



A study of the Rocky Mountain goat in Montana
by Arnold James Foss

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
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Abstract:

A study of the Rocky Mountain goat (*Oreamnos americanus missoulae*) was conducted in the Crazy Mountains in southwestern Montana during the summers of 1960 and 1961. Field observations provided information on food habits, range use, reproduction and behavior. Area differences in kid/adult ratios as determined by an aerial census were discussed. Twenty-one live-trapped goats gave data on body weights and measurements. Information on hunting was obtained from hunter questionnaires and by contacting hunters. The results of the study were compared with those of a similar study in the same area.

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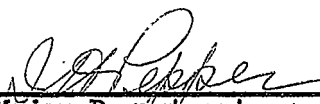
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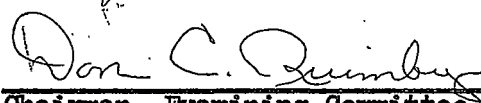
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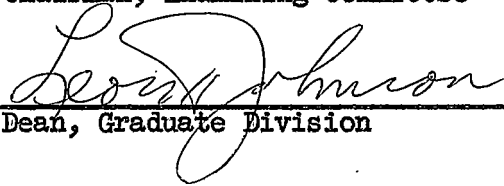
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ABSTRACT

A study of the Rocky Mountain goat (Oreamnos americanus missoulae) was conducted in the Crazy Mountains in southwestern Montana during the summers of 1960 and 1961. Field observations provided information on food habits, range use, reproduction and behavior. Area differences in kid/adult ratios as determined by an aerial census were discussed. Twenty-one live-trapped goats gave data on body weights and measurements. Information on hunting was obtained from hunter questionnaires and by contacting hunters. The results of the study were compared with those of a similar study in the same area.

INTRODUCTION

The Montana Fish and Game Department introduced 21 Rocky Mountain goats (Oreamnos americanus missoulae) into the lower Sweetgrass canyon of the Crazy Mountains in southwestern Montana during April of 1941 and of 1943. The age and sex classes were as follows: two mature females and one mature male; nine females and six males two years old or older; two yearling females and one yearling male. Surveys revealed a gradual increase in the population during subsequent years. A census during September of 1947 indicated a population of about 95 animals.

Lentfer (1955) studied the general ecology of the mountain goats in the Crazy Mountains during the summers of 1952 and 1953. This study indicated that the herd had increased to approximately 260 over a ten year period. Reproductive data suggested a thriving population with an annual increase of about one-third.

Aerial censuses in 1955 (Gaab, 1955), and in 1957 (Lentfer, 1957), disclosed that kid/adult ratios were lower than the ratios obtained during the 1952 and 1953 study (Lentfer, 1955). Lentfer (1957) considered the possibility that the population had started a leveling-off process.

The present study was carried out during the summers of 1960 and 1961 to investigate the status of the Crazy Mountain goat population and its range. Emphasis was placed on live-trapping and marking of animals for study, obtaining kid/adult ratios and procuring information on food habits.

STUDY AREA

The Crazy Mountains are situated in southwestern Montana, north and east of the town of Livingston. This isolated group of peaks comprise an area of approximately 350 square miles. The most rugged terrain is found in the southern portion of the area, with peaks exceeding an elevation of 11,000 feet. The northern portion is generally timbered and contains few sharp peaks.

Saunders (1955) described the general vegetative types of the study area. Four of these types, with some modifications, are included in the following descriptions which are also based in part on the vegetation analysis conducted by Peek (1962). Scientific and common names of plants follow Booth (1950) and Booth and Wright (1959).

Timber Type: This occurred below 9,000 feet. It was characterized by limber pine (Pinus flexilis), and/or whitebark pine (Pinus albicaulis), subalpine fir (Abies lasiocarpa) and engelmann spruce (Picea engelmanni), interspersed with douglas fir (Pseudotsuga menziessii). Dwarf huckleberry (Vaccinium scoparium), and elk sedge (Carex geyeri) were common in the understory.

Slide-rock Type: Slide-rock slopes extended upward from timberline to approximately 9,500 feet where they graded into extremely broken areas or cliffs. Major grass-like plants encountered were timberline bluegrass (Poa rupicola), wheatgrass (Agropyron latiglume), alpine bluegrass (Poa alpina), sheep fescue (Festuca ovina), spreading wheatgrass (Agropyron scribneri), and dunhead sedge (Carex phaeocephala). Lupine (Lupinus monticola), stonecrop (Sedum stenopetalum), milkvetch (Astragalus geyeri),

western bistort (Polygonum bistortoides), and cinquefoil (Potentilla multisecta) were abundant forbs.

Cliff Type: Cliffs occurred at various elevations, but were most common above 9,500 feet. Many of the plant species present on the slide-rock type were also found on some cliffs, but cliff vegetation was much more sparse. Predominant grasslike plants included timberline bluegrass, alpine bluegrass, spike trisetum (Trisetum spicatum) and sedges (Carex spp.). Lupine, fernleaf fleabane, field chickweed, mountain douglasia (Douglasia montana) and saxifrage (Saxifraga spp.) were also present. In areas along waterfalls arrowleaf groundsel (Senecio triangularis) and common monkey-flower (Mimulus guttatus) were common.

Alpine Meadow: Meadows occurred adjacent to mountain lakes and in areas where melting snow banks provided adequate moisture. Rushes (Juncus parryi, Juncus regelii, and Luzula wahlenbergia) were abundant. Tufted hairgrass (Deschampsia caespitosa), alpine bluegrass and sedge (Carex atosquama) were also present. Common forbs encountered were arrowleaf groundsel, mountain bluebells (Mertensia ciliata), common monkey-flower, and saxifrage (Saxifraga ascendens). In some areas mountain heath (Phyllodoce empetriiformis), white heather (Cassiope mertensiana), swamp laurel (Kalmia polifolia) and dwarf hubkleberry were abundant.

METHODS

Field work was carried out on a full time basis from June to September during both 1960 and 1961. Mountain goats were observed, with the aid of 7 X 35 binoculars and 20X spotting scope, and classified as kids or

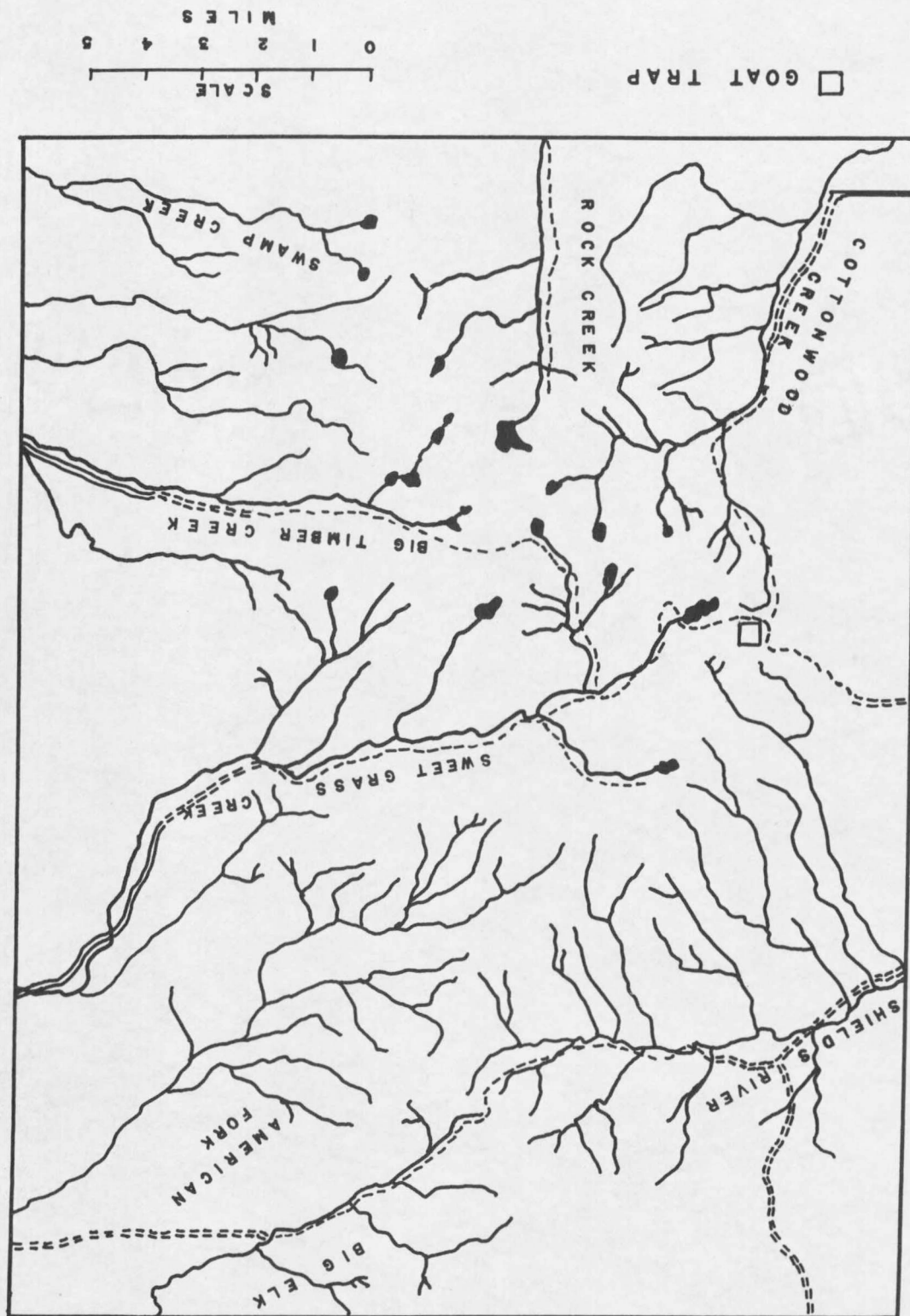
adults when possible. Other pertinent information such as activity, location of animals by drainage, use of vegetative types and exposure was recorded.

The Hindu Lake goat trap (Fig. 1) was operated 17 days during the summer of 1960 and 19 days during the summer of 1961. Twenty-three goats were trapped. Two escaped prior to handling, one died during trapping operations and 20 were marked and released for further study. All of the animals released from the trap were marked with ear tags and sheep branding paint. Adult goats were ear marked with anodized elk tags of various colors for individual identification. Kids were ear marked with small tags (Lentfer, 1955) and plastic ribbons similar to those used by Egan (1957) on mule deer and Rouse (1957) on elk. Large red numbers were painted on both sides of all goats trapped and released.

Sex, weight, standard measurements, horn development and condition of incisors were obtained for each animal trapped and for some animals killed by hunters. Reproductive tracts, lower jaws and rumen samples were collected from dead animals that became available from trapping or hunting.

Aerial observations were conducted at various times during the study. An aerial census during August of 1960 was not completed due to severe weather conditions. In July of 1961, an aerial census of the entire goat range was carried out. Censusing was accomplished by flying drainages at contour intervals. Distances between intervals varied from 100 to 500 feet depending on the terrain. All observations were made by the writer.

FIG. 1. MAP OF CRAZY MOUNTAINS



USE OF VEGETATIVE TYPES

Use of vegetative types was determined by ground and aerial observations. A total of 691 observations of goats was recorded (Table I).

Table I. Number of Mountain Goats observed in various vegetative types during the summers of 1960 and 1961.

	Timber		Slide-rock		Cliff		Alpine meadow		Total
	No.	%	No.	%	No.	%	No.	%	
June									
1960	2	7	26	86	2	7	--	--	30
1961	--	--	38	64	17	29	4	7	59
Total	2	2	64	72	19	21	4	7	89
July									
1960	--	--	77	81	12	13	6	6	95
1961	2	1	151	56	66	24	52	19	271
Total	2	1	228	62	78	21	58	16	366
August									
1960	--	--	6	75	2	25	--	--	8
1961	2	2	41	38	49	46	15	14	107
Total	2	2	47	41	51	44	15	13	115
September									
1960	18	23	19	25	21	27	19	25	77
1961	11	25	12	27	12	27	9	21	44
Total	29	24	31	26	33	27	28	23	121
1960	20	9	128	61	37	18	25	12	210
1961	15	3	242	50	144	30	80	17	481
Total	35	5	370	54	181	26	105	15	691

Relatively few goats were observed in the timber type from June through August. During September about one-fourth of the goats observed were in timber. Saunders (1955) reported timbered types received little use as feeding areas from June through September. A short flight over the study area during January of 1962 suggested that this type may be an

important use-area during periods of strong winds and blowing snow. An hour of flying over the study area revealed only five goats, all of the animals being in timbered areas.

Slide-rock slopes were major use-areas from June through September, but there was a gradual decrease in use as the season progressed. Comparison of data of the two years suggests that slide-rock areas were more heavily utilized, June through August, during the 1960 season as compared to 1961. This difference may be related to climatic factors. Weather records from Martinsdale and Melville, Montana (Table II) indicate that precipitation was greater during 1960. These data do not necessarily afford

Table II. Precipitation in inches for Martinsdale and Melville, Montana (USDC, Climatological Data, Montana. Annual Summaries, 1960 and 1961).

	Martinsdale ^{1/}		Melville ^{2/}	
	1960	1961	1960	1961
June	1.57	.72	1.99	.59
July	.36	1.68	.40	1.68
August	<u>2.28</u>	<u>.51</u>	<u>1.94</u>	<u>.72</u>
Three month total	4.21	2.91	4.33	2.99

^{1/} Elevation 5,390 feet

^{2/} Elevation 5,602 feet

a reliable comparison with conditions that existed in the study area due to differences in elevation, topography and other related factors, but the trend exhibited is apparently valid. Field observations revealed that precipitation differences between years for the study area were more pronounced than the data from weather records suggest.

Total use of cliffs, June through September, exceeded use of all types except slide-rock slopes. The peak period of use on this type occurred during August. Use by years shows an opposite trend as compared to use of slide-rock slopes, with greater use for the dryer summer of 1961 than during the wetter summer of 1960.

Alpine meadows were used less than either slide-rock slopes or cliffs. They were most heavily utilized during September. The time of snow melt influenced the use period. Snow banks receded at an earlier date in 1961 than in 1960 and earlier use of alpine meadows was observed for 1961.

Data for September indicate that goats were relatively well distributed over the various vegetative types. Comparison of data of the two years suggests a very similar pattern. During this period goats commonly fed on meadows and slide-rock areas then moved to cliffs or timber to bed-down.

FOOD HABITS

Food habits were determined by rumen analyses and feeding site examinations as described by Saunders (1955), Cole (1956), Wilkins (1957) and others.

One rumen sample was collected in August of 1960, three were collected in September of 1960, and one in September of 1961. Analyses were performed in the laboratory. Samples were washed with water on a 1/8-inch mesh screen. Recognizable portions of plants retained on the screen were separated. Identification of plant portions was accomplished by comparison with a reference plant collection. Volumes were determined by water

displacement after excess moisture was removed with paper towels. Samples were consolidated for seasons and the percentages that any one plant item constituted was computed by the aggregate volume method (Martin, et al., 1946).

Feeding observations involved examining an area where goats were observed feeding and recording instances of plant use. On occasion deer fed in areas frequented by goats, hence only recent plant use in areas where goats were observed feeding was recorded. All feeding observations were obtained during the 1961 season.

Summer (June, July, August): Feeding observations revealed that 49 per cent of the plants taken were grasses, sedges and rushes (Table III). The species most commonly utilized were tufted hairgrass, rushes (Juncus parryi and Juncus regelii), alpine bluegrass, and sedge (Carex atrosquama). Grass-like plants made up 46 per cent of the volume of the one rumen sample. Some of the species listed above were recognized in the rumen, but separation of the individual plants was not practical.

Forty-eight per cent of the plants utilized in the summer feeding areas were forbs. Species most commonly taken were common monkey-flower, mountain bluebells, arrowleaf groundsel, woodlandstar (Lithophragma spp.) and arnica (Arnica cordifolia). Forbs made up 52 per cent of the volume of the rumen sample. The most abundant forb that could be identified in the rumen sample was erigonum (Eriogonum spp.). This rumen sample was taken from a trap casualty. The animal was alive but did not feed for a minimum of 12 hours prior to collection. With the exception of erigonum, plant items had broken down to where species identification was impossible.

Table III. Mountain Goat food habits as determined by analysis of 5 rumen samples and 3548 instances of plant use (T = Trace - less than 0.5 per cent).

Plants	Summer				Fall			
	Instances of use		Rumen (1) sample		Instances of use		Rumen (4) samples	
	No.	%	Vol.	%	No.	%	Vol.	%
<u>Agropyron latiglume</u>	44	1	--		16	9	--	
<u>Agropyron scribneri</u>	10	T	--		--	-	--	
<u>Agrostis spp.</u>	52	2	--		--	-	--	
<u>Bromus marginatus</u>	2	T	--		--	-	--	
<u>Danthonia intermedia</u>	2	T	--		--	-	--	
<u>Deschampsia caespitosa</u>	413	13	--		4	2	--	
<u>Elymus spp.</u>	5	T	--		--	-	--	
<u>Festuca idahoensis</u>	--	-	--		114	61	--	
<u>Festuca ovina</u>	20	1	--		--	-	--	
<u>Phleum alpinum</u>	80	2	--		8	4	--	
<u>Poa alpina</u>	237	7	--		3	2	--	
<u>Poa arctica</u>	5	T	--		--	-	--	
<u>Poa cusickii</u>	1	T	--		--	-	--	
<u>Poa rupicola</u>	31	1	--		--	-	--	
<u>Trisetum spicatum</u>	12	T	--		--	-	--	
<u>Carex atrosquama</u>	179	5	--		--	-	--	
<u>Carex phaeocephala</u>	3	T	--		--	-	--	
<u>Carex spp.</u>	4	T	--		--	-	--	
<u>Juncus parryi</u>	231	7	--		4	2	1	
<u>Juncus regelii</u>	294	9	--		--	-	--	
<u>Luzula spicata</u>	2	T	--		--	-	--	
<u>Luzula wahlenbergii</u>	27	1	--		--	-	T	
Grass-like plants	--	-	46		--	-	89	
Total grass-like plants	1654	49	46		149	81	90	
<u>Achillea lanulosa</u>	2	T	--		--	-	--	
<u>Agoseris glauca</u>	13	T	--		--	-	--	
<u>Antennaria spp.</u>	2	T	--		--	-	--	
<u>Arnica cordifolia</u>	90	3	--		--	-	--	
<u>Aster divergens</u>	--	-	--		3	2	--	
<u>Aster foliaceus</u>	3	T	--		17	9	--	
<u>Astragalus geyeri</u>	37	1	--		--	-	--	
<u>Castilleja nivea</u>	3	T	--		--	-	--	
<u>Castilleja rhexifolia</u>	44	1	--		--	-	--	
<u>Cerastium arvense</u>	13	T	--		7	4	--	
<u>Compositae</u>	1	T	--		--	-	3	
<u>Epilobium alpinum</u>	18	1	--		--	-	T	

Continued on next page

Table III, continued.

Plants	Summer			Fall		
	Instances of use		Rumen (1)	Instances of use		Rumen (4)
	No.	%	sample Vol. %	No.	%	samples Vol. %
<u>Epilobium angustifolium</u>	33	1	--	--	-	--
<u>Erigeron spp.</u>	2	T	--	--	-	--
<u>Eriogonum spp.</u>	--	-	11	--	-	--
<u>Frasera speciosa</u>	13	T	--	--	-	--
<u>Heracleum lanatum</u>	51	2	--	--	-	--
<u>Liliaceae</u>	65	2	--	--	-	--
<u>Lithophragma spp.</u>	108	3	--	--	-	--
<u>Lupinus monticola</u>	11	T	--	7	4	1
<u>Mimulus guttatus</u>	415	13	--	--	-	--
<u>Mertensia ciliata</u>	312	10	--	--	-	--
<u>Oxyria digyna</u>	5	T	--	--	-	--
<u>Oxytropis sericea</u>	53	2	--	--	-	--
<u>Pedicularis groenlandica</u>	51	2	--	--	-	--
<u>Pentstemon spp.</u>	--	-	--	--	-	1
<u>Phacelia sericea</u>	1	T	--	--	-	T
<u>Polemonium pulcherrimum</u>	7	T	--	--	-	--
<u>Polemonium spp.</u>	1	T	--	--	-	T
<u>Polygonum bistortoides</u>	37	1	--	--	-	1
<u>Potentilla multisecta</u>	38	1	--	--	-	--
<u>Ranunculus eschscholtzii</u>	2	T	--	--	-	--
<u>Saxifraga cerna</u>	5	T	--	--	-	--
<u>Saxifraga spp.</u>	--	-	--	--	-	T
<u>Senecio triangularis</u>	163	5	--	--	-	--
<u>Syntheris dissecta</u>	--	-	--	--	-	T
<u>Taraxacum spp.</u>	1	T	--	--	-	--
<u>Veratrum spp.</u>	8	T	--	--	-	--
<u>Valeriana edulis</u>	2	T	--	--	-	--
Unidentified forbs	--	-	41	--	-	4
Total forbs	1610	48	52	35	19	10
<u>Kalmia polifolia</u>	42	1	--	--	-	--
<u>Pinus spp.</u>	--	-	2	--	-	T
<u>Vaccinium scoparium</u>	55	2	--	1	T	T
Total browse	97	3	2	1	T	T
<u>Polytrichum spp.</u>	2	T	--	--	-	T
Total moss	2	T	--	--	-	T

Browse species were minor food items during the summer as indicated by feeding observations and the rumen sample, making up 3 per cent of the use and 2 per cent of the rumen contents respectively. Dwarf huckleberry and swamp laurel were the only shrubs showing use on feeding areas. Dry pine needles were present in the rumen sample.

Use of moss was recognized during one feeding observation, but was not observed in the summer rumen sample.

Fall (September): A limited number of feeding observations indicated that grass-like plants made up 81 per cent of the fall use. Species receiving the heaviest use were bluebunch fescue (Festuca idahoensis), wheatgrass (Agropyron latiglume) and alpine timothy (Phleum alpinum). The locality of observations likely influenced the change in grass species from summer to fall. Grass-like plants composed 90 per cent of the volume of four fall rumen samples.

Use of forbs decreased during the fall, making up 19 per cent of the plant use. Leafybract aster (Aster foliaceus), field chickweed and lupine were the major forbs utilized. Ten per cent of the volume of four rumen samples was composed of forbs.

Browse was recorded in trace amounts on feeding areas during the fall. Dry pine needles were present in all of the September rumen samples. Moss was present as a trace in one of the fall rumen samples.

Discussion: The 1952 and 1953 study by Saunders (1955) in this same area suggested that use of grass-like plants in summer was slightly greater than in the present study (Table IV). Tufted hair grass, alpine bluegrass,

Table IV. A comparison of the food habits of Mountain Goats in the Crazy Mountains during two different study periods.

Period	Summer Feeding Observations			Fall Rumen Analysis		
	Grass-like plants	Forbs	Browse	Grass-like plants	Forbs	Browse
1952-53 ^{1/}	56%	24%	19%	76%	20%	1%
1960-61	49%	48%	3%	90%	10%	T

^{1/} After Saunders (1955)

sedge (Carex atosquama) and rushes (Juncus parryi and Juncus regelii) were commonly used during both study periods. The use of forbs in summer was much greater during the present study. Lupine, mountain bluebells and polemonium were important forbs in the earlier study. Common monkey-flower, mountain bluebells and arrowleaf groundsel were major forbs during the present study. Use of browse in summer was greater during 1952 and 1953 than during 1960 and 1961. Dwarf huckleberry was the most important browse plant during both study periods.

The principal difference in fall food habits revealed by the two studies was the greater use of grass-like plants in the later study. Comparison by species was not practical because of the rumen analyses technique used in both studies. The use of forbs in fall during 1952-53 was greater than during 1960-61. During the earlier study cow parsnip (Heracleum lanatum) and arrowleaf groundsel occurred most commonly in rumen samples. Composites were most important during the later period. Browse species were of minor importance in fall stomachs during both study periods.

Casebeer, et al. (1950), working in the Continental Divide area, Montana, reported that shrubs were of primary importance in the summer

diet of the mountain goat. Forbs were second followed by grasses. Anderson (1940) reported similar findings in Washington. Brandborg (1955, citing Cowan, 1944) indicated that the summer diet of mountain goats from Jasper and Banff National Parks in Canada consisted of 63 per cent grasses and sedges, 23 per cent browse and 14 per cent forbs. Klein (1953), working in Alaska, stated that grasses and sedges composed the greater part of the diet. Swift (1940) and Hanson (1950) considered aspen and birch as major food items during the summer in the Black Hills of South Dakota. They reported a shift to lichens, grasses and other herbaceous plants in the fall.

REPRODUCTION

Kid/Adult Ratios: Kid/adult ratios were obtained from ground and aerial observations. Animals classified as probable yearlings in the field were grouped with adults for tabulation (Table V).

Table V. Mountain Goats observed and classified from the ground and air during the summers of 1960 and 1961.

	Total	Adults	Kids	Kid/Adult Ratio
1960	151	125	26	.21
1961	327	260	67	.26
1961 ^{1/}	165	133	32	.24
Total	643	518	125	.24

^{1/} Aerial census

These data indicate a kid/adult ratio of 24 per cent. Lentfer (1955) reported a ratio of 35 per cent for the summers of 1952 and 1953 in the

same area. Aerial censuses in 1955 (Gaab, 1955), and in 1957 (Lentfer, 1957), revealed kid/adult ratios of 28 and 30 per cent respectively. Lentfer (1957) suggested the possibility of a leveling-off process occurring in the population of the Crazy Mountains. Data of the present study suggest a continuing decline in productivity. Hanson (1950) stated that goat introductions into parts of Washington and South Dakota brought about local upward trends over a 10 to 15 year period followed by a stabilized population. Brandborg (1955), using male-female ratios of 87:100 and 72:100, considered young/female ratios of between 50:100 and 70:100 as fairly typical of production during average years on most ranges. Klein (1953) presented kid/adult ratios of 10 to 22 per cent for Alaskan mountain goats. Hanson (1950) reported kid/adult ratios of 25 per cent for the Black Hills, South Dakota.

Five instances of twinning were observed during the present study. The five sets of twins constituted 8 per cent of the total kids observed. Lentfer (1955) reported a twinning incidence of 30 per cent during 1952 and 1953. He also observed three sets of triplets. Brandborg (1955) reported a twinning rate of 23 per cent for the Salmon River area in Idaho. Klein (1953) stated, "there is no evidence of twins occurring in Alaska." Casebeer, et al. (1950) gave one probable case of twinning in 88 individual kids observed in the Continental Divide area in Montana. Hanson (1950) considered twins rare, with one young usually born to an adult female in the Black Hills area of South Dakota.

The results of an aerial census of the entire Crazy Mountain range in July of 1961 suggested considerable differences in kid/adult ratios between

areas (Table VI). The study area was divided into three segments as

Table VI. Kid/adult ratios as determined by an aerial census in July, 1961.

	Total	Adults	Kids	Kid/adult ratio
Northern	7	6	1	.17
Sweetgrass	78	55	23	.42
Southern	80	72	8	.11
Total	165	133	32	.24

follows: Northern; including the American Fork, Big Elk, Blackaby and Shields drainages; Sweetgrass; including Sweetgrass Creek and its tributaries; Southern; including Big Timber, Cottonwood, Rock and Swamp Creek drainages (Fig. 1). Ground observations for these same areas reflected a similar trend in kid/adult ratios, but observational times spent in the respective areas were not equal. The information obtained from the one complete aerial census is thought to have given more directly comparable results. About three-fourths of the goats observed during the census were between elevations of 8,500 and 9,500 feet. Seventy per cent of the kids were at or below 9,000 feet. Extreme elevations at which goats were observed were 8,000 and 10,000 feet.

Information from hunter questionnaires indicated that 40 per cent of the hunter harvest, 1958 through 1961, was taken from the Sweetgrass area as compared to 30 per cent from each of the other areas. Data of the aerial census showed that the total number of animals for the Sweetgrass and Southern areas was about the same. Perhaps the heavier hunter harvest for the more accessible Sweetgrass area is responsible for the higher kid/

adult ratio for that area as compared to the Southern area. Increased productivity following heavy harvests by hunters has been reported for various big game species (Cheatum and Severinghaus, 1950; Gunvalson, 1952; Martin and Krefting, 1953; Pimlott, 1959 and others).

Some of the difference in kid/adult ratios for Sweetgrass as compared to the Southern area may be due to differences in adult sex ratios. Group size varied between the Sweetgrass and Southern area. Seventy per cent of the goats in the Southern area were in groups of five or less as compared to 42 per cent in the Sweetgrass area. Singles constituted 26 per cent of the total in the Southern area and 9 per cent in Sweetgrass. It was thought that many of the lone goats were males. If this assumption was correct, a higher proportion of males in the Southern area would be reflected in lower kid/adult ratios. Possibly males seek the rougher terrain encountered in the Southern area, however, some females with kids were observed in the most rugged terrain of the Crazy Mountains.

The Northern area is more heavily timbered and characterized by less rugged terrain than either of the other areas. The small number of goats observed here during the aerial census does not justify comparison with the other areas.

Reproductive Tracts: Testes from two animals four years old or older and from two three-year-olds were collected between September 18 and 20, 1960. The average weights per testes pair for the four-year-olds was 106.5 and 133.0 grams; for the three-year-olds 54.1 and 60.2 grams.

The ovaries of a 27-month-old female collected September 18, 1961 showed no evidence of corpora lutea, but contained two developing follicles

each of which measured about 7 mm. in greatest diameter.

PHYSICAL CHARACTERISTICS

Body Weights and Measurements: Body weights and measurements were obtained from eight kids and 16 goats older than kids (Tables VII and VIII). The weights and measurements for kids during the present study are

Table VII. Extreme weights (pounds) and measurements (inches) of Rocky Mountain Goat Kids from the Crazy Mountains, Montana.

Month	No.	Whole weight	Total length	Tail	Hind foot	Ear	Height at shoulder
July	5	17-26	31.0-35.0	2.0-3.1	8.5-8.7	2.5-3.5	20.3-20.8
August	3	21-33	32.7-36.0	3.0-3.3	8.5-9.5	3.0-3.5	21.3-24.0

similar to data obtained by Lentfer (1955). A pair of twin kids trapped during July of 1961 exhibited an eight pound difference in weight, the range being 17 and 25 pounds.

Data for goats older than kids suggest a size decrease when compared to weights and measurements of those from the same area in 1952 and 1953 (Lentfer, 1955). All of the extreme and mean body weights for similar age classes obtained during the present study were less than those reported during the previous study. The decreases in weight of various age classes varied from 13 to 27 per cent of total body weight. The difference was most pronounced in the older age classes. Body measurements reflected a similar trend.

The animal that died during trapping operations provided whole and hog-dressed (viscera removed) weights. The per cent of weight dressed off

Table VIII. Mean and extreme weights (pounds) and measurements (inches) of Rocky Mountain Goats from the Crazy Mountains, Montana.

Estimated age class	Sex	No.	Whole weight	Total length	Tail	Hind foot	Ear	Height at shoulder
13-14 mo.	F	1	58	41.5	3.4	10.3	3.0	27.5
13-14 mo.	M	2	58-72 (65)	43.7-47.5 (45.6)	4.0-4.4 (4.2)	11.0-11.1 (11.0)	4.0-4.0 (4.0)	28.5-28.7 (28.6)
25-26 mo.	F	2	76-87 (82)	46.1-47.5 (46.8)	3.7-4.7 (4.4)	10.7-10.8 (10.7)	3.6-4.4 (4.0)	31.0-31.3 (31.1)
38-39 mo.	F	1	94	47.8	5.3	11.8	4.0	32.5
38-39 mo.	M	1	87 ^{1/}	51.5	---	11.8	3.7	28.5
Over 48 mo.	F	6	103-123 (114.8)	52.0-57.3 (54.0)	4.0-5.1 (5.1)	11.2-12.6 (12.1)	3.5-4.4 (4.3)	32.0-35.5 (33.7)
Over 48 mo.	M	3	145 ^{2/}	58.0-62.1 (60.6)	4.3-4.5 (4.4)	12.6-13.0 (12.8)	4.1-4.6 (4.4)	34.0-42.4 (38.9)

^{1/} Hog-dressed weight

^{2/} Weight obtained for one animal

was 35. Lentfer (1955) reported an average of 31.6 per cent for seven animals.

Horn Development: Horn measurements were obtained from 16 goats older than kids (Table IX). Comparison of data with similar measurements

Table IX. Mean and extreme horn measurements (inches) of Rocky Mountain Goats.

Estimated age class	Sex	Sample size	Outside curve	Circumference at base
13-14 mo.	F	1	4.5	2.9
13-14 mo.	M	2	5.7(5.0-6.4)	3.9(3.9-3.9)
25-26 mo.	F	2	7.0(6.9-7.1)	3.5(3.5-3.5)
38-39 mo.	F	1	8.9	3.9
38-39 mo.	M	1	7.9	4.8
over 48 mo.	F	6	8.5(7.5-9.0)	4.0(3.7-4.0)
over 48 mo.	M	3	8.4(8.1-9.0)	4.9(4.6-5.1)

taken by Lentfer (1955) from the same area reveal a decrease in mean horn size of goats since the time of his study. All but one mean measurement for 1960 and 1961 was less than those reported in 1952 and 1953 for comparable age classes. Circumference at base measurements for males exceeded those for females for the same age classes in all cases.

BEHAVIOR

Group sizes: Data for two summers suggest a similar trend for average group size (Table X). The largest numbers of animals in one group, 28 and 25, were observed during July of 1960 and of 1961. Lone goats were observed more frequently than other groups during all months of the study.

Table X. Mean and extreme group sizes of Mountain Goats in the Crazy Mountains during the summers of 1960 and 1961.

Year	June	July	August	September
1960	2.0(1-6)	4.8(1-28)	2.0(1-3)	2.1(1-4)
1961	1.9(1-3)	4.2(1-25)	2.1(1-7)	2.0(1-7)

Movements: Twenty goats were marked at the Hindu Lake Trap and released for study. Six that were observed in the field after release provided 9 sight records (Table XI). Two marked animals killed by hunters

Table XI. Relocations of Mountain Goats marked and released at the Hindu Lake trap.

Goat no.	Sex	Age	Date trapped	Area of relocation	Date	Distance from trap site (Airline miles)
2	F	4+	7/31/60	Hindu Lake	8/60	1
				Trespass Creek	6/15/61	3/4
				Hindu Lake	8/2/61	1
				S.F. Shields ^{1/}	10/60	2
3	M	1	7/9/61	Cottonwood Creek	7/27/61	4
6	F	2	8/12/60	S.F. Sweetgrass	9/13/60	3.5
				S.F. Sweetgrass	9/17/60	3.5
7	F	4+	7/18/61	Rock Creek	7/28/61	5.5
8	M	Kid	7/18/61	Rock Creek	7/28/61	5.5
9	F	1	8/15/60	Hindu Lake Trap	7/9/61	0
11	F	4+	8/2/61	S.F. Shields ^{1/}	10/61	2

^{1/} Animals killed by hunters, distance of movement approximated from hunter's description of location

provided two additional relocations. The average distance that goats were

observed after release from the trap site was 2.8 miles. Eight of 9 sight records suggested movements in a south and east direction from the trapping site. These data reflect summer movement to areas of higher elevations. The maximum distance goats were observed from the trap location was 5.5 miles.

HUNTING SEASONS

The opening date for hunting in the Crazy Mountains for mountain goats has been in mid-September for 1953 through 1961. Hunting has been by a permit system. Thirty permits were issued in 1953, fifty in 1954 and 100 in 1955. One hundred were issued for the 37 day season during 1956, with an additional 146 permits valid the last seven days of the season. Three hundred were issued in 1957, two hundred in 1958 and 100 for each of the following three years.

Data from hunter questionnaires, 1958 through 1961, indicate a hunter success of 43 per cent for those that hunted, with a range of 35 (1961) to 50 per cent (1958). The number of goats harvested in relation to the number of permits issued averaged 35 per cent. Thirty-eight per cent of the total kill was taken the first day of the hunting season. By the end of the first week 75 per cent of the total harvest had been taken. Males accounted for 65 per cent of the kill over the four year period.

Weather has been a factor in reducing hunter success. An average of 26 per cent of the hunters reported that they were hampered by adverse weather conditions. During 1961, eighty-eight per cent of the hunters reported bad weather and snow as hunting hindrances. During the hunting

season of this year a snow storm occurred on the second day, making hunter movement in the area virtually impossible for the following week. These data suggest that an earlier opening date of the hunting season may facilitate the harvest of goats in this area. The ruggedness of the terrain in much of the Crazy Mountains renders the area relatively inaccessible during periods of snow cover.

Twenty-two hunter-killed goats were examined. Lower jaws were used in age class determinations. The sample included nine males and four females four years old or older; three males and two females three years old; one male and two females two years old and one yearling male. This limited sample suggests hunter selection of larger animals.

SUMMARY

A study of the mountain goat in the Crazy Mountains, Montana was conducted during the summers of 1960 and 1961. The results were compared with those of a similar study conducted in 1952 and 1953. A total of 690 observations of goats indicated that 54 per cent were on slide-rock areas, 26 per cent on cliffs, 15 per cent on alpine meadows and 5 per cent on timbered areas. Use of slide-rock areas decreased as the season progressed. Summer feeding observations showed that 49 per cent of the plants utilized were grasses, sedges and rushes, 48 per cent were forbs and 3 per cent were browse species. Fall rumen analyses revealed that 90 per cent of the plants used were grasses, sedges and rushes, 10 per cent were forbs, and browse appeared only in trace amounts. The principal difference between the results of this study and those of an earlier study were an in-

crease in the use of forbs and a decrease in the use of browse in summer. Ground and aerial observations indicated a kid/adult ratio of 24 per cent as compared to 35 per cent in 1952 and 1953. Eight per cent of the total kids observed were twins. Thirty per cent were considered twins in the earlier study. An aerial census of the entire Crazy Mountain range revealed area differences in kid/adult ratios ranging from 11 to 42 per cent. These differences were possibly related to differences in hunting pressure. Twenty-three goats provided information on body weights, measurements and horn development. The data indicated a decrease in size when compared to the results of the earlier study. Relocation observations of marked goats suggested summer movement to areas of higher elevations. Hunter questionnaires indicated that 35 goats were harvested for every 100 permits issued. Seventy-five per cent of the harvest was completed by the end of the first week of the hunting season. Weather was a factor in reducing hunter success.

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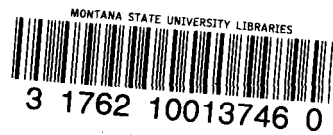
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