



A two year investigation of the food habits and range use of the Rocky Mountain goat in the Crazy Mountains, Montana  
by Jack K Saunders

A THESIS Submitted to the Graduate Faculty in partial fulfillment of the requirements for the degree of Master of Science in Fish and Wildlife Management  
Montana State University  
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**Abstract:**

An investigation of the food habits and range use of an introduced Rocky Mountain goat herd was conducted in the Crazy Mountains, Montana, 1952-1953. A general description of the various vegetative types inhabited by goats is given. The time of day when feeding animals were observed and the seasonal utilization of feeding areas are discussed. Information concerning the age at which mountain goat kids begin grazing is included. Several methods of studying food habits are reviewed. The procedure used for stomach analysis is described. Observations of animal use of plants on summer feeding areas, and the analyses of 27 stomach samples collected throughout the year, are considered in the food habits evaluation.

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A TWO-YEAR INVESTIGATION OF THE FOOD HABITS AND RANGE USE  
OF THE ROCKY MOUNTAIN GOAT IN THE CRAZY MOUNTAINS, MONTANA

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Jack K. Saunders, Jr.

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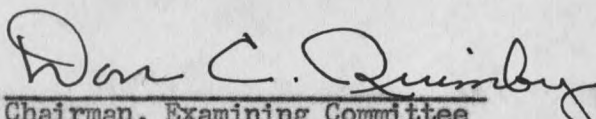
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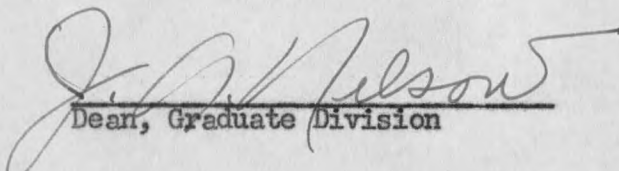
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TABLE OF CONTENTS

	Page
Abstract .....	3
Introduction .....	4
Methods .....	4
General Vegetative Types .....	7
Results .....	9
Feeding Periods .....	9
Use of Vegetative Types for Feeding .....	9
Food Habits .....	10
Summer .....	11
Fall .....	17
Winter .....	18
Spring .....	19
Summary .....	20
Literature Cited .....	21

ABSTRACT

An investigation of the food habits and range use of an introduced Rocky Mountain goat herd was conducted in the Crazy Mountains, Montana, 1952-1953. A general description of the various vegetative types inhabited by goats is given. The time of day when feeding animals were observed and the seasonal utilization of feeding areas are discussed. Information concerning the age at which mountain goat kids begin grazing is included. Several methods of studying food habits are reviewed. The procedure used for stomach analysis is described. Observations of animal use of plants on summer feeding areas, and the analyses of 27 stomach samples collected throughout the year, are considered in the food habits evaluation.

## INTRODUCTION

An investigation of a transplanted Rocky Mountain goat (Oreamnos americana missoulae) herd was conducted in the Crazy Mountains, Montana during 1952 and 1953. The history of the herd, biological data concerning the goats, and a general description of the area have been reported by Lentfer (In Press). The author worked in conjunction with Lentfer, but concentrated on the food habits and range use of the goat.

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## METHODS

During the spring, summer and fall of 1952 and 1953, plants of the vegetative types frequented by goats were collected. They were pressed, identified and mounted for use as reference specimens to be used in the verification of plants and parts of plants concerned in the food habits evaluation.

Seven 100-ft. line transects (two in alpine meadows, three on slide rock slopes, one on a ridge top, and one in the timber) were

used as an indication of the plants present. The author recognizes the limitations of the sampling, but believes the data warrants inclusion. A 100-ft. cord was stretched out on the vegetative type, and the basal intercept of each plant was measured, similar to the method described by Canfield (1941). Instances of animal use on these plants were also recorded.

A total of 149 days was spent in goat habitat: 24 in spring (June), 94 in summer (July and August), 21 in fall (September), and 10 in winter (December and March). Spring, summer and fall travel within the area was usually on horseback. When possible, close observations of goats were made on foot. Winter travel required the use of snowshoes. The animals were approached as closely as possible, sometimes a distance of 100 - 200 yards, but the majority of goats seen were at greater distances. One was observed at six feet. A total of 1262 goat observations was recorded, 795 of feeding goats. The following information was recorded for goats observed: time of day seen, vegetative type utilized, and when possible the plant species fed upon. Early in the study an attempt was made to evaluate the latter on the basis of "animal minutes" of feeding on individual plants, after the procedure of Cowan (1947) and Beuchner (1950). This method was abandoned. Observations were made with 7-power binoculars and a 20-power spotting scope. Even at distances of 10 - 100 yards, it was usually impossible to identify the individual plant species being utilized. A follow-up method as used by Brazda

(1953) on elk was adopted. The area where feeding occurred was closely examined. Plants utilized were recorded.

Twenty-seven stomach samples were obtained: three from intentionally collected animals, six from trap casualties, and 18 from hunter-killed goats. The monthly sequence was: 2 in June, 5 in July, 14 in September, 4 in October, and one each in December and March. The samples were preserved in 10% formalin as soon as possible after collection.

Stomach analyses were performed in the laboratory. Volumes of the samples were determined by water displacement, after the excess moisture was removed by squeezing on paper towels. The average volume of 19 samples was 218 cc. Each sample was washed on a four-mm. ( $3\frac{1}{2}$  mm. opening) mesh screen in a specimen pan. The material which passed through was collected on a one-mm. mesh (1 mm. opening) screen and retained as unidentifiable. The material on the four-mm. mesh screen was then emptied into the pan and flooded with water. Recognizable plant parts were removed with forceps and placed in dishes for comparison with reference specimens. With the use of a binocular microscope, identification to species was possible in most instances. Plant volumes were determined by water displacement in 10-cc. and 100-cc. graduated cylinders. This material was then air dried, and weights were determined to the nearest hundredth of a gram. The unidentifiable component from the four-mm. screen was combined with that from the one-mm. screen, and the volume and weight were determined. The

average percent of weights and volumes of the unidentifiable material was 65.4 and 70.9 respectively.

Smith (1952), studying the food habits of mule deer in Utah, used weight-estimate and ocular-estimate-by-plot methods supplemented by a modified volume-by-weight method. This was considered for the present study, but alpine vegetation, because of its low growth form, did not lend itself to this procedure.

Several exclosures were set up in feeding areas for comparison with similar unprotected plots (Beruldsen and Morgan, 1934), but this method was discontinued. It was thought that a comparison of the weights of clipped plants from each, following a seasonal feeding period, would reveal food preferences. The rocky nature of the feeding areas made it difficult to select plots of equal size relative to vegetative cover. A large number of plots would be required to reduce this error. Time required for such extensive construction of exclosures was not available.

#### GENERAL VEGETATIVE TYPES

The area below 9000 ft. is a timber type made up of a five-needle pine, limber pine (Pinus flexilis) or whitebark pine (Pinus albicaulis), and alpine fir (Abies lasiocarpa) interspersed with Douglas fir (Pseudotsuga taxifolia) and Engelmann spruce (Picea engelmanni). The vegetation of the forest floor is predominantly dwarf huckleberry (Vaccinium scoparium), elk sedge (Carex geyeri), and Ross sedge (Carex rossii).

Above timberline, there are grassy slide rock slopes and cliffs characterized by alpine bluegrass (Poa alpina), skyline bluegrass (Poa

epilis), timberline bluegrass (Poa rupicola), tufted hair grass (Deschampsia caespitosa), spreading wheat grass (Agropyron scribneri), and another wheatgrass (Agropyron latiglume). The most abundant dicotyledonous plants are field chickweed (Cerastium arvense), yellow stonecrop (Sedum stenopetalum), lupine (Lupinus monticola), cinquefoil (Potentilla sp.), and polemonium (Polemonium pulcherimum). Much of the vegetation is underlain with moss (Polytrichum sp.) and yellow dot saxafrage (Saxafraga bronchialis).

The ridge tops, commonly at 10,000 to 11,000 ft., are rocky. The vegetation is alpine. Predominant grasses are alpine bluegrass, timberline bluegrass, and spike trisetum (Trisetum spicatum). The sedges and rushes include Carex atrosquama, Carex scopulorum, and Luzula spicata. The important dicotyledonous plants are lupine, moss silene (Silene acaulis), Nuttall's sandwort (Arenaria nuttallii), cinquefoil, and field chickweed.

Small alpine meadows are present below semi-permanent snow drifts and on other moist areas. The rushes, Juncus parryi, Juncus regelii and Luzula spicata are the most abundant plants. Important sedges and grasses are Carex phaeocephala, Carex engelmannii, tufted hair grass, bent grass (Agrostis humilus), and alpine bluegrass. Dense, isolated stands of bluebells (Mertensia cilliata), goldenrod (Solidago multi-radiata), and butterweeds (Senecio crassulus and Senecio triangularis) are also present. White heather (Cassiope mertensiana), mountain heath (Phyllodoce empetrififormis), swamp laurel (Kalmia polifolia), and dwarf huckleberry are also abundant. This vegetative type is almost entirely

underlain by moss.

## RESULTS

### Feeding Periods

Records of feeding goats observed are given in Table I. The data indicate feeding throughout the day with peaks in early morning and evening. The number of observations during these periods was less than for the remainder of the day. No change was observed in this pattern during the spring, summer or fall. During the winter, 19 mountain goats were observed from the ground, all between 11:00 A. M. and 4:30 P. M. Twelve were feeding.

Table I. Number of Rocky Mountain goats observed, and number observed feeding during spring, summer and fall, 1952 - 1953.

Hours	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9
Animals Observed	6	10	12	47	127	146	32	149	161	68	151	125	134	56	8	11
Animals Feeding	6	9	11	17	62	57	16	50	105	60	113	111	98	49	8	11
Percent Feeding	100	90	92	36	49	39	50	34	65	88	75	89	73	88	100	100

### Use of Vegetative Types for Feeding

Timbered types received little use as feeding areas from June through September. Only 61 of 783 feeding mountain goats, observed during this period for the two years, were in this type. Spring utilization appeared to be by nannies during the parturition period. Summer and fall

use was usually by single animals or groups of less than five. These appeared to be adult males. Food habits discussed later suggest use in winter.

Grassy slide rock slopes were the major feeding areas during spring, summer and fall, as evidenced by 422 animals observed grazing in the type. Many of these slopes were found to be blown free of snow on the December and March trips into the area. Seven of the 12 feeding goats observed in winter were on this type. Several ranchers located on the west side of the Crazy Mountains reported seeing mountain goats feeding in winter, mostly on west slopes.

Ridge tops were next in importance. Records show 133 goats feeding in this type, June through September. This type is often snow-free in winter due to strong westerly winds, suggesting that it may be an important grazing area at that time.

Most alpine meadows are covered by snow drifts well into July. They become verdant as the snow recedes and remain lush until late fall. One hundred twenty-five animals were observed feeding here, principally in August and September.

Vegetation on cliffs is sparse, only 42 goats were observed grazing in this type.

#### Food Habits

Direct observations suggest that mountain goats are "snip-feeders", rarely grazing intently on any particular spot. Occasionally they graze off nearly all the flower stalks of mountain bluebell and butterweed

patches. A wide variety of forage plants was utilized, particularly during summer and fall (Table II). Examination of feeding areas and stomach analysis indicated that the following plant parts were utilized: foliage and seed heads of grasses, sedges and rushes; foliage stems and flowers of forbs; leaves and twigs of shrubs and trees; leaves of ferns; and the entire aerial part of mosses and lichens. Kids about one month old were observed grazing with adults as early as June 28. The stomach from a kid (trap casualty) collected July 10, 1953, contained fern, flower heads, seed heads from grasses, sedges, and rushes, and a few milk curds. This may indicate that young mountain goats choose tops of succulent plants on their first attempts at grazing. Captive kids were observed to feed in a similar manner.

#### Summer

Examination of feeding areas in summer indicated that 56% of the plants taken were grasses, sedges and rushes. Mule deer may have accounted for some of this use at lower elevations. The species used most frequently were tufted hair grass (Deschampsia caespitosa), sheep fescue (Festuca ovina), alpine bluegrass (Poa alpina), timberline bluegrass (Poa rupicola), sedge (Carex atrosquama), and rushes (Juncus parryi, Juncus regelii and Luzula spicata). All except one appeared in stomach samples (Table II). Grasses, sedges and rushes constituted 71.7% of the volume and 75.5% of the weight of the contents of five stomachs. Individual species of this group were commonly recognized in the stomach samples, but it was impractical to separate each for quantitative measure-

Table II. Average relative abundance of herbaceous plants in the four vegetative types as indicated by seven 100-ft. line transects and mountain goat usage of species as determined by examination of feeding areas and stomach analyses.

Plants	Tran- sects	Obs. Su. % Use	Stomach Analyses							
			Summer-5		Fall-18		Winter-2		Spring-2	
	Comp.	Freq.	% Vol.	% Wt.	% Vol.	% Wt.	% Vol.	% Wt.	% Vol.	% Wt.
Grasses, Sedges, Rushes	45.1	425	71.7	75.5	76.2	74.7	59.1	58.8	70.4	75.8
Graminae			x <sup>1</sup>						x	
<u>Agropyron latiglume</u>	2.2	13	x		x					
<u>Agropyron scribneri</u>	2.2	19	x		x					
<u>Agropyron spicatum</u>			x							
<u>Agropyron subsecundum</u>	0.6	6			x					
<u>Agrostis humilus</u>	0.1	2								
<u>Agrostis scabra</u>		15	x		x					
<u>Calamagrostis canadensis</u>					x					
<u>Danthonia intermedia</u>					x					
<u>Deschampsia atropurpurea</u>	tr	17			x					
<u>Deschampsia caespitosa</u>	4.7	27	x		x					
<u>Festuca idahoensis</u>					x					
<u>Festuca ovina</u>	4.0	27	x		x					
<u>Phleum alpinum</u>	0.2	1			x					
<u>Poa alpina</u>	4.3	47	x		x				x	
<u>Poa arctica</u>	0.7	4								
<u>Poa cusickii</u>			x		x					
<u>Poa epilis</u>	6.6	12	x							
<u>Poa fendleriana</u>		6								
<u>Poa pattersoni</u>			x		x					
<u>Poa rupicola</u>	2.0	40	x		x					
<u>Trisetum spicatum</u>	1.3	18			x					
<u>Trisetum wolfii</u>					x					
<u>Carex atosquama</u>	4.1	30								
<u>Carex engelmannii</u>	tr								x	
<u>Carex festivella</u>	0.2	5			x					
<u>Carex geyeri</u>		5							x	
<u>Carex hepburnii</u>		2								
<u>Carex pachystachya</u>	0.7	8								
<u>Carex phaeocephala</u>	1.0	6			x				x	
<u>Carex rossii</u>	0.4									
<u>Carex sp.</u>			x		x		x		x	
<u>Juncus parryi</u>	3.4	37	x		x					
<u>Juncus regelii</u>	1.9	31			x					
<u>Luzula parviflora</u>	0.4	10			x					
<u>Luzula spicata</u>	4.0	37	x		x		x			

<sup>1</sup> "x" denotes identification of the plant in the stomachs.



Table II, continued.

Plants	Tran- sects Su. % Comp.	Obs. Su. Use Freq.	Summer-5		Stomach Analyses					
			% Vol.	% Wt.	Fall-18 % Vol.	% Wt.	Winter-2 % Vol.	% Wt.	Spring-2 % Vol.	% Wt.
<u>Oxytropis sericea</u>	0.2						1.7	0.9		
<u>Pedicularis groenlandica</u>	tr	4								
<u>Penstemon attenuatis</u>					tr	tr				
<u>Penstemon procerus</u>					0.3	0.5				
<u>Phacelia serecia</u>		7								
<u>Polemonium pulcherimum</u>	1.7	17	tr	tr	1.2	1.1			tr	tr
<u>Polygonum bistortoides</u>	tr		2.5	2.5	tr	tr				
<u>Polygonum viviparum</u>			tr	tr	tr	tr				
<u>Potentilla sp.</u>	1.6				tr	tr	tr	tr		
<u>Potentilla diversifolia</u>	tr		5.2	4.1	tr	0.6				
<u>Potentilla glandulosa</u>					0.6	0.6				
<u>Potentilla multisecta</u>	0.4				0.1	0.3			10.4	3.3
<u>Potentilla nivea</u>	0.9				tr	tr				
<u>Saxafraga bronchialis</u>	1.4	3	tr	tr	0.1	0.2	tr	tr		
<u>Saxafraga montanensis</u>	0.3	4								
<u>Saxafraga punctata</u>			tr	tr	tr	tr				
<u>Sedum stenopetalum</u>	2.1	1			tr	tr				
<u>Senecio crassulus</u>	tr				3.0	2.6				
<u>Senecio fremontii</u>	tr									
<u>Senecio residifolius</u>	tr									
<u>Senecio saxosus</u>	0.4	4								
<u>Senecio triangularis</u>	tr	7			4.0	3.3				
<u>Silene acaulis</u>	4.4				tr	tr				
<u>Smilacina racemosa</u>	0.3	3								
<u>Solidago sp.</u>					0.2	0.2				
<u>Solidago multiradiata</u>	0.3	10			0.8	0.8				
<u>Syntheris dissecta</u>	0.3				tr	tr				
<u>Taraxacum laevigatum</u>									tr	tr
<u>Thalictrum dasycarpum</u>	0.9	10	tr	tr						
<u>Townsendia parryi</u>					tr	tr				
<u>Veronica wormskjoldii</u>	0.2	1			tr	tr				
Unidentified Forbs			2.7	2.0	1.0	1.1	tr	1.1	tr	tr
Shrubs	22.3	124	3.3	2.0	0.7	1.2	tr	tr	0.9	1.2
<u>Apocynum</u>										
<u>androsaemifolium</u>					tr	tr				
<u>Artemisia michauxiana</u>	tr	6	tr	tr	tr	tr	tr	tr		
<u>Cassiope mertensiana</u>	2.6	8	tr	tr	tr	tr				



ments. A complete list of plants concerned in the food habits evaluation is given in Table II.

Forbs made up 24% of the grazed plants observed on feeding areas. Lupine (Lupinus monticola), mountain bluebells (Mertensia cilliata), and polemonium (Polemonium pulcherimum) had been utilized most frequently. These plants, plus sweet vetch (Hedysarum sulphurescens), bistort (Polygonum bistortoides), and cinquefoil (Potentilla diversifolia) constituted the greatest volume or weight of forbs in stomachs. Forbs formed 17.2% of the volume and 13.9% of the weight of the material identified in summer stomachs.

Sixteen percent of the observed use was on shrubs. Dwarf huckleberry (Vaccinium scoparium), willow (Salix sp.), swamp currant (Ribes lacustre), mountain heath (Phyllodoce empetrififormis) and shrubby cinquefoil (Potentilla fruiticosa) were the principal plants recorded. All except Potentilla fruiticosa and Phyllodoce empetrififormis were present in stomachs. Vaccinium scoparium was the most important. Shrubs composed 3.3 and 2.0% of the volume and weight respectively.

Coniferous and deciduous trees made up less than 4% of the use detected on examination of feeding areas. Pine (Pinus flexilis or Pinus albicaulis) and juniper (Juniperus communis) received the most use. This class was relatively unimportant in the stomachs. Dry pine needles were present in the stomachs from all seasons. These may have been picked up incidental to other feeding.

Use of mosses, lichens and ferns was not recognized on feeding areas. They were all present in summer stomachs (vol. 3.2 and wt. 4.5%),

but fern (Woodsia scopulina) was the most important, chiefly because of the kid stomach mentioned previously.

#### Fall

The numbers of observations on feeding sites in fall, winter and spring were too few for consideration. Only stomach analyses are available for food habits evaluation. Grasses, sedges and rushes composed 76.2% of the volume and 74.7% of the weight of the contents of 18 stomachs. Most of the species identified in summer stomachs were present in stomachs of this season, and in addition several more were recognized, possibly because seed heads were more easily identified in fall.

Forbs increased from 17.2% of the volume and 13.9% of the weight in summer stomach contents to 19.9 and 21.5% in fall stomachs. Coincident with this increase in volume and weight was an increase in the number of species. These included the plants commonly found in summer stomachs. Species occurring in considerable amounts in fall stomachs only, were cow parsnip (Heracleum lanatum) and butterweeds (Senecio crassulus and Senecio triangularis).

Shrubs decreased in volume and weight from that found in summer (vol. 3.3 to 0.7%, wt. 2.0 to 1.2%). Species in fall stomachs were in general the same as those in summer stomachs. Percentages of Vaccinium scoparium decreased; Salix increased slightly; and the others remained about the same.

Coniferous trees, mosses and lichens changed little in importance from summer to fall. It is notable that Douglas fir (Pseudotsuga taxifolia) and/or alpine fir (Abies lasiocarpa), which was used most often

in winter, appeared first in a stomach collected about the middle of October. Mosses (Polytrichum sp.) and crustose lichens were present only as traces. The fern, (Woodsia scopulina), which was important in summer stomachs, was not found in stomachs from this season.

#### Winter

Grasses, sedges and rushes constituted 59.1% of the volume and 58.8% of the weight of two stomach contents, which is a decrease when compared with summer or fall. With two exceptions, plants were identifiable to family only.

Forbs represented 15.8% of the volume and 10.4% of the weight of the stomach contents. Only a few species were represented. Cushion eriogonum (Eriogonum ovalifolium), which made up the principal part of the volume or weight of this class, and white pointloco (Oxytropis sericea) were the only forbs occurring in significant amounts in the winter stomach samples.

Shrubs were an unimportant plant class. They were represented only by Michaux sage (Artemisia michauxiana).

Coniferous trees formed 24.6% of the volume and 30.4% of the weight of the samples. This class of plants was found most commonly during winter. Pseudotsuga taxifolia and/or Abies lasiocarpa (indistinguishable) made up most of this volume or weight. Juniperus communis, Juniperus scopulorum, and Pinus flexilis or Pinus albicaulis were present, but constituted only a small part of the samples.

Mosses, lichens and ferns were all present, but only as traces.

Spring

Grasses, sedges and rushes made up 70.4% of the volume and 75.8% of the weight of the two stomach samples. While this group increased in volume and weight, as compared to winter, the number of species identified remained low. Volumes and weights are similar to those for summer and fall.

Forbs made up 13.1% of the volume and 4.8% of the weight of the samples. The number of species recognized was greater than in the winter, but fewer than in summer or fall. Two plants, alumroot (Heuchra ovalifolia) and cinquefoil (Potentilla multisecta) made up most of the volume or weight. These two plants were more abundant in stomach samples for this season than any other.

Shrubs were present in relatively small amounts as in winter. Desert mountain penstemon (Penstemon fruiticosus), the most prominent, was identified only in spring stomachs.

Coniferous trees made up 12.7% of the volume and 17.9% of the weight of stomach contents. This class decreased in relative volume and weight from winter, but was still a major item. Pseudotsuga taxifolia and/or Abies lasiocarpa were the most outstanding of this group. As was noted in winter, pine (Pinus flexilis and/or Pinus albicaulis) was less important, but made up a higher percentage in this season than in any other. Some green pine needles were recognized as part of this component.

Mosses, lichens, and ferns were an insignificant part of these stomach samples, with crustose lichens the most important.

The data indicate that grasses, sedges, and rushes were taken more commonly than any other class of plants during all seasons. Forbs were next in importance in summer and fall, but third in winter and spring. Coniferous trees were second in winter and spring, but unimportant in summer and fall. Shrubs were third in summer and fall, and fourth in winter and spring. Mosses, lichens and ferns were minor items during all seasons. Casebeer, et al. (1950), working in the Continental Divide area, Montana, and Anderson (1940) in Washington, have stated that shrubs, grasses and forbs ranked in that order as mountain goat foods in summer. In winter, Casebeer found that grasses and shrubs were the major items. Anderson found grasses to be most important in winter. Swift (1940) in the Black Hills, South Dakota, observed use of aspen and birch in spring and summer, but lichens, grasses and other herbaceous material in fall. Harmon (1944), also in the Black Hills, South Dakota, found moss and lichen, bearberry, pine and miscellaneous vegetation as the forage used in winter.

#### SUMMARY

1. The food habits and range use of an introduced mountain goat herd in the Crazy Mountains, Montana were studied during 1952-1953.
2. Plants from the vegetative types inhabited by goats were collected for use as reference specimens to identify plants and parts of plants concerned in the food habits evaluation.
3. Seven 100-ft. line transects were used as an indication of the plants present in four vegetative types. Animal use of plants on these

transects was recorded.

4. A total of 149 days was spent in immediate goat habitat. A total of 795 goats was observed feeding throughout the day, with peaks suggested in morning and evening.

5. The order of importance of vegetative types as feeding areas was: grassy slide rock slopes, ridge tops, alpine meadows, timber and cliffs.

6. Twenty-seven stomach samples, representing all seasons, were collected and analysed. The procedure of analysis is described.

7. The results of this study indicate that grasses, sedges and rushes were taken more commonly than any other class of plants during all seasons. Forbs were next in importance in summer and fall, but third in winter and spring. Coniferous trees were second in winter and spring, but unimportant in summer and fall. Shrubs, mosses, lichens, and ferns were minor items throughout the year.

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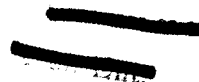
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