Class III

*Explanation of soil and erosion terms: Residual soils are found on the sites of the rock masses from which they were derived; transported soils have been moved to new sites by water, gravity, wind, etc. Texture—light to heavy soils are sand, medium soils are silt and clay, and heavy soils include the clay soils, loams, silty clays, and the clays. Degree of erosion.—Class 1—Definite recognizable soil loss; slight gullying; plant roots occasionally exposed. Class 2—Very evident sheet erosion; plant roots definitely exposed; erosion scars present; vegetation depleted; gullies rapidly forming. Class 3—Rapid land destruction; topsoil all removed or nearly so; conspicuous erosion scars; frequent and deep gullies. Gullies.—“Shallow” is less than two feet deep. Gullies are “occasional” when they are more than 100 feet apart.

Active or healing

Additional type comments _____

Figure 1. Schematic representation of the experimental design. The subjects were divided into two groups: the control group and the experimental group. The control group was divided into two subgroups: the control group and the control group. The experimental group was divided into two subgroups: the experimental group and the experimental group. The control group was divided into two subgroups: the control group and the control group. The experimental group was divided into two subgroups: the experimental group and the experimental group.

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◆

19

Age Group	Percentage (%)
18-24	18
25-34	15
35-44	12
45-54	10
55-64	8
65-74	6
75-84	4
85+	1

4

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[illegible]

NOTE.—The information contained on this sheet is primarily a forage inventory. When and if further data

are secured on timber, water, soils, erosion, wildlife, etc., by experts along these lines, such information should be further correlated to best serve range management.

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FIGURE 8 (Cont.)

FORM FOR RECORDING SURGER FIELD DATA (Back side)

AREA, DENSITY AND COMPOSITION OF THE VEGETATION ON THE RED BUTTE
MOUNTAIN GOAT SUMMIT RANGE (AUGUST 1-15, 1947)
(Derived by Per Cent Estimates Similar to Range Reconnaissance Method)

Type No.:	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Area (In Acres):	163	180	90	67	20	225	24	12	193	19	12	62	13	22
Density:	.25	.10	.25	.15	.30	T	.25	.20	.10	.20	.15	.10	.25	.15
Composition:														
Woods:														
Xerophyllum tenax	59	5	10	15				50	5			8	38	
Arnica latifolia	T	T	T	T	3	T	1	T						
Senecio triangul- laris	T		T	1	T	T			5	1	T			T
Erigeron sp.	T	T												
Astragalus sp.	1			T					T			5	5	18
Veratrum viride	T		T	T	T									
Chamaenerion angustifolium	T	T	T	T			T				T	T		T
Pedicularis groenlandica	T					T	2	1	2	3		2	1	
Erythronium sp.	T													
Antennaria rosea	T	T	T		10		3	T	T	1	6	T		T
Sedum stenopetalum	T	T		T		T		T	T	T	T	T		1
Castilleja sp.	T													
Achillea lanulosa		T	T	T		T	1	T	1	T		3	T	2
Phacelia sp.		T				T						T		4
Pentstemon ellipticus		T	T			T	1	T	1					
Heuchra glabella		T				T		T	T			T		
Eriogonum sp.		T				T	2	3	3			3	1	
Anaphallis margaritacea		T												
Arenaria formosa		T			T	T		T	3	2	10	3		5
Valeriana scouleri			T	T										
Gentiana calycosa					1		2			1				T
Veronica wormskjoldii					T		2	T		1				
Aster sp.					T	T		T				T	T	1
Potentilla sp.						T			T		T			3
Sieversia ciliata						T	T		T			1		
Cirsium hookerianum						T	T							
Ranunculus sp.						T								
Cogswellia sp.						T								
Agoseris villosa						T			T					
Hypericum Scouleri								T						
Hieracium Scouleri								T	T					

88

[illegible]

TABLE 18

WEIGHT CORRECTION FACTORS FOR FORAGE SPECIES
ON MOUNTAIN GOAT SUMMER RANGE

<u>Species</u>	<u>Correction Factor</u>	<u>Species</u>	<u>Correction Factor</u>
Achillea lanulosa	.4	Juncoides sp.	.3
Agropyron spicatum	.4	Juncus Parryi	1.0
Agoseris villosa	.2	Oryzopsis exim	.3
Agrostis hiemalis	.25	Pedicularis groenlandica	.5
Antennaria rosea	.15	Pentstemon ellipticus	6.0
Arenaria formosa	.3	Phyllodoce empetriformis	3.0
Arnica latifolia	.8	Poa alpina	.25
Aster sp.	.6	Potentilla sp.	.8
Astragalus sp.	1.5	Ribes sp.	6.0
Carex Oeyeri	1.0	Salix sp.	8.0
Chamenerion angustifolium	3.0	Sedum stenopetalum	.1
Dasiophora fruticosa	6.0	Senecio triangularis	1.2
Drymocallis pseudorupestris	.5	Sieversia ciliata	.3
Eriogonum sp.	.9	Silene multicaulis	.3
Festuca idahoensis	.15	Sitanion hystrix	.3
Gentiana calycosa	.4	Vaccinium membranaceum	6.0
Heuchera glabella	.3	Vaccinium scoparium	3.0
Hieracium Scouleri	.3	Veratrum viride	3.0
Hypericum Scouleri	.05	Veronica wormskoldii	.05
Koeleria cristata	.4	Xerophyllum tenax	8.0

TABLE 19

COMPOSITION OF THE VEGETATION AVAILABLE ABOVE THE SNOW DURING MIDWINTER
(1947-48) IN THE RED BUTTE AND RATTLESNAKE AREAS
(In Per Cent, by Weight)

Species	Red Butte	Rattlesnake					
	Dec.	Type 1 Dec.	Type 1 Jan.	Type 1 Feb.	Type 2 Jan.	Type 2 Feb.	Type 3 Jan. Feb.
Weeds:							
Xerophyllum tenax	6		1-	1			1-
Antennaria rosea		1					
Sedum stenopetalum		1-	1-				
Achillea lanulosa	1		1-		1		
Phacelia sp.		1-					
Pentstemon sp.			1-		1-	1-	1- 1-
Heuchera glabella	1		1-		1-	1-	
Eriogonum sp.	5		1-	1-	1-		1-
Potentilla sp.	5		1-	1-	1-		1-
Woodsia sp.		2		1-	1-		1-
Artemisia discolor		38	1-	1-	4		1
Erigeron sp.				1-			
Sub total for weeds:	18	6	2	1	5	1-	1- 1
Grasses and grasslike plants:							
Agropyron spicatum	6	6	4	3	24	6	1 1-
Festuca idahoensis			1-		1-		
Koeleria cristata	35		1	1	3	1-	1- 1-
Carex Geyeri	4						
Calamagrostis rubescens	6	1					
Bromus tectorum		2	1-	1-	1-		1
Bromus inermis		1-					
Stipa sp.					1-		
Poa sp.	3	3	1	1-	1-	1-	1-
Sub total for grasses and grasslike plants:	54	12	6	5	27	7	1 1
Shrubs:							
Vaccinium scoparium	2						
Salix sp.		3					1
Ribes sp.				1	7	25	3 1
Amelanchier alnifolia	14	36		36	11		3 26
Acer glabrum	12	18		12	3		7 35
Philadelphus Lewisii		13	12	20	20		3 6
Holodiscus dumosus		3		3	3		3 3
Berberis repens		1-					
Rosa sp.		1	1	1-	1		3
Ceanothus velutinus		2				40	1-
Prunus demissa			27	1	3	3	
Symphoricarpos albus			1	2	3		1- 1
Juniperus scopulorum			50	13	9		3 17
Physocarpus malvaceus			1	1	2		2
Sub total for shrubs:	28	82	82	94	68	67	44 98

Species	Red Butte Dec.	Rattlesnake					
		Type 1		Type 2		Type 3	
		Dec.	Jan. Feb.	Jan. Feb.	Jan. Feb.	Jan. Feb.	Jan. Feb.
Trees:							
Pseudotsuga taxifolia						53	
Pinus ponderosa					26	2	
Sub total for trees:					26	55	
Total	100	100	100 100	100 100	100 100	100 100	100 100

Table 20

USE MADE OF SPECIES AS INDICATED BY AVAILABLE FORAGE IN THE PRESENCE OF SNOW DURING MIDWINTER OF 1947-48
ON THE RED BUTTE AND RATTLESNAKE WINTER RANGES OF MOUNTAIN GOATS
(In Per Cent, of Number or Weight)

Species	Red Butte									Rattlesnake											
	December			December			Type 1 January			February			January			Type 2 February			Type 3 January		
	1/ 1/	2/ 2/	3/ 3/	1/ 1/	2/ 2/	3/ 3/	1/ 1/	2/ 2/	3/ 3/	1/ 1/	2/ 2/	3/ 3/	1/ 1/	2/ 2/	3/ 3/	1/ 1/	2/ 2/	3/ 3/	1/ 1/	2/ 2/	3/ 3/
Seeds:																					
<i>Xerophyllum tenax</i>	100	75	63				0	-	0	67	55	27							100	80	80
<i>Antennaria rosea</i>				0	-	0															
<i>Sedum stenopetalum</i>				0	-	0	0	-	0												
<i>Achillea lanulosa</i>	0	-	0				100	45	42				20	21	3						
<i>Phacelia</i> sp.				0	-	0															
<i>Pentstemon</i> sp.							100	50	50				0		0	57	60	52	0	-	0
<i>Heuchera glabella</i>	0	-	0				0	-	0						0	100	10	10			
<i>Eriogonum</i> sp.	10	40	3				0	-	0	0	-	0	0		0				0	-	0
<i>Potentilla</i> sp.	0	-	0				0	-	0	0	-	0	0		0				0	-	0
<i>Rhodola</i> sp.				67	30	20				67	20	13	0		0						
<i>Artemisia discolor</i>				100	62	48	100	13	13	100	36	41	45	11	8						
<i>Erigeron</i> sp.										100	20	20							100	36	36
Average for seeds:	13	66	22	50	48	29	27	38	11	69	43	31	26	11	6	63	35	48	25	80	80
Grasses and grasslike plants:																					
<i>Agropyron spicatum</i>	86	50	40	88	66	48	92	45	42	100	41	42	98	53	57	62	48	30	100	89	76
<i>Festuca idahoensis</i>							100	50	50				0	-	0						
<i>Koeleria cristata</i>	93	67	60				100	69	73	100	86	86	85	61	59	100	50	54	75	48	43
<i>Carex Geyeri</i>	80	65	56																		
<i>Calamagrostis rubescens</i>	100	90	91	100	75	75															
<i>Bromus tectorum</i>				20	20	4	0	-	0	0	-	0	0	-	0						
<i>Bromus inermis</i>				0	-	0															
<i>Stipa</i> sp.													0	-	0						
<i>Poa</i> sp.	60	50	40	80	55	47	86	37	24	100	80	80	75	70	60	0	-	0	38	60	30
Average for grasses and grasslike plants:	89	66	65	85	60	48	92	44	43	97	69	55	92	67	57	63	49	31	84	64	68

Table 20 (a)

Species	Red Butte						Ratlesnake																	
	December			December			Type 1 January			February			Type 2 January			February			Type 3 January			February		
	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/	1/	2/	3/
Shrubs:																								
Vaccinium scoparium	0	-	0																					
Salix sp.				100	16	16													0	-	0			
Ribes sp.										0	-	0	-	0	0	-	0	50	14	2	100	7	7	
Amelanchier alnifolia	25	32	9	25	23	9				67	30	13	67	65				53	33	8	100	33	9	
Acer glabrum	33	13	77	0	-	0				89	33	23	90	40				93	43	48	100	21	10	
Philadelphus Lewisii				11	17	3	8	13	1	0	-	0	-	0				15	36	6	50	12	3	
Hedysarum dumosum				0	-	0				0	-	0	-	0				0	-	0	0	-	0	
Berberis repens				0	-	0																		
Rosa sp.				0	-	0	50	40	27	0	-	0	322	10								0	-	0
Ceanothus velutinus				0	-	0										80	13	12	100	50	50			
Prunus demissa							67	4	4							100	4	4	10	40	14	100	67	67
Symphoricarpos albus							0	-	0	0	-	0	113	3				33	18	8	100	67	67	
Juniperus scopulorum							0	-	0	0	-	0	-	0				80	6	3	0	-	0	
Physocarpus malvaceus							0	-	0	0	-	0	-	0				80	42	34				
Average for shrubs:	18	25	8	14	20	29	19	21	14	32	32	8	148	15	58	9	7	48	37	12	74	29	6	
Trees:																								
Pseudotsuga taxifolia																			85	68	56			
Pinus ponderosa																50	16	9	100	87	88			
Average for trees:																50	16	9	87	71	57			
Total Average	58	64	41	37	50	10	55	41	41	66	57	10	6	54	26	62	44	7	52	47	37	67	32	10

1/ Number of plants grazed of each species, in per cent of total number.

2/ Average utilization of grazed plants only, in per cent by weight.

3/ Total use made of species, in per cent by weight.

SUMMARY OF UTILIZATION AND AVAILABLE FORAGE ON THE RED BUTTE
AND RATTLESNAKE MOUNTAIN GOAT WINTER RANGES
(In Per Cent of Weight)

Month	Type No.	Total Use of Type	Available forage			
			Weeds	Grasses	Shrubs	Trees
Red Butte						
December		41	19	53	28	
March		26	1	31	63	
Rattlesnake						
December	1	10	6	12	82	
January	1	4	1	6	93	
	2	26	5	27	63	
	3	37	1	1	44	54
	Ave.	31	1	5	54	40
February	1	10	1	5	94	
	2	10	1	7	67	25
	3	7	1	1	98	
	Ave.	11	1	5	86	8
April	1	6	1	12	87	
	2	1	1	2	97	
	Ave.	2	1	5	94	

COMPARISON BETWEEN USE MADE OF TYPES AND THE RELATIVE AMOUNT
OF GRASSES IN THE AVAILABLE FORAGE
(Red Butte and Rattlesnake Winter Ranges, 1947-48)

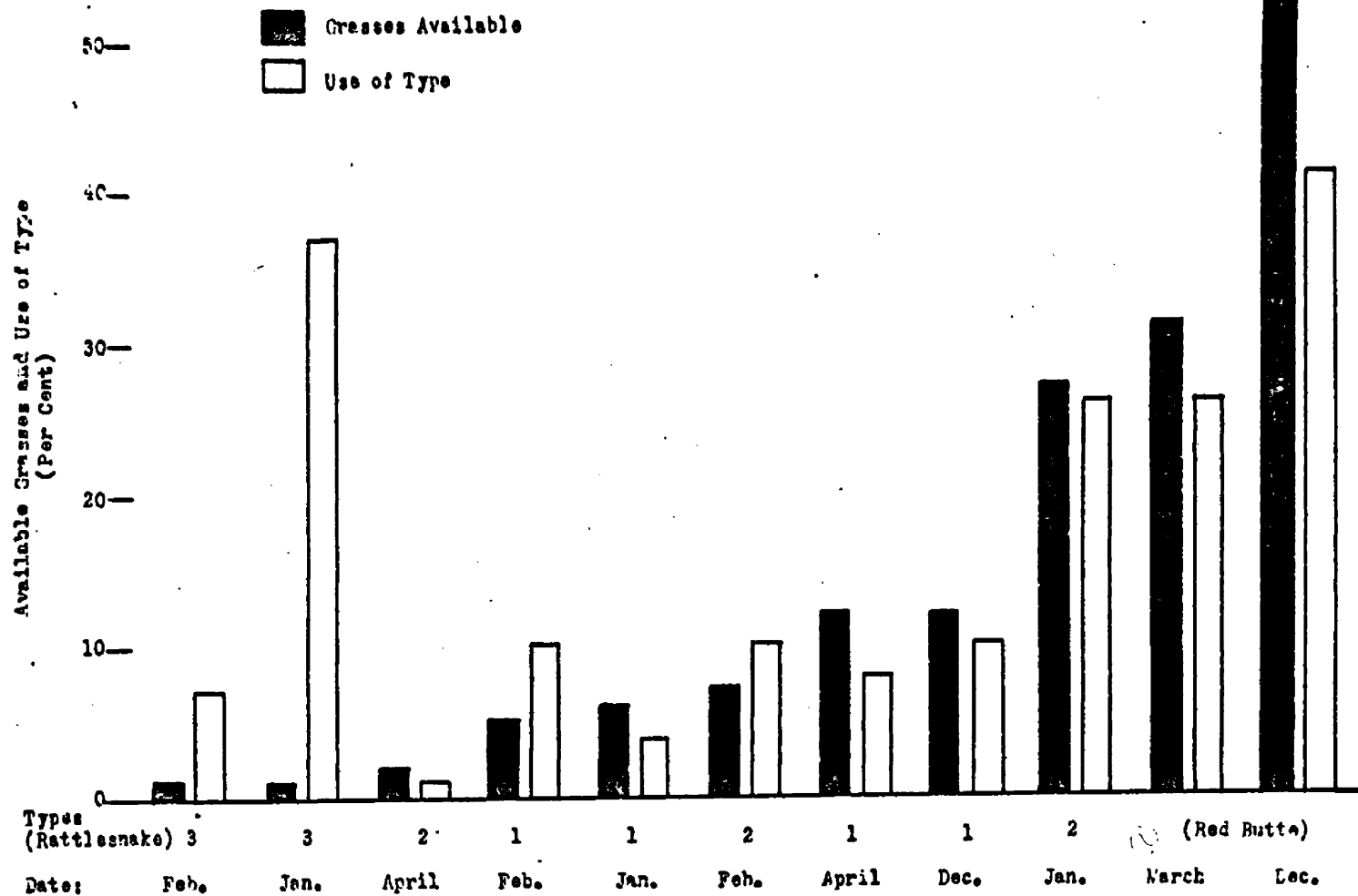


FIGURE 10

COMPARISON BETWEEN USE MADE OF TYPES AND THE RELATIVE AMOUNT
OF SHRUBS IN THE AVAILABLE FORAGE
(Red Butte and Rattlesnake Winter Ranges, 1947-48)

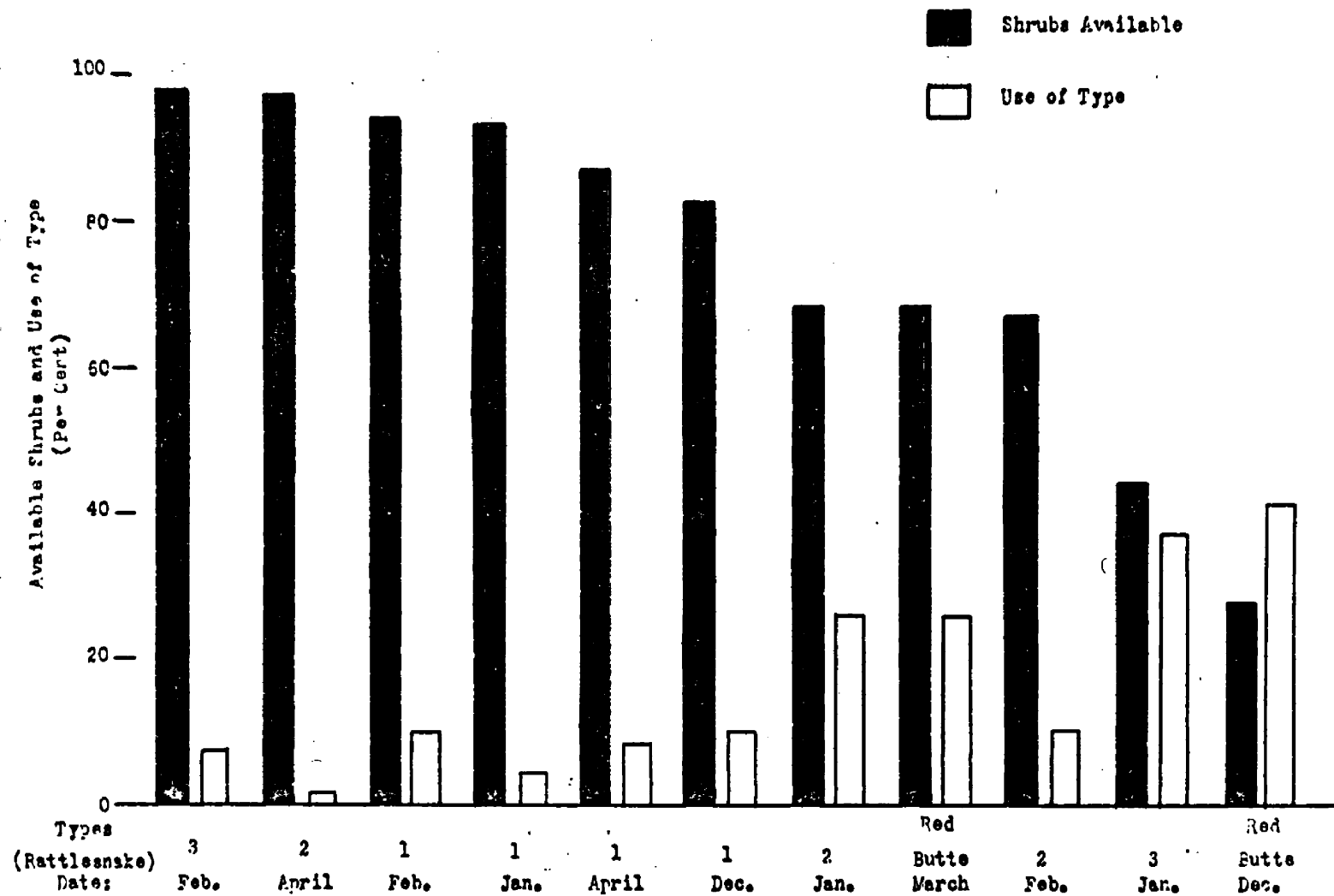


FIGURE 11

TABLE 22

FOODS OF MOUNTAIN GOATS IN THE RED BUTTE AND RATTLESNAKE
 AREAS DETERMINED BY THE FORAGE AVAILABLE ABOVE THE SNOW
 (In Per Cent, by Weight)

Species	Red Butte	Type 1		Rattlesnake		Type 2		Type 3	
	December	Dec.	Jan.	Feb.	Jan.	Feb.	Jan.	Feb.	
Weeds:									
Xerophyllum tenax	10		0	1				1-	
Antennaria rosea		0							
Sedum stenopetalum		0	0						
Achillea lanulosa	0		2		1-				
Phacelia sp.		0							
Pentstemon sp.			1-		0	2	0	1-	
Heuchera glabella	1-		0			1-			
Eriogonum sp.	0		0	0	0		0		
Potentilla sp.	0		0	0	0		0		
Woodsia sp.		4		1-	0			1-	
Artemisia discolor		12	1	2	1			2	
Erigeron sp.				1-					
Sub total for weeds:	10	16	4	3	1	2	1-	2	
Grasses and grasslike plants:									
Agropyron spicatum	5	36	45	13	53	20	2	1	
Festuca idahoensis			1-		0				
Koeleria cristata	57		15	12	6	2	1-	1-	
Carex Geyeri	6								
Calamagrostis rubescens	14	10							
Bromus tectorum		1-	0	0	0		0		
Bromus inermis		0							
Stipa sp.					0				
Poa sp.	3	14	5	1-	1	0	1-		
Sub total for grasses and grass- like plants:	85	60	65	25	60	22	2	1	
Shrubs:									
Vaccinium scoparium	0								
Salix sp.		5					0		
Ribes sp.				0	0	0	1-	1	
Amelanchier alnifolia	3	16		46	27		2	57	
Acer glabrum	2	0		26	12		9	24	
Philadelphus Lewisii		3	1		0		1	1	
Holodiscus dumosus		0		0	0		0	0	
Berberis repens		0							
Rosa sp.		0	6	0	1-			0	
Ceanothus velutinus		0				50	1-		
Prunus demissa			24			1-	1-	13	
Symphoricarpos albus			0	0	1-		1-	1	
Juniperus scopulorum			0	0	0		1-	0	
Physocarpus malvaceus			0	0	0		1		
Sub total for shrubs:	5	24	31	72	39	50	14	97	

Species	Red Butte December	Rattlesnake					
		Type 1		Type 2		Type 3	
		Dec.	Jan. Feb.	Jan. Feb.	Jan. Feb.	Jan. Feb.	
Trees:							
<i>Pseudotsuga taxifolia</i>						79	
<i>Pinus ponderosa</i>					26	5	
Sub total for trees:					26	84	
Total:	100	100	100 100	100 100	100 100	100 100	