Mountain goat distribution, population characteristics and habitat use in the Sawtooth Range, Montana
by Michael James Thompson

A thesis submitted in partial fulfillment of the requirements for the degree of MASTER OF SCIENCE
in Fish and Wildlife Management
Montana State University
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Abstract:
Population characteristics, distribution, and habitat use of an estimated 130 mountain goats were studied in the Sawtooth Range of Montana from June 1978 through May 1980. Summer and fall home ranges of three adult nannies and two adult billies were determined using biotelemetry in 1979. In addition, goat population surveys by helicopter of the Front Unit of the study area were accomplished during March 1979 and 1980. Summer and fall food habits were investigated by histological analysis of fecal pellets. Population size has been reduced and distribution has been altered since live-trapping and hunting of this native herd was initiated in the 1940's and 1950's. Since the late 1960's kid-producing population segments have been severely depleted where suitable habitat is limited and separated from presently occupied goat habitat by stream bottoms, forests, and roads. Where suitable habitat is extensive and continuous, goat distribution was similar to that of the late 1960's. The number of kids observed per 100 nonkids during summer surveys from aircraft has correlated negatively with mid-winter snow depths of the same year since 1967. Numbers of kids observed for every 100 adult nannies from June-September 1979 were 78 and 46 in the Front and Divide Units respectively. Goats periodically moved as far as 10 airline km from high elevation, open vegetation structures to salt licks during the summer months. June-September home ranges of three adult nannies averaged 14 km2 (S.D.=5), corresponding with a general diet of shrubs and forbs. October-November home ranges of these nannies averaged 2 km 2(S.D.=1), centered around feeding sites of fescue grasses. Two adult billies had average home range sizes of 18 km2 (S.D.=10) in June-September and 22 km (S.D.=10) in October-November.

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by

MICHAEL JAMES THOMPSON

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

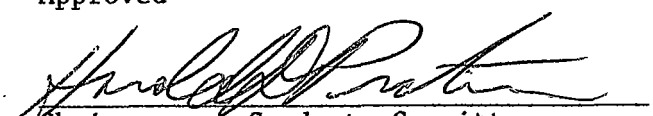
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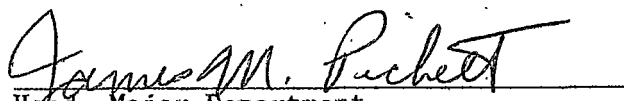
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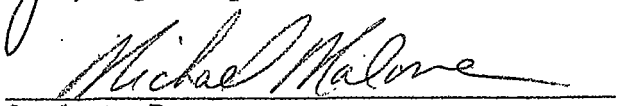
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ABSTRACT

Population characteristics, distribution, and habitat use of an estimated 130 mountain goats were studied in the Sawtooth Range of Montana from June 1978 through May 1980. Summer and fall home ranges of three adult nannies and two adult billies were determined using biotelemetry in 1979. In addition, goat population surveys by helicopter of the Front Unit of the study area were accomplished during March 1979 and 1980. Summer and fall food habits were investigated by histological analysis of fecal pellets. Population size has been reduced and distribution has been altered since live-trapping and hunting of this native herd was initiated in the 1940's and 1950's. Since the late 1960's kid-producing population segments have been severely depleted where suitable habitat is limited and separated from presently occupied goat habitat by stream bottoms, forests, and roads. Where suitable habitat is extensive and continuous, goat distribution was similar to that of the late 1960's. The number of kids observed per 100 nonkids during summer surveys from aircraft has correlated negatively with mid-winter snow depths of the same year since 1967. Numbers of kids observed for every 100 adult nannies from June-September 1979 were 78 and 46 in the Front and Divide Units respectively. Goats periodically moved as far as 10 airline km from high elevation, open vegetation structures to salt licks during the summer months. June-September home ranges of three adult nannies averaged 14 km^2 (S.D.=5), corresponding with a general diet of shrubs and forbs. October-November home ranges of these nannies averaged 2 km^2 (S.D.=1), centered around feeding sites of fescue grasses. Two adult billies had average home range sizes of 18 km^2 (S.D.=10) in June-September and 22 km^2 (S.D.=10) in October-November.

INTRODUCTION

A native herd of mountain goats (Oreamnos americanus) inhabits the Teton and Marias River drainages of the Sawtooth Range, Montana. Casebeer et al. (1950) conducted an intensive study of mountain goat ecology in Montana and included the Sawtooth goats in their 1946 census of the Northern Continental Divide herd. Brandborg (1950) gathered additional population data in the Teton drainage during June and July, 1948. However, further information concerning the Sawtooth herd is limited.

Mountain goat populations in Idaho and Montana typically consist of relatively small subpopulations which exhibit specific habitat use patterns and population dynamics (Brandborg 1955, Smith 1976). Brandborg (1955) found nearly two-thirds of Idaho's estimated population of 2,785 goats in herds of 50 animals or less. These small subpopulations seem traditional in their use of seasonal ranges (Brandborg 1955, Chadwick 1973); marked adult females have returned to the same summer ranges in Montana (Rideout 1977) and winter ranges in Montana and Idaho, respectively (Smith 1976, Kuck 1977). Brandborg (1955) also observed little interchange of goats among herds and reported differing herd-specific sex and age ratios. Mountain goat population structure and density were related to winter snow depth and the abundance of summer forage in Alaska by Hjeljord (1973). He also found

the food habits and range use patterns of two populations of mountain goats in Alaska differed. Therefore, proper management of goat populations such as the Sawtooth herd requires recognition of local subpopulations and a management plan sensitive to their dynamics and environment (Brandborg 1955).

This study was initiated to determine the distribution, population structure and habitat use of mountain goats in the Teton and Marias drainages. Field research was conducted from 15 June to 15 September 1978 and from 7 June to 13 December 1979 with occasional observations made during spring, 1979 and 1980. Data were collected to facilitate the recognition of subpopulations and provide the information needed for intensive management of the goat herd.

STUDY AREA

The Sawtooth Range extends approximately 130 km (80 mi) southeasterly from Glacier National Park to the Dearborn River in west-central Montana. The study area is located in the central portion of that range, approximately 41 km (25 mi) west of the town of Choteau. It stretches roughly 48 km (30 mi) southward from the North Fork of Birch Creek, in the Marias River drainage, to the South Fork of Deep Creek, in the Teton River drainage. Westward, the study area extends an average distance of about 13 km (8 mi) from the abrupt eastern edge of the mountains to the Teton-Sun River and Continental divides. Almost 95% of the study area lies within Lewis and Clark National Forest, and the northern one-third of the area was added to the adjacent Bob Marshall Wilderness Area in 1979. The remaining eastern edge of the study area includes lands administered by the Bureau of Land Management and private ownership.

The general topography of the area is a series of parallel north-south trending ridges. The eastern faces of these ridges are nearly vertical fault escarpments while the western faces are less extreme 40 to 80% slopes. Extensive glaciation and erosion of the Lewis overthrust formation (Deiss 1941) modified these ridges, forming mountain peaks, alpine cirques, narrow stream bottoms, and canyons.

Elevations range from about 1550 m (5000 ft) in the eastern canyon bottoms to 3100 m (9392 ft) at the top of Rocky Mountain.

Landtypes have been identified and mapped for Lewis and Clark National Forest by Holdorf (1978) on the basis of observed patterns of habitat type (Pfister et al. 1974, Mueggler and Handl 1974), landform and soil family occurrence. Approximately 580 km^2 (226 mi^2) or about 94% of the study area have been partitioned into 21 landtypes. Eleven of these are high elevation landtypes covering roughly 447 km^2 (174 mi^2) or about 77% of the landtyped area, and are of considerable potential importance to mountain goats. These landtypes are described below while the pattern of occurrence of the five landtypes that were used by goats is depicted in Figures 1 and 2.

Glacial Cirques. Approximately 170 km^2 (68 mi^2) or about 30% of the landtyped area is comprised of nearly vertical, north- or east-facing alpine cirque headwalls, with essentially barren bowl-shaped indentations and numerous avalanche chutes formed in limestone bedrock. Scree is the dominant habitat type; scattered wind-deformed stands of whitebark pine (Pinus albicaulis Engelm.), spruce (Picea spp.), and alpine fir (Abies lasiocarpa (Hook.) Nutt.) occupy the more favorable sites. This landtype is found at elevations above 1850 m (6000 ft).

Glacially Scoured Limestone Breaks. Glacially scoured limestone slopes of 60 to 80 % comprise roughly 110 km^2 (44 mi^2) or about 19% of

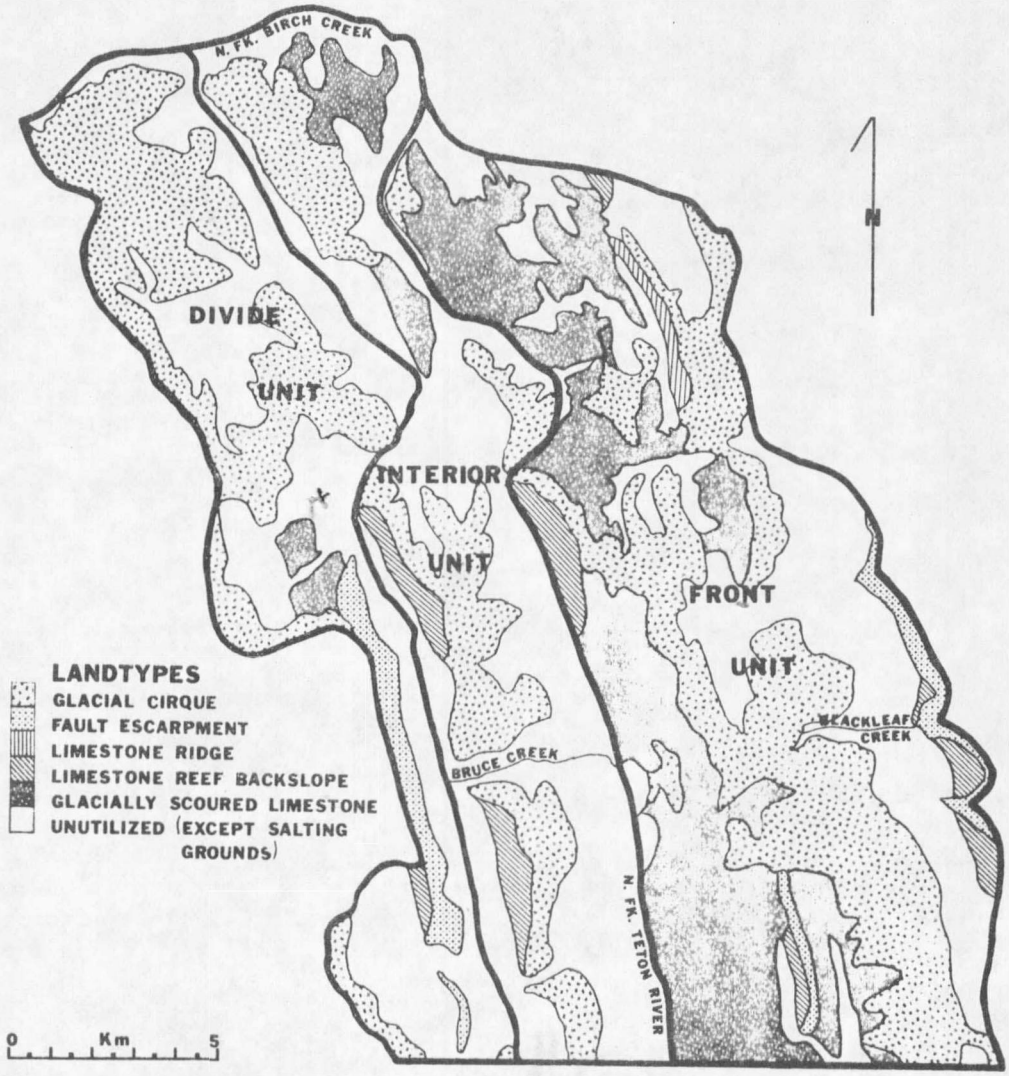


Figure 1. Unit boundaries and distribution of landtypes used by goats on the northern half of the study area.

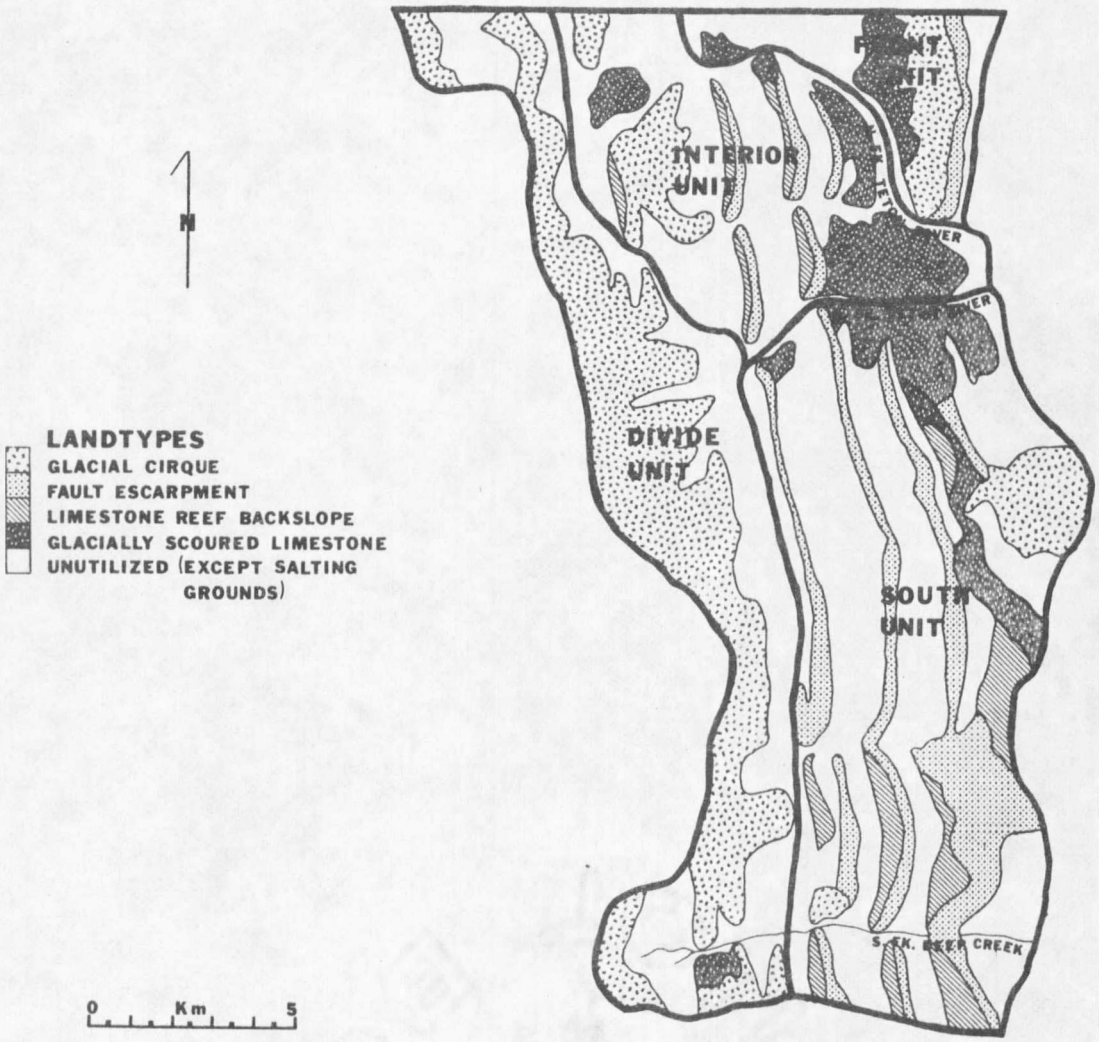


Figure 2. Unit boundaries and distribution of landtypes used by goats on the southern half of the study area.

the landtyped area. Most of this type is rock outcrop and talus supporting a scree habitat type. Stable soils support Pseudotsuga menziesii/Arctostaphylos uva-ursi (PSME/ARUV), Symphoricarpos oreophilus (PSME/SYOR), or Juniperus communis (PSME/JUCO) habitat types. The altitudinal range of this landtype is 1550 to 2450m (5000 to 8000 ft).

Steep Glacially Scoured Slopes. Approximately 56 km^2 (22 mi^2) or about 10% of the landtyped areas are south- or west-facing, 40 to 60% slopes of interbedded sandstones and shales covered by 25 to 102 cm (10 to 40 in) of well drained, weakly developed forest soils. Major habitat types are Abies lasiocarpa/Xerophyllum tenax (ALBA/XETE) on lower slopes and Abies lasiocarpa-Pinus albicaulis/Vaccinium scoparium (ABLA-PIAL/VASC) on upper slopes. This landtype occurs at elevations of 1950 to 2100m (5500 to 7000 ft).

Fault Escarpment Breaks. Vertical limestone fault escarpments broken by numerous avalanche chutes cover approximately 32 km^2 (13 mi^2) or about 6% of the landtyped area. This type is nearly barren of vegetation and occurs at elevations of 1950 to 2640m (5500 to 8500 ft).

Subdued Glacial Cirques. Alpine glacial cirques with very steep (65 to 80% slopes), north- or east-facing headwalls formed in interbedded sandstones and shales comprise roughly 25 km^2 (10 mi^2) or about 4% of the landtyped area. Cirque bowls in this type are capable of

supporting nearly continuous forest cover. Dominant habitat types found on stable sites are ABLA-PIAL/VASC and Abies lasiocarpa/Luzula hitchcockii (ABLA/ LUHI). However, old burns are characteristic of the type and support open stands of Whitebark pine and Spruce. This landtype typically occurs at elevations of 1750m (6000 ft) to 2450m (8000 ft).

Limestone Reef Backslopes. Approximately 23 km^2 (9 mi^2) or about 4% of the landtyped area is comprised of west-facing, 40 to 60% slopes apparently subject to erosive frost churning. Landforms in this type are smooth and undissected with very weakly developed, excessively drained, calcareous forest soils. Scree is sparsely vegetated with wind-deformed stands of alpine fir, spruce, and whitebark pine. Favorable sites support an Abies lasiocarpa/Pinus albicaulis (ABLA/PIAL) habitat type. This landtype is found at elevations of 1950 to 2450m (6500 to 8000 ft).

Moderately Steep, Glacially Scoured Slopes. This type, covering roughly 15 km^2 (6 mi^2) or about 3% of the landtyped area, is similar to the Steep, Glacially Scoured Slope landtype. Slopes are more moderate, supporting a mosaic of Abies lasiocarpa habitat types, including Abies lasiocarpa/Carex geyeri (ABLA/CAGE), Arnica cordifolia (ABLA/ARCO), Calamagrostis rubescens (ABLA/CARU), and ABLA/VASC. Old burns dominate this type and are presently vegetated with fescue (Festuca spp.) grassland parks and open, mixed stands of Douglas fir

(Pseudotsuga menziesii (Mirbel) Franco.), spruce, and lodgepole pine (Pinus contorta Dougl.). This landtype occurs at elevations of 1750 to 2100m (6000 - 7000 ft).

Limestone Plateaus. Less than 2.5 km^2 (1 mi^2) or less than 1% of the area is comprised of limestone beds (0 to 25% slopes) covered by 25 to 50cm (10 to 20 in) of excessively drained, calcareous, weakly developed grassland soils. Bedrock outcrops and ledges may cover as much as 10% of this landtype. Habitat types are Festuca scabrella/ Festuca idahoensis (FESC/ FEID) and Potentilla fructicosa/Festuca scabrella (POFR/FESC). Scattered pockets of limber pine (Pinus flexilis James) or Douglas fir also occur. This landtype occupies elevations from 1950 to 2350m (6500 to 7500 ft).

Ridge Saddles. Steep (40 to 60% slopes) ridge saddles cover less than 2.5 km^2 (1 mi^2) or less than 1% of the landtyped area. Interbedded sandstones and shales underlie shallow, excessively drained, weakly developed grassland soils. The dominant habitat type is FESC/ FEID, with scattered whitebark pine and spruce stands also occurring. Elevations of this landtype are 1950 to 2350m (6500 to 7500 ft).

Glacially Scoured Sandstone/Shale Breaks. These nearly barren, very steep (60 to 80%) slopes also cover less than 2.5 km^2 (1 mi^2) or less than 1% of the area. Parent material is sandstone and shale, generally supporting a scree habitat type. Scattered lodgepole pine and Douglas fir stands dominate the vegetation; ABLA/XETE or Menziesia

ferruginea (ABLA/MEFE) habitat types occur on the more favorable sites. These slopes occur at elevations of 1850 to 2450m (6000 to 8000 ft).

Limestone Ridges. Less than 2.5 km^2 (1 mi^2) or less than 1% of the landtyped area is comprised of very strongly frost churned limestone ridges. These gently sloping (0 to 40 percent slopes), undissected ridges hold 105 to 155 cm (40 to 60 in) of well drained, calcareous, weakly developed grassland soils. Stable sites support an Idaho fescue (Festuca idahoensis Elmer)- sedge (Carex spp.) community related to the Festuca idahoensis/Deschampsia cespitosa (FEID/ DECE) habitat type. Dryas (Dryas octapetala L.) communities occur on the more unstable sites. This landtype is found at elevations of 2450 to 2750m (8000 - 9000 ft).

The study area was partitioned into four Units on the basis of the dominance and patterns of occurrence of landtypes within goat habitat (Figs. 1, 2). Goat habitat within the Front Unit, located generally north and east of the North Fork of the Teton River, consists largely of continuous blocks of glacial cirque and glacially scoured limestone breaks landtypes. Continuous blocks of the glacial cirque landtype also occur along the Continental and Teton divides, the Divide Unit. North of the Teton River and between the Front and Divide Units is the Interior Unit, where goat habitat is composed of individual blocks of the glacial cirque landtype on mountain peaks,

separated by low-elevation, forested landtypes. South of the Teton River and east of the Divide Unit is the South Unit, where goat habitat is largely characterized by parallel ridges and canyons of the fault escarpment breaks landtype, separated by forested, low elevation landtypes.

The climate of the study area, as summarized by Holdorf (1978), is generally Continental, with a strong Pacific Maritime influence along the Continental Divide. Average annual precipitation ranges from approximately 38 to 125 cm (15 to 50 in) on the eastern foothill and western alpine portions of the area, respectively. Most of this precipitation falls during the period from March through June. Snow accounts for 45 to 75% of the precipitation annually and may fall during any month of the year. Downslope chinook winds, capable of warming winter temperatures by 10°C over a period of several hours, interact with the topography to differentially distribute snow cover over the study area.

METHODS

Population Analysis

Capture Techniques

Goats were captured and marked at a traditionally used salt lick originally established for domestic livestock. Six goats were captured using a cannon net in July and August, 1979 (Thompson and McCarthy, in press). The sex of the goats was determined. Body and horn measurements were taken and goat ages were determined by inspecting incisor replacement and horn annuli (Brandborg 1955). One other adult nanny was chemically immobilized with 24 mg of succinyl-choline chloride using a Cap-chur gun and dart. In addition, three kids were captured in Clover traps in August and September, 1978.

Radio Telemetry

Two adult billies, two nannies with kids, and one nanny whose kid was lost were equipped with radio collars in summer, 1979. Each collar consisted of an AVM transmitter (150-151 MHz frequency) and lithium battery encapsulated in dental acrylic, connected to an antenna, inserted and sealed in color-coded PVC plastic pipe. All radios were transmitting at the end of the study period.

Relocations of instrumented goats were made using an AVM LA12 receiver. A hand-held three element Yagi antenna was used for ground tracking and, occasionally, for aerial relocating when strapped to the

strut of a fixed-wing aircraft. In addition, a Cessna 180 aircraft equipped with dual whip antennas was regularly used for relocating radio-equipped goats.

An attempt was made to relocate all instrumented goats at roughly 1 week intervals during summer and fall, 1979. Relocations were plotted on 7.5 minute topographic maps. Nonvisual aerial relocations were considered adequate for analysis since the mobility of the aircraft allowed transmitter signals to be interpreted with confidence. Ground relocations were considered reliable only when radioed animals were sighted or when terrain and animal location made signal interpretation certain. Home range sizes were estimated by measuring the areas of convex polygons, formed by the plotted relocations (Jennrich and Turner 1969), with a polar planimeter.

Marking

All captured goats were marked with a metal tag in each ear. A pair of 2-yr-old billies captured in 1979 were fitted with individually recognizable neckbands. Two male kids were marked with color-coded Ritchey ear tags in 1978. One male kid captured in 1979 was marked with a plastic streamer attached to a metal ear tag (Picton 1960).

Observations

Two aerial surveys of mountain goat distribution covered the available goat habitat of the study area as completely as possible. A

fixed-wing Cessna 150 aircraft was used for the survey of August 22, 24, and 28, 1978. A Bell-47 helicopter was used for the similar survey of July 19, 20 and 21, 1979. Several additional aerial surveys covering specific portions of the study area were flown using either a helicopter or fixed-wing aircraft. Goats observed from aircraft were classified as kids or nonkids, and their locations were plotted.

Throughout the study period, observations of mountain goats were made from the ground using 7x35 mm and 8x24 mm binoculars and a 15-60x spotting scope. During summer, 1978, goats observed in this manner were classified as kids, yearlings and adults when practical. In 1979, when circumstances permitted, kids, yearlings, 2-yr-olds and adults were distinguished on the basis of horn length (Brandborg 1955) and rostral length (Smith 1976); the sex of adults was determined by judging horn curvature and basal circumference (Brandborg 1955) or observing urination posture (Hibbs et al. 1969). Questionable classifications were recorded as kid, nonkid or unknown.

Habitat Analysis

Observations

Location, time of day, general weather conditions, snow conditions, and animal activity were recorded for each ground observation of goats. Vegetation structure was recorded for each observation, using the following structural types described by Dansereau (1957):

crust, tundra, short grass, brush, parkland, and forest (Fig. 3). Krumholtz structure was also recognized, found on rocky, exposed sites and characterized by stunted, wind-deformed stands of limber pine dominating mats of kinnikinnik (Arctostaphylos uva-ursi) and juniper (Juniperus communis and J. horizontalis).

Elevation and aspect for each observation were read from topographic maps. Degree of slope was calculated over 200 ft intervals of elevation on topographic maps as described by Smith (1976) and categorized as follows: cliff (65°-89°), very steep (45°-64°), steep (18°-44°), moderate (5°-17°), gentle (0°-4°). The landtype in use was determined by referring to the map and legend prepared by Holdorf (1978).

Feeding Site Analysis

Feeding sites used by mountain goat female and subadult groups were examined during the period from 7 June to 14 December 1979. Relative frequency of plant species occurrence was determined for 17 feeding sites using 2x5 dm plots spaced at 2m intervals along the contour of the slope. Ten or fifteen plots were established depending on the amount of sampling required to reflect the vegetational diversity of the site. Systematic vegetational sampling on two additional feeding sites was abandoned due to snow cover; a list of available plant species was compiled for each of these sites. Forage species were identified at all feeding sites; however, quantification of bites

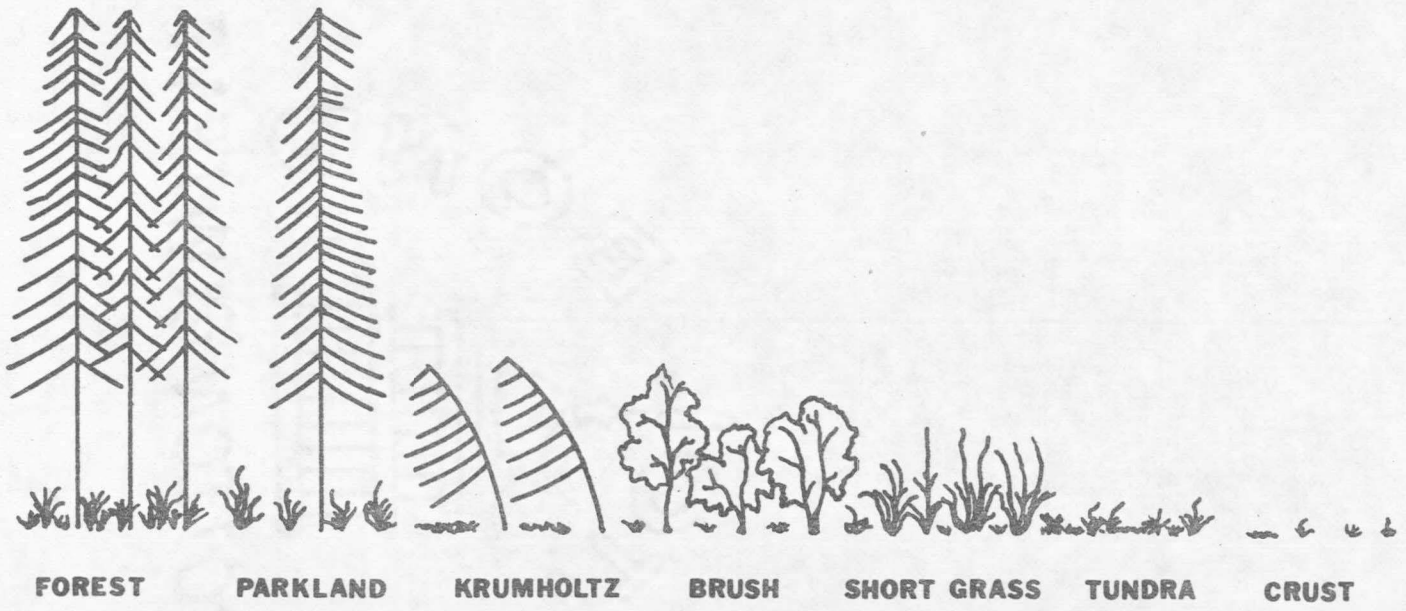


Figure 3. Structural vegetation types.

was found to be impractical due to the inability to differentiate between use by goats and other herbivores. Plants found on feeding sites and other alpine and subalpine sites were collected, and identified following Hitchcock and Cronquist (1976). Identifications taken to species were verified by Dr. J. H. Rumley, Montana State University Herbarium.

Fecal Analysis

Fresh mountain goat fecal pellets were collected and frozen for later analysis. Forty-one samples were salted, dried and sent to T. M. Foppe, Range Science Department, Colorado State University to determine seasonal food habits by histological analysis.

RESULTS

Based on experience gained from frequent observations of goats made during ten months of field work, 130 goats were estimated to inhabit the study area during 1978 and 1979. Casebeer et al. (1950) covered the area in the summer of 1947 by foot and horseback and estimated the population size at 174 goats. A survey by helicopter in July 1967 revealed 54 nonkids in the study area (Martin 1969). Comparable counts of 51 and 52 nonkids, respectively, were recorded during a survey by Piper Super Cub in August 1978 and a survey by helicopter in July, 1979.

Distribution and Movements

Population distribution was determined from aerial and ground surveys conducted during 1978 and 1979 which, in combination, covered the study area during each of three time periods: (1) June-July, (2) August-September, and (3) October-November (1979 only). In addition, the Front Unit was surveyed by helicopter in March 1979 and 1980. Surveys made during a single time period varied between years with respect to methods and scope. Therefore, results of 1978-1980 surveys were combined for each time period to increase the data base for comparison of population distribution among time periods. Numbers of nonkids and kids accounted for in each Unit during each time period

are presented below as indicators of relative goat abundance and actually represent the largest numbers of goats observed during a single survey. The study was not designed to detect variation in seasonal population distribution between years, but it appeared that such variation was slight.

Individual movements of goats in the Front Unit were determined from 147 relocations of 5 radio-equipped nonkids. Aerial relocations were accomplished periodically from July 1979 through early May, 1980; ground relocations were made from late June through November, 1979. The radio-equipped goats were observed during 43% of the relocations, with ground relocations accounting for most of the observations even though aerial relocations were more common (Table 1). Two neckbanded 2-yr-olds also provided data on movements of individuals in the Front Unit in 1979. In addition, an adult nanny in the Divide Unit, recognizable by her deformed right horn, was reobserved during summer and fall, 1979.

Front Unit

June-July. The Front Unit was surveyed by helicopter in July, 1979 and was largely covered by foot during June-July of both years. At least 27 nonkids and 8 kids were observed in the Unit during this time period, their distribution centered primarily in the Blackleaf Creek drainage and secondarily at the head of Frenchy Gulch where artificial salt licks were located (Fig. 4). Average group size was

Table 1. Number and percent (in parentheses) of observations of radioed mountain goats made during successful relocations from the air and ground.

Months	Air		Ground		Total	
	Observed	Not Observed	Observed	Not Observed	Observed	Not Observed
Jun-Jul	3(43)	4(57)	1(25)	3(75)	4(36)	7(64)
Aug-Sep	4(19)	17(81)	7(37)	12(63)	11(28)	29(72)
Oct-Nov	1(3)	29(97)	23(74)	8(26)	30(45)	37(55)
Dec-May	18(62)	11(38)	--	--	18(62)	11(38)
	26(30)	61(70)	31(57)	23(43)	63(43)	84(57)

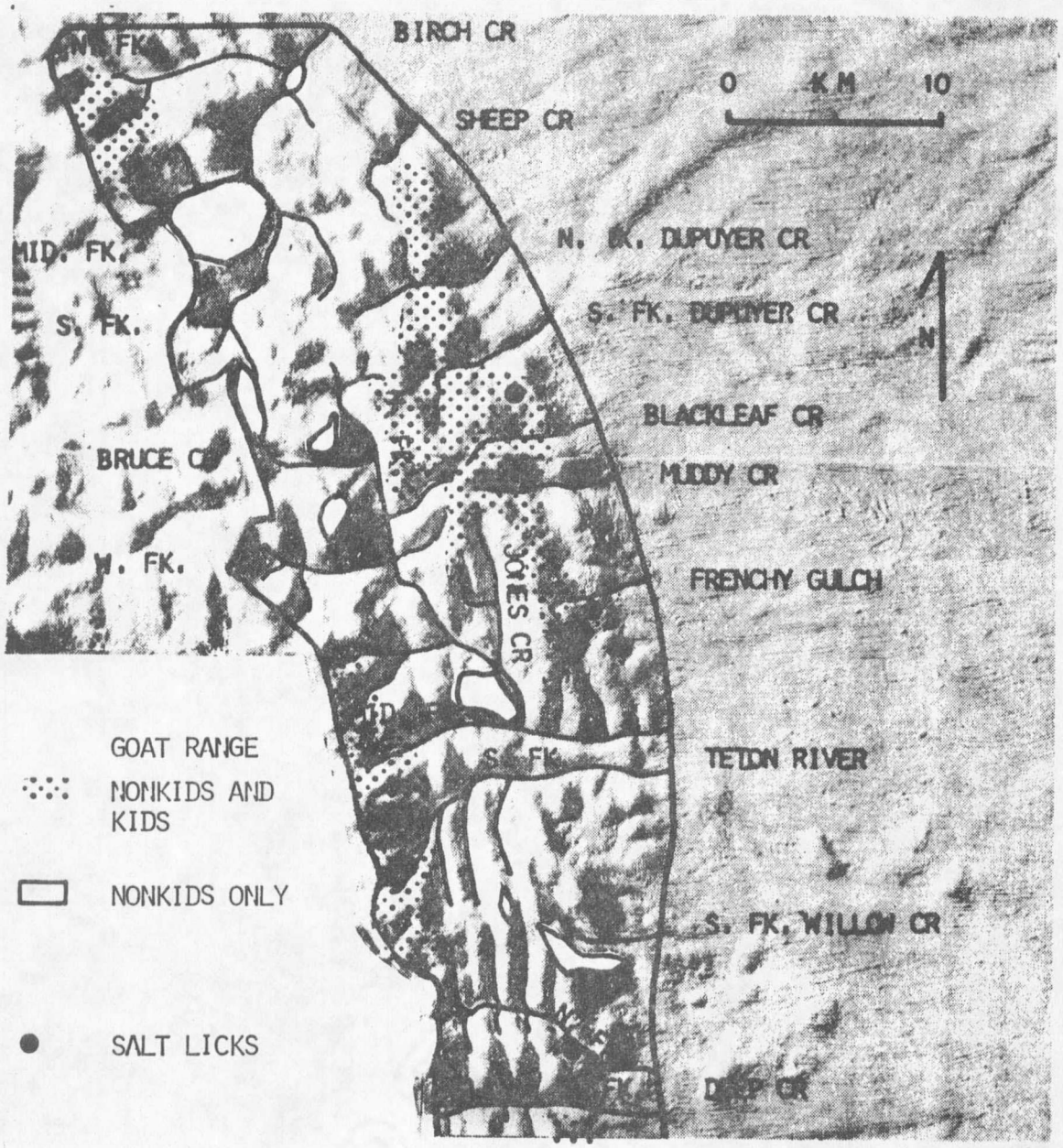


Figure 4. Goat distribution on the study area determined during June-November, 1978 and 1979.

4.2 (N=85, S.D.=3.7). A similar pattern of distribution was reported by Olson et al. (1978) for 35 nonkids and 15 kids observed during a survey by helicopter in July 1977.

Two adult billies (3 and 8 years old, respectively) and an adult nanny (3 years old, permanently separated from her kid at the trap site) were equipped with radio transmitters at the Blackleaf salt licks during June-July 1979. In addition, two 2-yr-old billies were marked with neckbands at Blackleaf during the season. Nine of ten relocations of radioed adults in June-July were within 4.5 airline-km of the Blackleaf salt lick. The adult nanny was once observed at the head of Frenchy Gulch, about 7.5 airline-km from Blackleaf and about 3.5 airline-km from the Frenchy Gulch salt lick. Eleven days later she was observed at the head of Muddy Creek, 4.5 airline km from Blackleaf. The neckbanded 2-yr-olds were reobserved once at Blackleaf, 8 days after they were captured.

August-September. A survey of the Front Unit by Cessna 150 in August, 1978 and ground surveys of most of the Unit in 1978 and 1979 revealed at least 31 nonkids and 11 kids (1979) during August-September. Distribution was concentrated in the North and South Forks of Dupuyer Creek, Blackleaf Creek, Muddy Creek, West Fork of Jones Creek, and Frenchy Gulch drainages (Fig. 4). All of these concentration areas were used by goats in June-July, but the salt licks were definitely the focal points of distribution then, while the other

concentration areas increased in relative importance in August-September. Average group size was 4.8 (N=35, S.D.=4.1). A similar pattern of distribution was found during a survey by helicopter in August, 1969 (Watts et al. 1971).

Two adult nannies (both 4 years old), each with a kid, were equipped with radio transmitters at Blackleaf in August-September. They were relocated 9 times generally 3 to 4 airline-km west of the trap site, but were never relocated at Blackleaf. The adults captured in June-July were relocated a total of 35 times and ranged 1.5 to 10.0 airline-km west and south of Blackleaf. One adult billy crossed the North Fork of the Teton River and a well-used dirt road to reside in the Interior Unit. The adult nanny and one adult billy were relocated at Blackleaf twice in 3 days in early August, but were not found there again in August-September. The neckbanded 2-yr-olds were not reobserved during this period.

October-November. Ground surveys of nearly the entire Front Unit during October-November 1979 revealed at least 28 nonkids and 8 kids concentrated in the same areas as during August-September (Fig. 4). However, the Blackleaf and Frenchy Gulch salt licks were not used in October-November, resulting in a more consistent distribution of goats in the Unit without movements to and from the licks. Average group size was 3.5 (N=48, S.D.=3.1). Eleven nonkids were similarly distributed during a survey by helicopter in October 1967 (Martin 1969).

The two radio-collared nannies with kids were relocated 22 times, always in the South Fork of Dupuyer Creek drainage. The adult nanny without a kid was relocated 9 times, always in the East Fork of Jones Creek drainage. The two adult billies were more mobile. Thirty relocations of these billies were scattered over the Front Unit south of Blackleaf Creek and one adult billy remained in the Interior Unit for much of the period. One of two neckbanded 2-yr-old billies was reobserved three times in October-November, always in the West Fork of Jones Creek drainage. No marked individuals were relocated at either salt lick during the period.

December-February. Surveys of population distribution were not conducted in the study area during this period. However, all radio-equipped adults were relocated from the air twice in December and once in January. The two nannies with kids were located at the head of Muddy Creek in December, then about 4.5 airline-km away at the head of the South Fork of Dupuyer Creek in January. The nanny without a kid was relocated progressively southward along the Frenchy Gulch drainage as winter continued, with relocations spanning about 0.75 airline-km from December-January. One billy was always relocated at the head of Muddy Creek while the other billy was always found in the Blackleaf Creek drainage.

March Surveys of the Front Unit by helicopter in March 1979 and 1980 revealed at least 40 nonkids and 8 kids in the same areas as in

August-November (Fig. 5). In addition, groups of goats were found in the East Fork of Jones Creek drainage, where only scattered individuals were found during summer and fall surveys. Distribution was remarkably consistent between years over the portion of the Unit that received comparable survey coverage in both 1979 and 1980. Also, goats were more evenly distributed over the Front Unit during March than during any other time of observation. Average group size was 3.1 (N=32, S.D.= 2.3). Since these were the first systematic surveys of goat distribution conducted on the study area during late winter-early spring, past data is unavailable for comparison.

March-May. Radioed adults were relocated monthly in March-May. The two nannies with kids were found in the South Fork of Dupuyer Creek drainage all three times. The nanny without a kid was located progressively northward on a 9 km line from Frenchy Gulch to the head of Muddy Creek during March-May. One billy was located in the Blackleaf and South Fork of Dupuyer Creek drainages, with extreme relocations separated by about 3.5 km. The other billy was not found in March, but was located in the Interior Unit in April and May. One of two neckbanded 2-yr-olds was observed in March in the East Fork of Jones Creek drainage.

Home Ranges. The composite year-round range, based on 147 relocations, of the five radio-collared adults captured at the Blackleaf salt lick in the Front Unit is presented in Fig. 6. The range covers

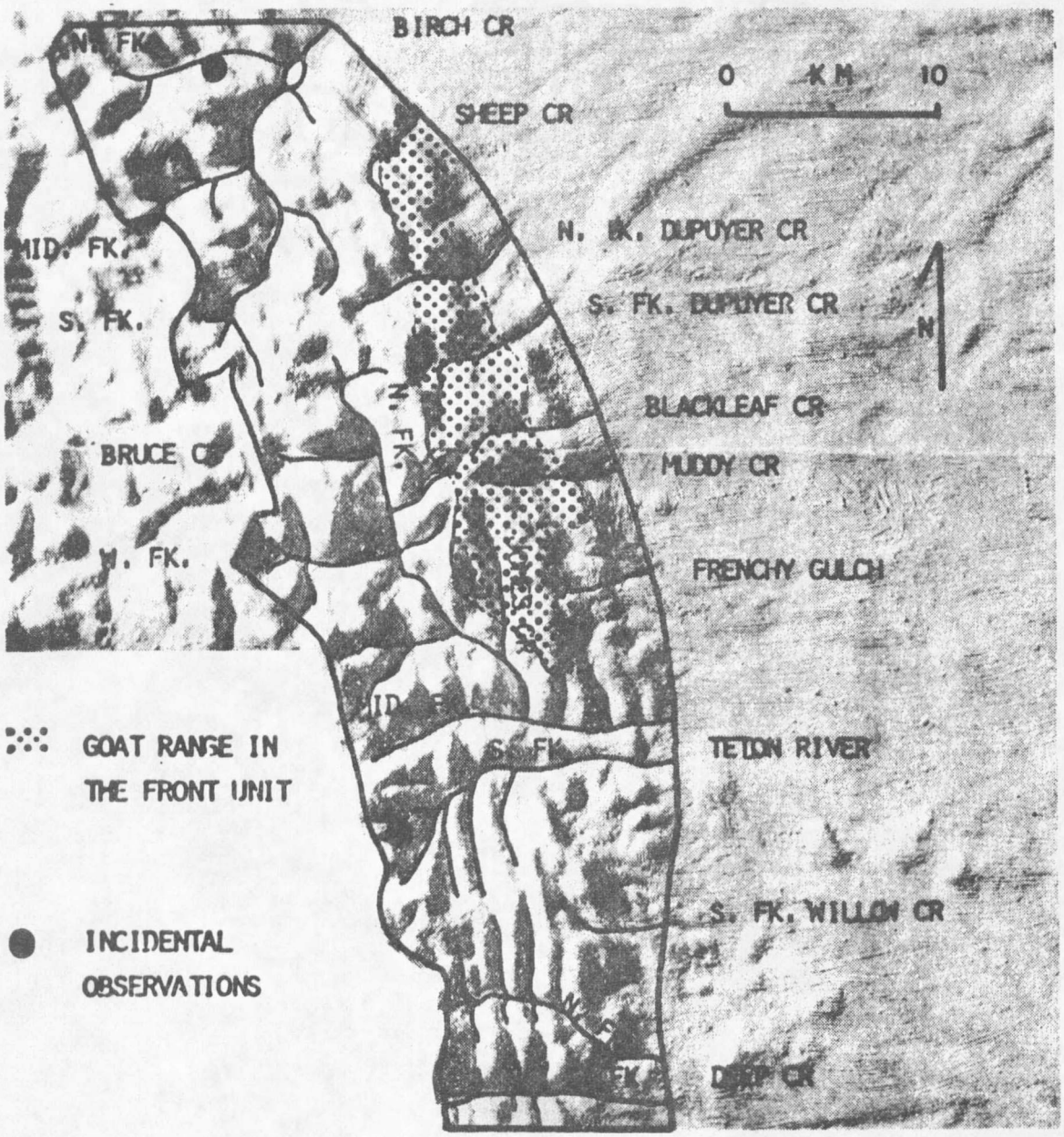


Figure 5. Goat distribution in the Front Unit during March surveys by helicopter in 1979 and 1980, and locations of incidental goat observations made in March, 1979.

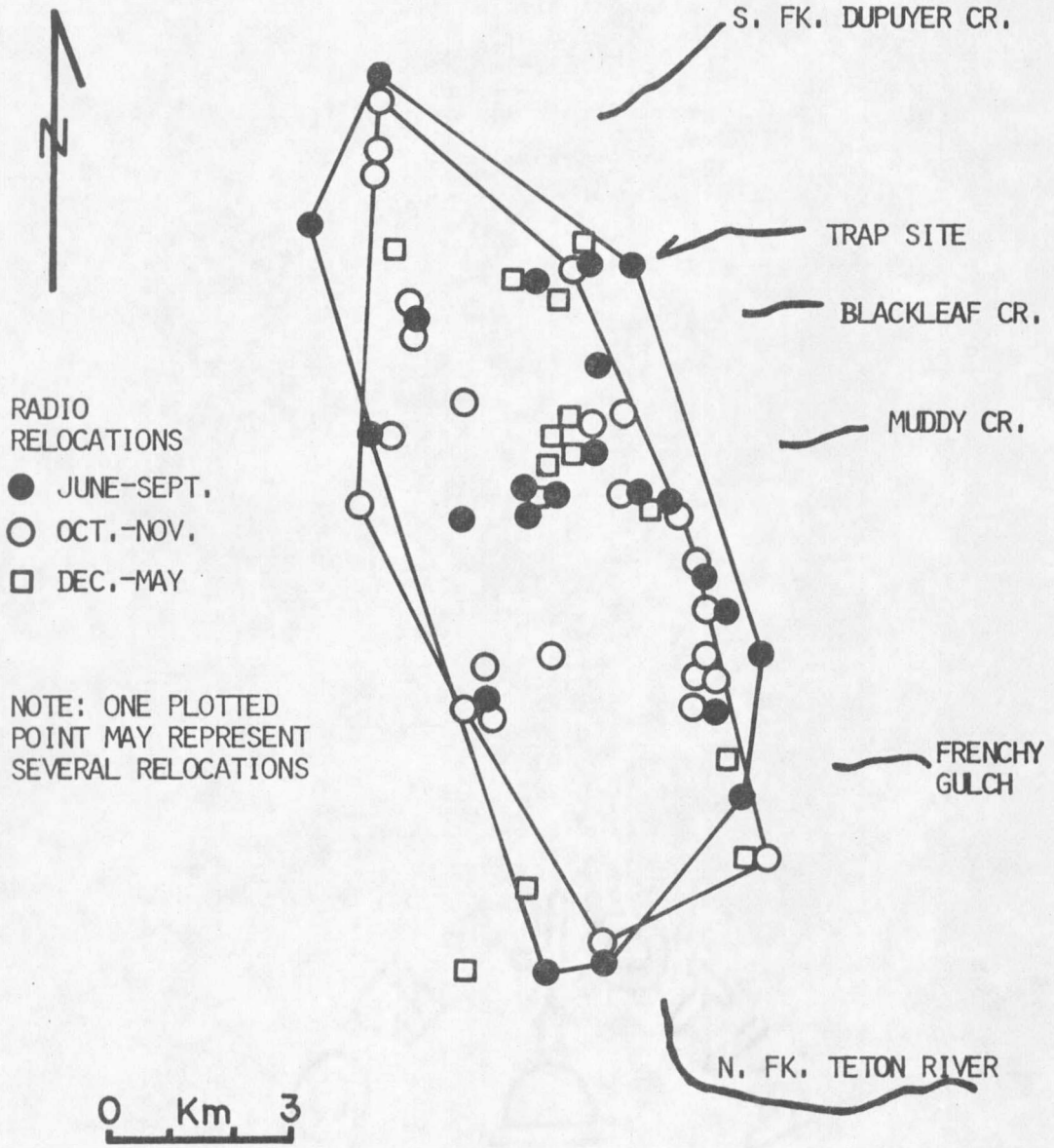


Figure 6. Composite summer and fall ranges of five adult goats captured and radio-equipped at Blackleaf salt lick, 1979.

69 km^2 (27 mi^2) and lies entirely within the Front Unit with the exception of the portion of one adult billy's range that includes part of the Interior Unit.

Summer (June-September) and fall (October-November) home ranges for each of the five radio-equipped adults are outlined in Figs. 7 and 8. An average of 12 relocations of each goat were made in summer and again in fall. Mean home range sizes for two adult billies were 18 km^2 (S.D.=10) and 22 km^2(S.D.=10) in summer and fall, respectively (7 mi^2 and 8 mi^2). Mean home range sizes for three adult nannies were 14 km^2 (S.D.=5) and 2 km^2 (S.D.=1) in summer and fall, respectively (5 mi^2 and 1 mi^2). Rideout (1977) reported mean summer-fall home range sizes of 17.6 km^2 and 19.8 km^2, respectively, for adult billies and adult nannies in the Sapphire Mountains, Montana.

Divide Unit

June-July. The Divide Unit was surveyed by helicopter in July 1979 while the Bruce Creek and the West and South Forks of the Teton River drainages were surveyed by foot during June-July of both years. At least 16 nonkids and 6 kids were observed in the Unit, distributed almost entirely in the South Fork of the Teton River drainage (Fig. 4). Seven nonkids and one kid were similarly distributed over the Divide Unit during a survey by helicopter in July 1967 (Martin 1969). Brandborg (1950) found 28 goats during a ground survey of the South Fork of the Teton River drainage in June, 1948.

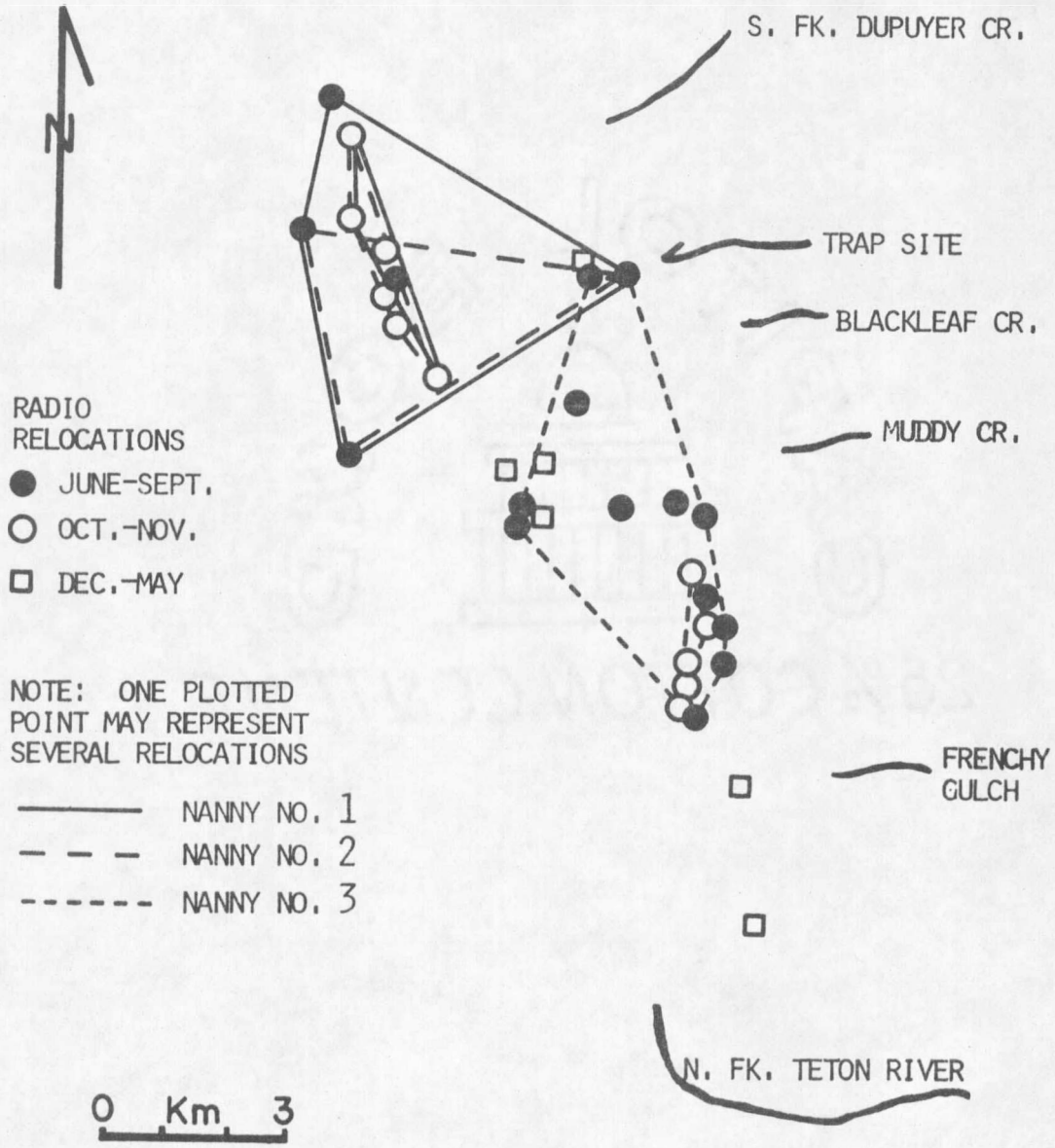


Figure 7. Summer and fall home ranges of three adult nannies captured and radio-equipped at Blackleaf salt lick, 1979.

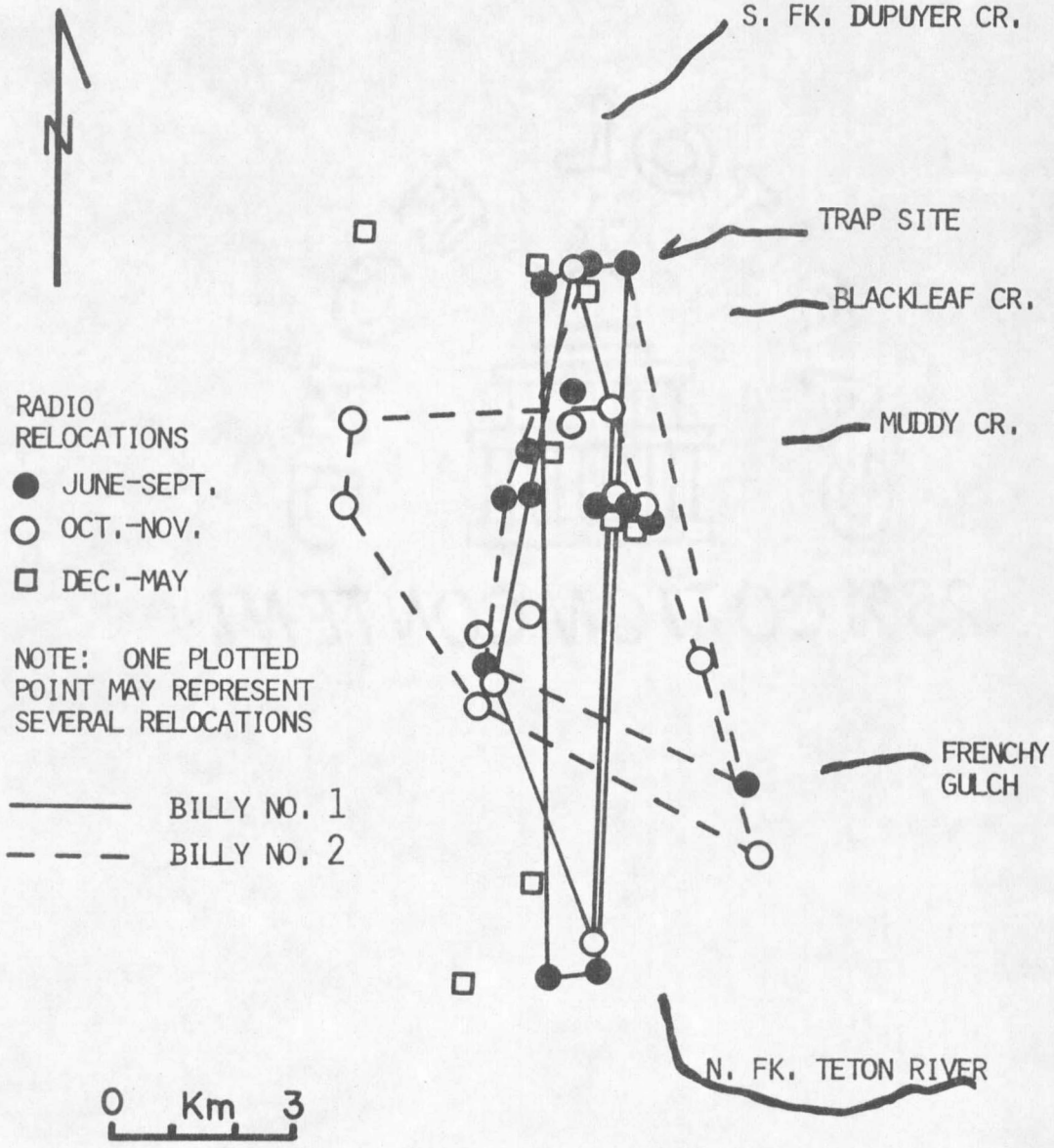


Figure 8. Summer and fall home ranges of two adult billies captured and radio-equipped at Blackleaf salt lick, 1979.

August-September. A survey by Cessna 150 in August 1978 and ground surveys covering most of the Unit in August-September 1979 revealed at least 27 nonkids and 10 kids, their distribution concentrated in the Middle and North Forks of the Birch Creek drainage and the South Fork of the Teton River drainage (Fig. 4). Average group size was 4.6 (N=18, SD=3.9). Aerial surveys of various portions of the Divide Unit accomplished in August-September, 1969 (16 nonkids, 6 kids observed), 1971 (11 nonkids, 2 kids observed), 1975 (18 nonkids, 3 kids observed), and 1977 (18 nonkids, 3 kids observed) revealed nonkids and kids in these concentration areas as well as in the West Fork of the Teton River drainage (Watts et al. 1971, 1973, Erickson et al. 1977, Olson et al. 1978). In addition, these surveys found nonkids in the South Fork of Birch Creek and Bruce Creek drainages where no more than one nonkid was seen at any one time during this study.

The Birch Creek drainage was not a concentration area in June-July during this study or during a survey by helicopter in July 1977 (Olson et al. 1978). However, the July 1977 survey revealed 16 nonkids and 10 kids on Family Peak, less than 2 km north of the study area and adjacent to the Divide Unit. Conversely, 13-15 nonkids and 4-7 kids were found in the Birch Creek drainage during August-September of this study while only one nonkid and one kid were observed on Family Peak. Aerial surveys in August, 1971 (Watts et al. 1973) and

September, 1975 (Erickson et al. 1977) revealed 10 and 6 nonkids, respectively, at the head of Birch Creek, but none were observed on Family Peak.

An adult nanny with a deformed right horn was observed on 8 and 9 August and 6 and 10 September 1979 at the head of the South Fork of the Teton River drainage, with extreme relocations separated by about 1.5 km. The nanny was regularly observed as part of a group of 12-14 goats and was observed with a kid each time but the last, when visibility was too poor to make a determination regarding the presence of her kid.

October-November. The Birch Creek drainage was surveyed by Piper Super Cub in November, 1979 after the rest of the Divide Unit had been surveyed by helicopter earlier in November. Ground surveys were limited to the South Fork of the Teton River drainage during October-November. At least 18 nonkids and 1 kid (kids could not be distinguished from nonkids during the survey of Birch Creek) were distributed in the South Fork of the Teton River and Birch Creek drainages as in August-September (Fig. 4). Average group size was 3.5 (N=10, S.D.=2.0). Nine nonkids and one kid observed during an October 1967 survey by helicopter were concentrated at the head of Birch Creek (Martin 1969). However, it is unknown if the Teton River drainage was surveyed during that time.

The adult nanny with a deformed right horn was observed on 31 October, 1979, this time without her kid, at the head of the South Fork of the Teton River within her observed home range of August-September. Eleven other goats were also observed in that range on that date.

March. Seven nonkids were observed during a survey by helicopter of the head of the South Fork of the Teton River drainage in March 1979 (Fig. 5). Again, no information on past late winter-early spring use of the area is available.

South Unit

June-July. The South Unit was surveyed by helicopter in June and again in July, 1979. Ground surveys were limited to the North Fork of Willow Creek drainage during June-July 1979. At least six nonkids were observed in the Unit, distributed over the South Fork of Willow Creek, South Fork of Deep Creek, and Rierdon Gulch drainages (Fig. 4). Average group size was 1.7 (N=6, S.D.=0.8). The distribution of at least 24 nonkids and 6 kids was also concentrated in these drainages during a survey by helicopter conducted in July 1967 (Martin 1969). However, nonkids previously were observed throughout the Unit as opposed to the limited distribution observed during this study. Brandborg (1950) found 87 goats relatively evenly distributed over the South Unit during a ground survey in June-July 1948.

August-September. A survey by Cessna 150 in August 1978 and ground surveys of the Deep Creek and South Fork of the Teton River drainages in 1979 revealed at least four nonkids and two kids in the South Unit, all in the South Fork of Deep Creek drainage (Fig. 4). Average group size for two observations was 3.0. Eight nonkids and 3 kids observed during a survey by helicopter in August 1969 were similarly distributed (Watts et al. 1971).

October-November. The South Unit was surveyed by helicopter again in November, 1979, but only Rierdon Gulch was surveyed by foot. The distribution of at least 14 nonkids and 1 kid was centered in Deep Creek drainage and spread north to the South Fork of Willow Creek and Rierdon Gulch drainages (Fig. 4). Average group size was 2.1 (N=8, S.D.=1.4). Twenty-one nonkids and seven kids observed during a survey by helicopter in October, 1967 were similarly distributed (Martin 1969).

Interior Unit

June-July. A survey by helicopter covered the Interior Unit in July 1979 and surveys by foot and horseback covered most of the Unit during June-July 1979. A minimum of three nonkids were observed in the South Fork of Birch Creek, Bruce Creek, and North Fork of the Teton River drainages respectively (Fig. 4). One nonkid was observed near Bruce Creek during a previous survey by helicopter of the Unit in July 1977 (Olson et al. 1978). A helicopter survey of the Unit in

July 1967 found 12 nonkids and 3 kids concentrated in the Bruce Creek and North Fork of Birch Creek drainages (Martin 1969).

August-September. The Interior Unit was surveyed by Cessna 150 in August 1978 and much of the Unit was surveyed by foot during August-September 1979. At least four nonkids were distributed over the same drainages as in June-July (Fig. 4). Average group size was 1.4 (N=7, S.D.= 0.8). Aerial surveys of the Unit during August-September, 1969 (3 nonkids, 2 kids observed, Watts et al. 1971), 1971 (16 nonkids, 1 kid observed, Watts et al. 1973), and 1975 (8 nonkids, 2 kids observed, Erickson et al. 1977) revealed consistent use of the Bruce Creek area by kids and nonkids. Other locations of nonkid observations included drainages as recorded during this study, plus the North Fork of Birch Creek drainage during the 1975 survey.

October-November. The Interior Unit was incompletely surveyed during October-November while emphasis was placed on units more heavily used by goats. The Birch Creek drainage was surveyed by Piper Super Cub in November 1979 and the lower North Fork of the Teton River drainage was surveyed on foot during October-November 1979. No goats were observed in the Unit during that time (Fig. 4). Nineteen nonkids and seven kids were observed in the Unit during a survey by helicopter in October 1967 (Martin 1969), primarily in the North Fork of the Teton River and North Fork of Birch Creek drainages, which were both surveyed during October-November of this study.

March. Systematic surveys of the Interior Unit were not accomplished during March of this study or in the past. However, goat observations were recorded during the course of other surveys from aircraft. One nonkid was found in the North Fork of the Teton River drainage and nine nonkids and one kid were observed in the North Fork of Birch Creek drainage in March 1979 (Olson et al. 1980, Fig. 5).

Survey Efficiency

Two surveys of goat numbers and distribution were accomplished using a helicopter when marked nonkids were in the population. In late July 1979, 52 nonkids and 11 kids were observed on the study area, and one of four marked nonkids was observed. In late March 1980, 35 nonkids, 8 kids, and a group of 10 unclassified goats were observed during a survey of the Front Unit only. Five of seven marked nonkids were observed. Of those that were not observed, one neckbanded 2-yr-old billy had not been found since July 1979. The other was a radio-equipped adult billy that was captured, and sometimes relocated, in the Front Unit. However, it spent much of summer and early fall, 1979 in the Interior Unit where it was next relocated on 28 April following this survey. Tracks in the snow could be followed to each group of goats in March, greatly increasing the efficiency of this survey over that of the July survey.

Harvest

Five permit-holders harvested four goats in both 1978 and 1979 in hunting district 414. That portion of the study area was open to hunting from 15 September - late November both years. In 1978, two adults were harvested in the Front Unit and two in the Divide Unit. In addition to the legal harvest, one adult was killed but not retrieved in 1978 due to inaccessibility of the carcass. One of the goats reported harvested in 1979 was a nanny shot in the Front Unit that had a kid with it. The other three adults were harvested from unknown locations.

The study area and surrounding habitats were first opened to sport hunting in 1955 with 10 permits issued to sportsmen (Montana Fish, Wildlife, and Parks Dept. Progress Reports 1962-1980). Permits and goat harvest reported by hunters increased over the next 7 years to 80 and 55 respectively in 1962 (Fig. 9). The number of permits issued remained at 80 through 1967, but hunter harvest steadily declined. The number of permits issued was increased to 100 in 1968 and to 125 in 1970, but the goat harvest only increased to 55, as in 1962 under 80 permits. Harvest and the number of permits declined drastically through the early 1970's and have remained low through the period of this study.

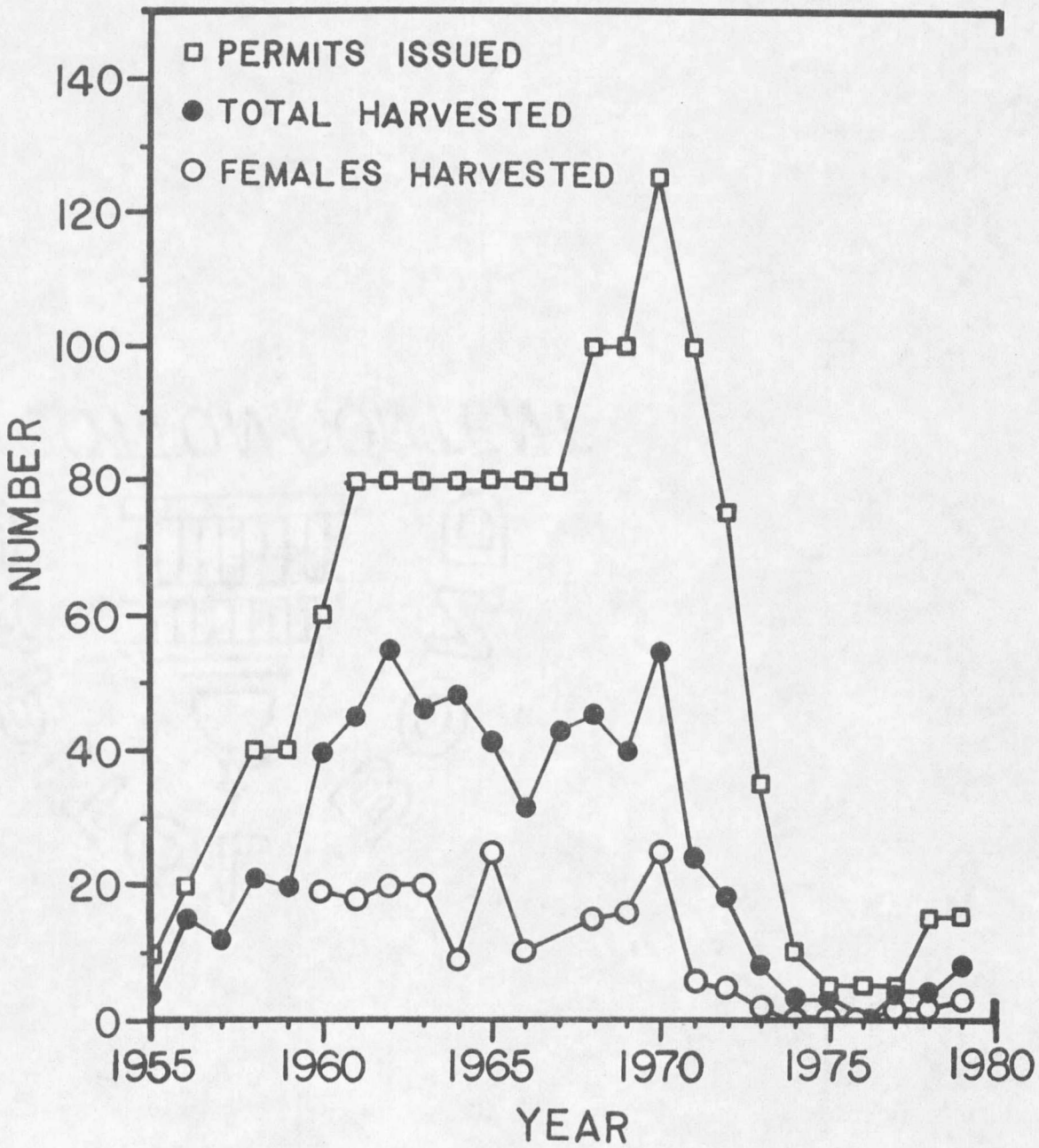


Figure 9. Goat harvest and the number of permits issued along the Rocky Mountain Front, 1955-1979 (includes information from areas adjacent to the study area).

Since hunting began in 1955, 633 goats have been reported killed on the study area, with 490 (77%) of those being harvested from 1960 through 1970. Forty-four percent (155 goats) of the study area goat harvest reported by location of kill during that period came from the Front Unit (Watts et al. 1972). Twenty-four percent (84 goats) of that harvest came from the South Unit. Goats were also live-trapped in the South Unit and transplanted to locations away from the study area. Ninety-two goats were trapped at Deep Creek salt lick from 1941 through 1950 and 16 more have been trapped since 1950 (Watts et al. 1972). Less of the goat harvest, 20% (71 goats) and 12% (42 goats) respectively, came from the Divide and Interior Units from 1960 through 1970. Hunter harvest by sex in the study area since 1960 has been 62% males and 38% females.

Population Structure

During June-November 1979, 55% (367/666) of the goats observed from the ground were classified as kids, yearlings, 2-yr-olds, adult billies or adult nannies. Two-year-olds were not accompanied by kids during this study and were not considered adults. Based on these classifications, the population structure for each study area Unit was computed for June-September and October-November (Table 2). Classifications made at salt licks were excluded from this analysis to reduce

Table 2. Age and sex class composition of the Sawtooth Range mountain goat population, 1979.

	1/ Unit	Percentage N 2/	B	2Y	Y	K	Goats/ 100 N B	2Y	Y	K	No. Of Goats Classified
Jun-Sep	F	44.0	14.3	3.6	3.6	34.5	32.4	8.1	8.1	78.4	84
	D	52.0	12.0	5.3	6.7	24.0	23.1	10.3	12.8	46.2	75
	S	60.0				40.0				66.7	5
Oct-Nov	F	36.4	25.0	8.0	2.3	28.4	68.8	21.9	6.2	78.0	88
	D	41.7	33.3	0.0	16.7	8.3	80.0		40.0	20.0	12
	S	0.0	100.0			0.0					1

1/ F = Front, D = Divide, S = South

2/ N = Adult Nanny, B = Adult Billy, 2Y = 2-Yr-Old, Y = Yearling, K = Kid.

any bias possible from differential utilization of salt licks by certain sex and age classes of goats. Separation of 2-yr-olds, adult billies, and adult nannies from the nonkid portion of the population was not possible in 1978, due to the inexperience of the observer.

Aerial surveys of various portions of the study area have been conducted periodically since 1967. The kid:nonkid ratios obtained during these surveys are compared in Table 3. These ratios were negatively correlated ($R = -.95$, $p < .01$) with late February-early March snow depths of the same year (Fig. 10). Snow depths were measured on Wrong Ridge, located just west of the study area at an elevation of 2072 m (6800 ft) (U.S.D.A. Soil Conservation Service 1949-1979). Mid-winter snow depths were 147 cm (57 in) in 1978 and 158 cm (62 in) in 1979, compared with the 1949-1979 average of 150 cm (58 in) (S.D.=36).

Kid:100 nonkid ratios were determined monthly for the Front Unit, based on summer and fall, 1979 ground observations (Fig. 11). The proportion of kids observed in the population increased from June through September and then decreased through November. In mid-July, 1979, 20 kids:100 nonkids were observed during a survey by helicopter (Table 3). This ratio was similar to those from June and November surveys by foot and to that from a March 1980 survey by helicopter where 23 kids were observed for every 100 nonkids (43 goats observed).

Table 3. Number of kids observed per 100 nonkids during aerial surveys in selected summers from 1967-1979. Kid/nonkid ratios are in parentheses.

Unit	1967 (Martin 1969)	1969 (Watts et al 1971)	1971 (Watts et al 1973)	1975 (Erickson et al 1977)	1977 (Olson et al 1978)	1978 (present study)	1979 (present study)
Front	12.5	25.0	29.4		42.9	24.0	20.0
	(1/8)	(7/28)	(5/17)	-	(15/35)	(6/25)	(5/25)
Divide	14.3	42.9	15.4	16.7	46.2	41.7	33.3
	(1/7)	(6/14)	(2/13)	(3/18)	(18/39)	(10/24)	(6/18)
South	25.0	37.5					0.0
	(6/24)	(3/8)	-	-	-	(0/0)	(0/6)
Interior	25.0	66.7	7.1	25.0	0.0	0.0	0.0
	(3/12)	(2/3)	(1/14)	(2/8)	(0/1)	(0/2)	(0/3)
Combined	21.6	34.0	18.2	19.2	44.0	31.4	21.2
	(11/51)	(18/53)	(8/44)	(5/26)	(33/75)	(16/51)	(11/52)

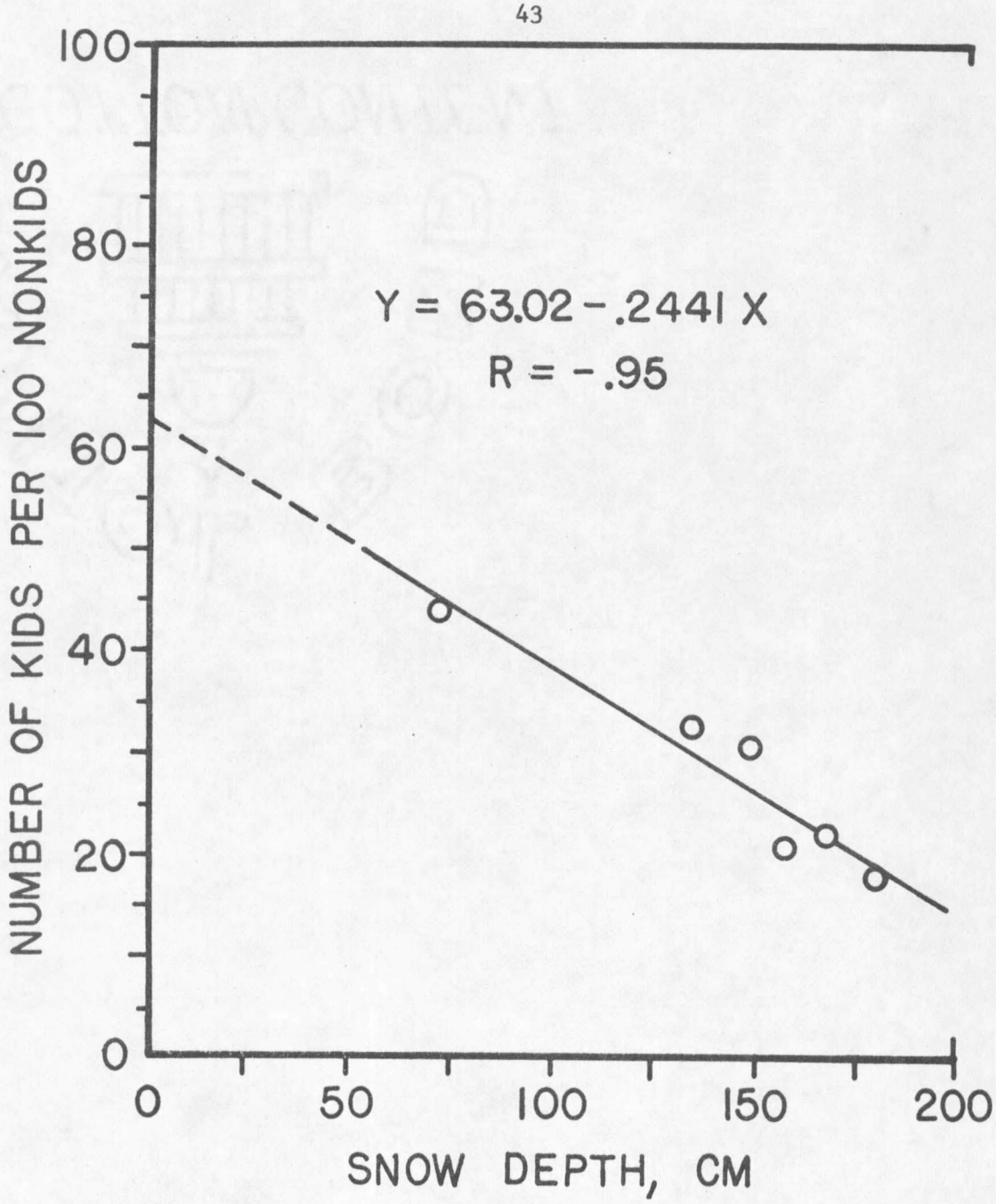


Figure 10. Numbers of kids per 100 nonkids relative to late February-early March snow depths measured on Wrong Ridge (2073 m elevation).

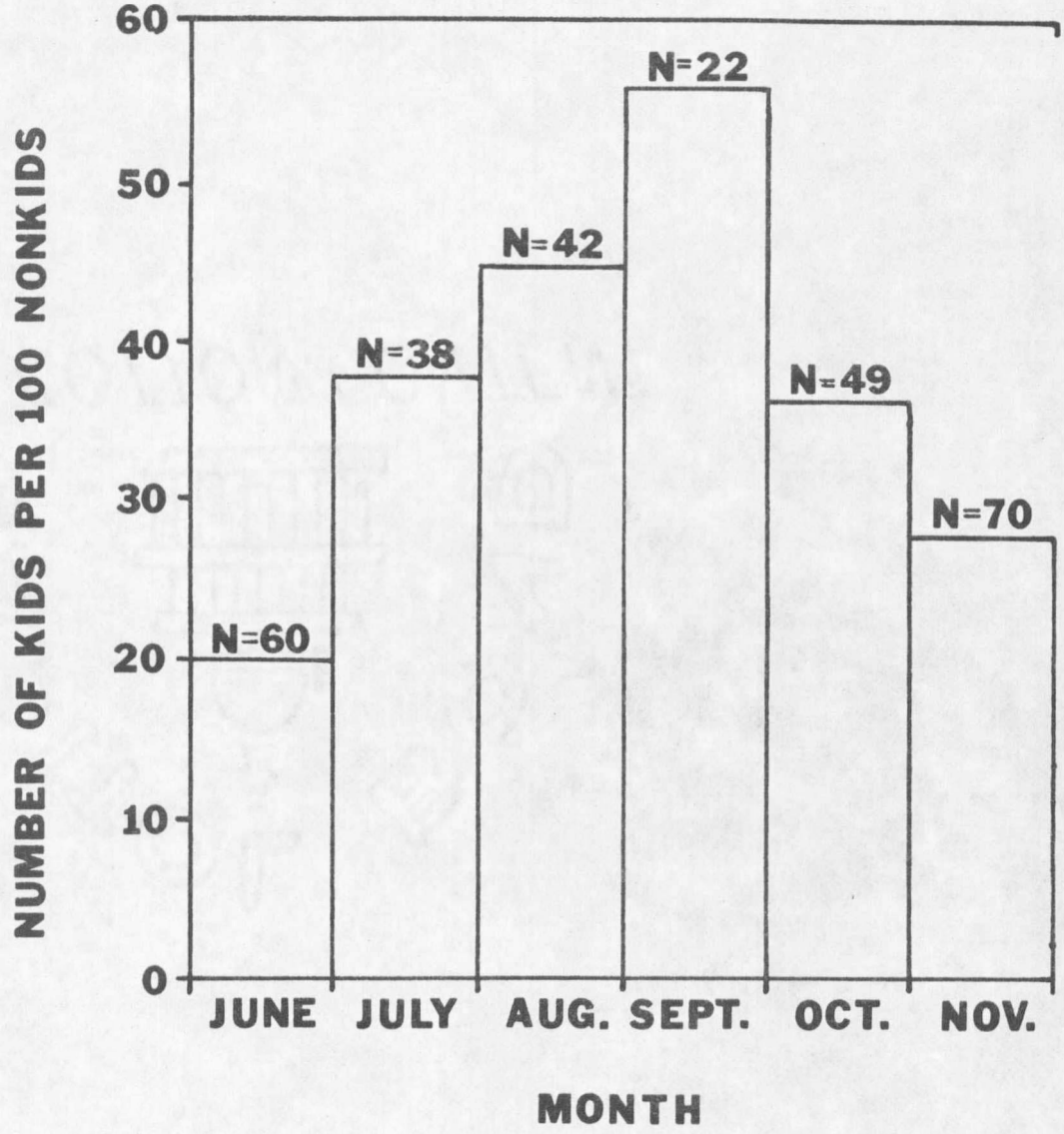


Figure 11. Numbers of kids per 100 nonkids observed during ground surveys of the Front Unit, June-November, 1979.

Kid loss was difficult to determine from direct observation. Two kids marked with red plastic ear tags at Blackleaf in August 1978 were never observed again during the study. In the South Fork of the Teton River drainage, an adult nanny with a deformed right horn was observed with a kid three times in August and September 1979, but was clearly observed without a kid in late October 1979. Two radio-collared adult nannies captured with kids at Blackleaf in August 1979, were observed with kids regularly thereafter through the survey by helicopter in March 1980.

Lick Use

Some salt licks used by goats during this study were established previously for domestic livestock in the Blackleaf, Frenchy Gulch, and North Fork of Deep Creek drainages. Goat hair, tracks, and diggings were regularly observed during the summer at a campsite in the South Fork of the Teton River drainage and indicated that the site was also used as a lick by goats. A maximum of 35, 10 and 8 goats, respectively, were observed at one time at the Blackleaf, Frenchy Gulch, and South Fork of the Teton licks. Bureau of Land Management personnel reported about 7 goats on the Deep Creek salt lick in June 1979. Habitat characteristics of these sites are presented in Table 4.

Table 4. Habitat characteristics of lick sites used by mountain goats in the Sawtooth Range, 1978-1979.

Site	Elev.	Slope	Distance From Typical Habitat1/	Distance From Water	Veg. Structure
Blackleaf	1926m (6320 ft.)	Gentle	0.6 km (0.38 mi.)	70m 2/ (100 ft.)	Parkland
Frenchy Gulch	1877m (6160 ft.)	Gentle	1.0 km (0.62 mi.)	700m 3/ (2218 ft.)	Short grass
S. Fk. Teton	2097m (6880 ft.)	Gentle	0 km (0 mi.)	0m 3/ (0 ft.)	Parkland
N. Fk. Deep	2059m (6670 ft.)	Gentle	0.15 km (0.1 mi.)	200m 3/ (750 ft.)	Parkland

1/ Typical habitat is terrain that goats frequently inhabit when not on the lick.

2/ Creek that dries up in summer

3/ Spring-fed

Licks were used from the time they became snowfree in spring until the end of September. At the Blackleaf lick in 1979, use was first observed on 9 June, peaked in late June - early July, and was last observed on 24 September. Adult billies were the age and sex class most frequently observed at Blackleaf in June, while nannies with kids accounted for most of the observations in July, August and September (Table 5).

Five nonkids were marked at Blackleaf between 27 June and 23 July 1979. Seven observations of 35 total nonkids were then made at the lick between 27 July and 26 August 1979, and the proportion of marked nonkids observed was determined for use in calculating a Lincoln index estimate of the number of nonkids that used the lick during the summer (Table 6). Four of the five marked animals were observed on the lick after the date of their capture, and an estimate of 44 nonkids was calculated. For comparison, the largest number of nonkids observed at the lick at one time during the period was 17, with 2 of them marked, giving an estimate of 42 nonkids.

Structural Habitat Characteristics

Observations made from the air and ground during June-November, 1979, and observations made from a helicopter in March 1979 and 1980 were used to determine the structural components of goat habitat on

Table 5. Sex and age classes of goats classified at Blackleaf salt lick during summer, 1979.

	Number of Goats (Percentage of Total)					
Month	Total	Kids	Yearlings	2-yr-olds	Adult Nannies	Adult Billies
June	33	2(6)	2(6)	6(18)	5(15)	18(54)
July	27	7(26)	1(4)	5(18)	9(33)	5(18)
August	37	14(38)	2(5)	0(0)	18(49)	3(8)
September	5	2(40)	0(0)	1(20)	2(40)	0(0)
Totals	102	25(24)	5(5)	12(12)	34(33)	26(26)

Table 6. Number of marked and unmarked nonkids observed at Blackleaf salt lick in July and August 1979 (five marked nonkids were in the population).

Date	No. Observed	
	Total	Marked
27 July	2	0
31 July	6	2
7 August	17	2
15 August	1	0
17 August	2	0
22 August	4	0
26 August	3	0
Totals	35	4

the study area. Goat activity on salt licks accounted for a high proportion of observations made during summer, and those observations were omitted in this analysis to eliminate biasing the data in favor of salt lick habitats. Overall, goats were most frequently observed in open vegetation structures on steep east-facing slopes at elevations averaging 2256 m (7400 ft) within the alpine cirque landtype (Tables 7, 9, 11, 12, 14). Feeding goats followed the same general pattern of landtype, slope, and aspect selection throughout the year (Tables 8, 10, 11, 13, 15). However, feeding goats were observed an average of 30.5 m (100 ft) higher and made proportionally greater use of tundra vegetation structures, than nonfeeding goats.

Goats were found almost exclusively in the glacial cirque landtype in June-July. They selected steep slopes other than southern exposures at an average elevation of 2256 m (7400 ft), almost always in crust or tundra vegetation structures (Tables 7, 9, 11, 12, 14). Feeding sites were located on steep, north-facing slopes at higher elevations ($\bar{X}$ = 2316 m or 7600 ft). Feeding activity was observed in all 10 tundra structures, but only 9 of 18 crust structures, where goats were found (Tables 8, 10, 11, 13, 15).

The glacial cirque landtype also provided most occupied goat habitat during August-September. Goats selected steep, east and northeast-facing slopes at somewhat lower elevations ($\bar{X}$ = 2225 m or

Table 7. Seasonal usage of landtypes by all mountain goats observed on the study area.

	N	Glacial Cirque	Fault Escarpment	Glacially Scoured Limestone	Limestone Ridge	Limestone Reef Backslope
Jun - Jul	31	28(90)[1/]	1(3)	2(6)		
Aug - Sep	43	37(86)	5(12)	1(2)		
Oct - Nov	62	42(68)	8(13)	12(19)		
March	34	22(65)	5(15)	5(13)	1(3)	1(3)
Total	170	129(76)	19(11)	20(11)	1(1)	1(1)

1/ Number of observations(percent).

Table 8. Seasonal usage of landtypes by feeding mountain goats observed on the study area.

	N	Glacial Cirque	Fault Escarpment	Glacially Scoured Limestone
Jun - Jul	20	19(95)[1/]		1(5)
Aug - Sep	20	16(80)		4(20)
Oct - Nov	33	22(67)	5(15)	6(18)
	73	57(78)	5(7)	11(15)

1/ Number of observations (percent).

Table 9. Seasonal usage of slopes by all mountain goats observed on the study area.

	N	Cliff	Very Steep	Steep	Moderate	Gentle
Jun - Jul	31	0(0)[1/]	3(10)	27(87)	1(3)	0(0)
Aug - Sep	41	0(0)	6(15)	34(83)	0(0)	1(2)
Oct - Nov	62	0(0)	6(10)	55(89)	1(2)	0(0)
March	33	0(0)	4(12)	28(85)	1(3)	0(0)
Total	167	0(0)	19(2)	144(86)	3(2)	1(1)

1/ Number of observations (percent).

Table 10. Seasonal usage of slopes by feeding mountain goats on the study area.

	N	Cliff	Very Steep	Steep	Moderate	Gentle
Jun - Jul	19	0(0)[1/]	1(5)	17(90)	1(5)	0(0)
Aug - Sep	20	0(0)	2(10)	18(90)	0(0)	0(0)
Oct - Nov	33	0(0)	2(6)	31(94)	0(0)	0(0)
Total	72	0(0)	5(7)	66(92)	1(1)	0(0)

1/ Number of observations (percent).

Table 11. Seasonal usage of elevations by mountain goats observed on the study area.

	All Goats			Feeding Goats		
	N	Elev.	S.D.	N	Elev.	S.D.
June-Jul	33	2256m (7400 ft)	195m (640 ft)	20	2316m (7600 ft)	143m (470 ft)
Aug-Sep	43	2225m (7300 ft)	137m (450 ft)	20	2256m (7400 ft)	122m (400 ft)
Oct-Nov	62	2256m (7400 ft)	137m (449 ft)	33	2256m (7400 ft)	123m (404 ft)
March	34	2256m (7400 ft)	183m (600 ft)	--	--	--
	172	2256m (7400 ft)	155m (509 ft)	73	2285m (7500 ft)	129m (422 ft)

Table 12. Seasonal usage of aspects by all mountain goats observed on the study area.

	No.	N	S	E	W	NE	SE	NW	SW
Jun-Jul	32	9(28)[1/]	3(9)	7(22)	5(16)	3(9)	1(3)	3(9)	1(3)
Aug-Sep	42	5(12)	5(12)	14(33)	3(7)	8(19)	4(10)	3(7)	0(0)
Oct-Nov	61	3(5)	8(13)	33(54)	4(7)	3(5)	8(13)	0(0)	2(3)
March	32	4(12)	3(9)	10(31)	12(38)	3(9)	0(0)	0(0)	0(0)
Total	167	21(13)	19(11)	64(38)	24(14)	17(10)	13(8)	6(4)	3(2)

1/ Number of observations (percent).

Table 13. Seasonal usage of aspects by feeding mountain goats observed on the study area.

	Obs.	N	S	E	W	NE	SE	NW	SW
Jun-Jul	20	7(35)[1/]	1(5)	4(20)	2(10)	2(10)	1(5)	2(10)	1(5)
Aug-Sep	20	0(0)	3(15)	8(40)	1(5)	6(30)	1(5)	1(5)	0(0)
Oct-Nov	32	0(0)	3(9)	19(59)	3(9)	1(3)	6(19)	0(0)	0(0)
Total	72	7(10)	7(10)	31(43)	6(8)	9(12)	8(11)	3(4)	1(1)

1/ Number of observations (percent).

Table 14. Seasonal usage of vegetation structures by all mountain goats observed on the study area.

	N	Crust	Tundra	Krum-holtz	Short-grass	Park land	Forest	Brush	Open
Jun-Jul	33	18(54)[1/]	10(30)	0(0)	1(3)	2(6)	0(0)	2(6)	
Aug-Sep	42	16(38)	10(24)	6(14)	9(0)	7(17)	2(5)	1(2)	
Oct-Nov	61	19(31)	11(18)	3(13)	7(12)	14(23)	2(3)	0(0)	
March	30	6(20)	1(3)	5(17)	2(7)	7(23)	1(3)	0(0)	8(27)
Totals	166	59(36)	32(19)	19(11)	10(6)	30(18)	5(3)	3(2)	8(5)

1/ Numbers of observations (percent).

Table 15. Seasonal usage of vegetation structures by all feeding mountain goats observed on the study area.

	N	Crust	Tundra	Krum-holtz	Short-grass	Park land	Forest	Brush
Jun-Jul	20	9(45)[1/]	10(50)	0(0)	0(0)	0(0)	0(0)	1(5)
Aug-Sep	20	5(25)	8(40)	4(20)	0(0)	3(15)	0(0)	0(0)
Oct-Nov	33	9(27)	8(24)	3(9)	5(15)	8(24)	0(0)	0(0)
Totals	73	23(32)	26(36)	7(10)	5(7)	11(15)	0(0)	0(0)

1/ Numbers of observations (percent).

7300 ft) than during June-July. Crust and tundra vegetation structures again received the most observed goat use, but krumholtz and parkland structures increased in observed use from 6% in June-July to 31% in August-September (Tables 7, 9, 11, 12, 14). Feeding goats followed this same seasonal trend of lower elevational use on steep east- and northeast-facing slopes with increased use of wooded vegetation structures. Tundra structures continued to be the most frequently used feeding sites in August-September (Tables 8, 10, 11, 13, 15).

Goats continued to be observed most frequently in glacial cirque landtypes during October-November, but increased use of glacially scoured limestone breaks and fault escarpment landtypes was observed. Steep, east-facing slopes at slightly higher average elevations ($\bar{X}$ = 2256 m or 7400 ft) than recorded during August-September provided the goat habitat most frequently used in October-November. Crust vegetation structures continued to be the most important in observed goat use, but parkland and short-grass structures increased in observed use compared to August-September, while tundra use dropped somewhat (Tables 7, 9, 11, 12, 14). Feeding goats also used fault escarpment and glacially scoured limestone breaks, as well as glacial cirque landtypes, during October-November and also selected steep, east-facing slopes at an average elevation of 2256 m (7400 ft). Crust, tundra and parkland vegetation structures comprised 27, 24 and 24%,

respectively, of the feeding sites observed. Seventy-three percent (8/11) of the tundra structures used by goats were observed to be feeding sites, compared with 57% (8/14) of the parkland and 47% (9/19) of the crust structures (Tables 8, 10, 11, 13, 15).

Most March observations were made in glacial cirque landtypes, with the remaining observations distributed over fault escarpment and glacially scoured limestone breaks landtypes. Goats were found on steep, west- and east-facing slopes at an average elevation of 2256 m (7400 ft). Crust, tundra and short-grass structures often could not be differentiated using aircraft due to snow cover. However, when considered as a whole, these open structures accounted for 63% (19/30) of the goat observations. Parkland and krumholtz structures received 23 and 17%, respectively, of the observed goat use during March (Tables 7, 9, 11, 12, 14).

Observations of five radio-equipped nonkids made from the ground and the air in 1979 reflected a similar seasonal pattern of habitat use with respect to vegetation structure (Fig. 12). June through early August observations were confined to crust and tundra structures. A definite shift in use was observed in August through early October when timbered structures accounted for all observed feeding sites. During October and November, goat use shifted back toward typically high elevation structures, particularly crust, tundra and krumholtz.

Dates of Observation	6/28	7/31	8/1	8/7	8/20	9/3	9/21	9/25	10/3	10/11	10/17	10/25	11/2	11/6	11/8
Crust	O		X	X		O	O				X	O	X		X
Tundra		X								X					
Krumholtz													X	O	
Short grass														X	
Parkland				X	O	X					X				
Forest								O	X			O			
Brush															

X = Feeding activity observed
O = Feeding activity not observed

Figure 12. Vegetation structures used by radio-equipped goats during summer-fall, 1979.

Feeding Site Vegetation

The vegetative composition of feeding sites was characterized by determining the relative frequency of plant species occurrence in 10-15 2x5 dm frames spread over each site (Appendix Table 16). Thirteen feeding sites used during June-September were dominated by low-growing forbs adapted to rocky sites such as Achillea millefolium, Galium boreale, Phacelia hastata, and various species of Ranunculus and Senecio. Four feeding sites used in October-November were characterized by frequent occurrence of Festuca ovina, Erigeron sp., Galium sp., and Sedum sp. Plant species identified on two feeding sites in December 1979 are listed in Appendix Table 17.

Food Habits

Fecal Analysis

Shrubs, primarily Shepherdia canadensis (L.) Nutt. and Salix sp., made up the greatest proportion of discernable plant fragments in goat fecal samples collected in June-September, 1978 and 1979 (Appendix Table 18). Grasses, sedges, and forbs, although comprising a much smaller proportion of the diet than shrubs throughout the period, increased in relative importance during August-September. During October-November 1979, food habits were determined to shift almost entirely to grasses, specifically Festuca ovina L. and F. idahoensis

Elmer. Shrubs, particularly Salix sp., and forbs comprised a minor proportion of the diet. F. ovina, F. idahoensis, and shrubs, primarily Shepherdia canadensis, comprised the greatest proportion of the early winter diet determined from a limited sample of fecal material collected in December 1979.

Feeding Observations

Observations of feeding goats indicated that from June through September, 1978 and 1979, various forb flowers, stems and leaves constituted the bulk of goat forage (Appendix Table 19). Use by goats of Shepherdia canadensis or Salix sp. was not observed during the summer months. Observed use of grass was also infrequent. Species most frequently observed to be utilized were Erigeron sp., Senecio sp., Arnica sp., and Pedicularis sp. During October-November 1979, most observed use was on Festuca ovina and F. idahoensis plants, while several forb species were also fed upon. On two sites visited in December 1979, use of Shepherdia canadensis was most evident, while grasses and Pinus flexilis were also used.

DISCUSSION

The number of goats on the study area has declined since the late 1940's when Casebeer et al. (1950) surveyed the area. Their population estimate of 174 goats may be viewed with skepticism since it is based on a single survey by horseback conducted as part of an extensive study of goat distribution in western Montana. However, they viewed their estimates as generally conservative, and the fact that Brandborg (1950) found 115 goats in the Deep Creek and South Fork of the Teton River drainages in the summer of 1948 supports that view. The population estimate of 130 goats obtained during the present study is considered realistic based on several surveys by aircraft and frequent surveys on foot of goat habitat within the study area during the course of field work.

Goat distribution was affected as numbers declined in regions of discontinuous goat habitat such as the South and Interior Units (Figs. 1, 2). Nursery groups (groups of goats with kids) were never observed during this study in the South Unit north of Deep Creek where they were found during summer surveys of the late 1940's (Brandborg 1950) and late 1960's (Martin 1969) (Fig. 4). Similarly, nursery groups were never found during this study in the Interior Unit in the Bruce Creek and North Fork of the Teton River drainages where they were regularly located in past summers (Martin 1969, Watts et al. 1971,

Watts et al. 1973, Erickson et al. 1977) (Fig. 4). Adult nannies typically display fidelity to their summer home ranges from year to year (Chadwick 1973, Smith 1976, and Rideout 1977). Therefore, if nursery groups were regularly observed in certain portions of the area previously, they should have been observed there sometime during this study. Brandborg (1955) reported that goats in Idaho and Montana were found in herds of 50 animals or less and that little movement occurred between herds regardless of relative herd densities. Possibly, small groups of goats, displaying fidelity to particular ranges separated by unsuitable habitat, were depleted by hunting, live-trapping, and natural losses such that they could not maintain their numbers.

Goat distribution remained the same as was reported in the past (Martin 1969, Watts et al. 1971, Watts et al. 1973, Olson et al. 1978) in the Front Unit. This was true in spite of the fact that goats there have sustained the greatest proportion of the harvest in the study area (Watts et al. 1972). In the Front Unit, goat habitat is extensive and largely unbroken by forests, creek bottoms, and roads (Figs. 1, 2), providing security that may allow goats more freedom to roam than in discontinuous habitat. Also, goats familiarize themselves with a large portion of the area through habitual summer movements to and from the Blackleaf salt lick (Figs. 6, 7). These habitat-directed behavior patterns may allow goats to fill depleted habitats in the Front Unit more readily than in the South or Interior Units.

Combined classifications of goats in the Front Unit made during June-September 1979 yielded a ratio of 78 kids observed for every 100 adult nannies. The same ratio was obtained during October-November of that year (Table 2). However, the ratio of kids/100 nonkids obtained each month during ground surveys in the Front Unit varied from 20 to 57 in June and September, respectively, and dropped back to 28 in November (Fig. 11). It should be noted that the ratios were generally highest when sample sizes were smallest (Fig. 11), but population structure data also indicate that certain classes of nonkids were more observable from the ground in early summer and late fall than during other seasons (Table 2).

Even though these observations were made away from salt licks, temporal sex-and age-specific observability paralleled the temporal sex- and age-specific pattern of use observed at Blackleaf salt lick in 1979 (Table 5). Apparently, adult billies were more mobile than adult nannies and kids in early summer, while the reverse was true in late summer. Chadwick (1973) reported that nannies with newborn kids in the Swan Range of Montana isolated themselves from other goats for 8-18 days following parturition. This may partially account for their low observability during early summer ground surveys. As summer progressed, nannies with kids made regular trips to artificial salt licks while adult billies were often solitary and remained on isolated, high-elevation summer ranges.

More than twice as many adults billies were observed for each adult nanny in October-November as in June-September 1979 in the Front Unit (Table 2). Average group sizes were smaller and their variation was less during October-November, largely reflecting the desegregation of many adult billies from the rest of the population and the pairing of males and females during the prerut (Geist 1964). Also, relocations of radio-equipped adults indicated that billies were much more mobile than nannies in October-November (Figs. 7, 8). This behavior increased their observability compared to that of the summer months.

Although not genetically isolated from the rest of the population, goats in the Front Unit may be considered a subpopulation with a characteristic sex and age structure. Goats captured at Blackleaf salt lick distributed themselves over most of the observed goat range in the Front Unit (Figs. 4, 5, 6), indicating the probable range of this subpopulation. The year-round nursery group range in the Front Unit was separated from those in the Divide and South Units by the Interior Unit, a 5-12 km zone where goats were seldom observed. None of the five adults radio-equipped in the Front Unit were relocated in the South or Divide Units during this study (Fig. 6) nor during a follow-up study by Tomasko (1980) in summer and fall of 1980. One adult nanny and one yearling billy were radio-equipped in the Divide Unit in the summer of 1980 and apparently remained there through November (Tomasko 1980).

The sex and age structure of the Front Unit subpopulation may be computed for 1979 using census data from March, 1980 and sex and age class proportions observed from June-November, 1979 (Table 2). The March census by helicopter approached total accuracy for the following reasons: (1) all goat habitat in the Unit was surveyed; (2) tracks in the snow could be followed to each group of goats, minimizing the effects of cover; and (3) five marked goats were observed, probably the only marked goats in the Unit at the time (see Survey Efficiency). The proportions of adult nannies and adult billies in the subpopulation were most accurately determined from October and November observations because solitary adult billies entered nursery group habitat at that time, making the sexes more equally observable. The proportions of kids, yearlings, and 2-yr-olds in the subpopulation were most accurately determined from June-September observations. Nursery groups were mobile in June-September (Fig. 7), and observations of subadults away from salt licks were therefore somewhat random. However, during October-November, nursery groups were stationary (Fig. 7), and observed proportions of subadults could therefore be biased toward the sex and age composition of these groups that were regularly located.

Thirty-five nonkids were observed in the Front Unit during the March, 1980 census by helicopter. Ten additional goats were observed that could not be classified by age. Therefore, up to 45 nonkids were

located during the census. Fifty percent of these nonkids were adult nannies, according to October-November, 1979 observations (Table 2), giving a total of about 23 adult nannies in the Front Unit. About 16 adult billies were present, based on October-November numbers per 100 adult nannies (Table 2). Similarly, about 18 kids, 2 yearlings, and 2 2-yr-olds were present in November, 1979, based on June-September numbers per 100 adult nannies (Table 2).

The proportion of 2-yr-olds observed in the study area population during summer and fall, 1979 apparently represented recruitment into the breeding population for that year. A 3-yr-old nanny with a kid was trapped at Blackleaf salt lick in June, 1979, but no 2-yr-olds were observed during the summer with kids by their side. Therefore, it appears that female goats first bred successfully at 2.5 yrs of age on the study area. This concurs with the findings of Lentfer (1955), who studied an expanding population in the Crazy Mountains of Montana and found that goats became sexually mature at that age.

Annual (summer) kid production from 1967 through 1979 has been negatively correlated ($p < .01$) with mid-winter snow depths of the same year (Fig. 10). Brandborg (1955) concluded that kid production in certain Idaho goat herds varied with the severity of the winter immediately preceding parturition. Smith (1976) reported fluctuating kid production in the Bitterroot Range of Montana in contrast to the relatively constant kid production, but fluctuating recruitment, over

the same period of years reported by Rideout (1974) for goats in the nearby Sapphire Mountains regardless of winter severity (as assessed by subjective judgements). Chadwick (1979) reported that juvenile mortality seemed to vary with winter severity in Glacier National Park, Montana, yet annual kid production was nearly constant over a 3-year period.

Fecal analysis of food habits revealed that browse comprised the greatest proportion of plants consumed during June-September (Appendix, Table 18). However, observations of feeding goats indicated that forbs were most often selected in summer (Appendix Table 19). The degree of analysis performed on fecal material in this study (1 slide prepared per pellet group, 20 fields read per slide) did not justify statistical comparisons of percent composition of the diet for each component. Instead, in this case, percent relative density values of plant fragments in the feces should be used only to rank various components of the diet in terms of the amount ingested (Hansen pers. comm.). Therefore, browse may not actually form as great a proportion of the summer diet as percentage figures obtained from fecal analysis indicate.

However, the discrepancy between the results of fecal analysis and direct observations of goat food habits during the summer remains large. In fact, Shepherdia canadensis, the major browse species

identified in the summer diet by fecal analysis (Appendix Table 18) was not found on the 13 summer feeding sites where vegetational composition was systematically sampled (Appendix Table 16). Assuming that plant species were accurately identified during fecal analysis, it appears that summer observations of mountain goat habitat use may have been biased in favor of high-elevation, open vegetation structures where goats were easily visible (Tables 9, 10, 14, 15). Goats may have fed to a greater extent than observed in more timbered or brushy structures, or in old burns at lower elevations during the summer months where Shepherdia canadensis was commonly found. Goats adopted their daytime routine of feeding, bedding, and licking salt during bright, moonlit nights in the Swan Range of Montana (Chadwick 1973). Differential habitat use by goats during the day compared to that of the night is a possibility on the study area and also could account for part of the discrepancy in food habits analysis.

In October and November, grasses comprised the major portion of the diet as determined both by fecal analysis and direct observation (Appendix Tables 19, 20). Festuca spp. made up most of the discernable plant fragments in fecal samples and F. ovina was the species most heavily utilized on feeding sites examined in the fall. During the summer, when goats exhibited a fairly general diet of forbs and shrubs, no single forage species was found in as many as 40 percent of the sample plots on the feeding sites examined (Appendix Table 16).

However, during October-November, Festuca ovina occurred in over 50 percent of the 2 x 5 dm plots used to sample the vegetative composition of feeding sites (Appendix Table 16). During the summer, a more general diet corresponded with larger home ranges for adult nannies compared with October and November, when a more restricted diet and more restricted feeding site selection corresponded with restricted adult nanny home ranges (Fig. 7).

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APPENDIX

Table 16. Percent relative frequency of plant species occurring on mountain goat feeding sites as determined with 2 x 5 dm plots.

Species	June-September[1/]	October-November[2/]
GRASSES AND SEDGES		
Agropyron sp.	0.0	20.0
A. caninum	20.0	17.5
A. scribneri	0.7	0.0
Bromus sp.	0.7	0.0
B. carinatus	10.7	2.5
B. ciliatus	0.7	0.0
B. inermis	0.7	0.0
Calamagrostis purpurascens	3.6	0.0
Carex sp.	17.1	7.5
Festuca idahoensis	2.1	0.0
F. ovina	4.3	52.5
F. scabrella	2.9	0.0
Phleum alpinum	4.3	0.0
Poa sp.	9.3	0.0
P. alpina	2.9	20.0
P. cusickii	2.9	0.0
P. interior	2.1	0.0
P. nervosa	6.4	0.0
P. rupicola	0.7	0.0
P. sandbergii	3.6	0.0
Sitanion hystrix	0.7	0.0
Trisetum spicatum	9.3	0.0
Unknown grass	10.0	0.0
FORBS		
Achillea millefolium	47.9	27.5
Anemone multifida	13.6	0.0
Antennaria contorta	5.0	0.0
Arenaria sp.	7.9	15.0
A. capillaris	4.3	0.0
A. obtusiloba	7.9	0.0
Arnica sp.	10.7	0.0
A. mollis	6.4	0.0
Asteraceae	11.4	0.0
Aster sp.	0.7	0.0

1/ 13 feeding sites for a total of 140 2x5 dm plots.
2/ 4 feeding sites for a total of 40 2x5 dm plots.

Table 16 continued.

Species	June-September	October-November
Astragalus sp.	38.6	5.0
Bupleurum americanum	3.6	0.0
Campanula rotundifolia	2.1	0.0
Castilleja sp.	0.7	0.0
Cerastium berringianum	17.9	0.0
Cirsium sp.	12.1	5.0
Compositae	5.7	0.0
Dryas octapetala	7.1	0.0
Epilobium sp.	7.1	0.0
E. gladulosum	1.4	0.0
Erigeron sp.	15.4	40.0
Fragaria virginiana	8.6	0.0
Galium sp.	22.1	45.0
G. boreale	13.6	0.0
Gentiana calycosa	7.1	17.5
Hedysarum alpinum	5.0	0.0
H. sulphurescens	5.0	0.0
Pedicularis contorta	5.0	5.0
Penstemon confertus	2.1	0.0
P. ellipticus	2.1	0.0
Phacelia hastata	13.6	22.5
Physaria sp.	6.4	0.0
P. didymocarpa	2.1	0.0
Polygonum sp.	2.9	0.0
Potentilla sp. or Geum sp.	9.3	0.0
Potentilla uniflora	0.7	0.0
Ranunculus sp.	18.6	12.5
Ribes sp.	1.4	0.0
Rosa sp.	5.7	0.0
Rubus sp.	3.6	7.5
Rumex sp. or Oxypia sp.	2.9	0.0
Saxifragaceae	9.3	1.0
Sedum sp.	9.3	27.5
Senecio sp.	15.7	0.0
S. canus	1.4	0.0
Solidago sp.	0.7	0.0
S. multiradiata	1.4	0.0
Townsendia sp.	7.1	0.0
Umbelliferae	7.1	0.0
Zigadenus sp.	7.9	0.0
Z. elegans	2.1	0.0
Unknown forb	28.6	32.5

Table 16 concluded.

Species	June-September	October-November
SHRUBS		
Arctostaphylus uva-ursi	5.0	0.0
Artemesia michauxiana	2.9	12.5
Potentilla fruticosa	5.7	7.5
Salix sp.	1.4	12.5
Unknown	2.1	12.5
TREES		
Abies lasiocarpa	0.7	2.5
Pinus flexilis	0.7	0.0

Table 17. Plant species identified on two mountain goat feeding sites in December, 1979.

Agropyron sp.
Arctostaphylus uva-ursi
Bromus inermis
Dryas octapetala
Erigeron sp.
Festuca idahoensis
Gentiana calycosa
Pinus flexilis
Potentilla fruticosa
Pseudotsuga menziesii
Ranunculus sp.
Rosa sp.
Salix sp.
Saxifragaceae
Shepherdia canadensis
Trisetum spicatum

Table 18. Mean percent relative density of discerned plant fragments in mountain goat fecal samples collected in 1978 and 1979 (based on 20 fields per slide).

	June-July			Aug.-Sept.			Oct.-Nov.			Dec.		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
GRASSES & SEDGES	12	10.77	10.16	12	25.01	25.19	11	82.61	11.90	6	47.15	29.36
Agrostis scabra	12	1.01	1.87	12	0.48	1.68	11	0.60	1.52	6	0.0	0.0
Carex	12	0.0	0.0	12	4.05	5.64	11	0.74	2.47	6	2.78	3.34
Deschampsia caespitosa	12	0.44	1.06	12	0.67	1.29	11	5.00	5.05	6	1.20	1.34
Festuca	12	7.38	8.05	12	18.03	24.18	11	75.02	13.29	6	43.16	27.96
Phleum	12	0.24	0.84	12	0.0	0.0	11	0.0	0.0	6	0.0	0.0
Poa	12	1.73	2.85	12	1.64	2.73	11	1.24	2.34	6	0.0	0.0
Sitanion	12	0.0	0.0	12	0.12	0.43	11	0.0	0.0	6	0.0	0.0
FORBS	12	8.98	10.83	12	19.56	18.21	11	8.97	9.09	6	1.58	2.78
Achillea	12	0.0	0.0	12	0.54	1.27	11	0.0	0.0	6	0.0	0.0
Antennaria-Cirsium	12	0.0	0.0	12	0.0	0.0	11	0.0	0.0	6	0.38	0.93
Astragalus	12	1.70	2.91	12	5.93	5.87	11	1.25	2.43	6	0.38	0.93
Borage	12	0.0	0.0	12	0.0	0.0	11	1.19	2.94	6	0.0	0.0
Composite	12	0.13	0.44	12	1.7	3.3	11	0.48	1.60	6	0.0	0.0
Delphinium	12	0.29	0.71	12	0.3	1.05	11	0.0	0.0	6	0.0	0.0
Descurainia	12	2.57	3.77	12	7.99	13.86	11	1.05	2.09	6	0.0	0.0
Draba	12	0.0	0.0	12	1.24	2.93	11	0.27	0.89	6	0.0	0.0
Epilobium	12	0.0	0.0	12	0.32	1.10	11	0.0	0.0	6	0.0	0.0
Lesquerella	12	2.33	5.85	12	0.0	0.0	11	0.0	0.0	6	0.0	0.0
Liliaceae	12	0.0	0.0	12	0.0	0.0	11	3.35	4.98	6	0.0	0.0
Lupinus	12	0.0	0.0	12	0.0	0.0	11	0.12	0.42	6	0.0	0.0
Phacelia	12	0.0	0.0	12	0.69	1.33	11	0.0	0.0	6	0.0	0.0
Plantago	12	0.0	0.0	12	0.0	0.0	11	0.18	0.59	6	0.0	0.0

Table 18 concluded.

	June-July			Aug.-Sept.			Oct.-Nov.			Dec.		
	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD	N	$\bar{X}$	SD
Potentilla-Geum	12	0.99	1.48	12	0.34	1.18	11	0.0	0.0	6	0.0	0.0
Trifolium	12	0.43	1.50	12	0.28	0.96	11	0.0	0.0	6	0.0	0.0
Unknown forb	12	0.00	0.00	12	0.26	0.92	11	1.07	3.03	6	0.44	1.09
SHRUBS	12	78.74	15.88	12	49.26	28.74	11	16.70	32.08	6	37.65	20.37
Berberis	12	0.0	0.0	12	0.0	0.0	11	1.43	1.91	6	7.79	5.43
Prunus	12	0.0	0.0	12	0.26	0.92	11	0.0	0.0	6	0.0	0.0
Rosa	12	5.19	4.0	12	2.66	3.34	11	0.34	0.75	6	0.0	0.0
Rubus	12	1.20	2.2	12	0.87	2.2	11	0.77	1.74	6	0.38	0.93
Salix	12	30.57	25.2	12	32.65	22.46	11	4.80	6.01	6	1.52	3.71
Shepherdia canadensis	12	42.3	27.89	12	12.04	21.84	11	0.45	1.05	6	27.97	24.58
Sibbaldia procumbens	12	0.35	1.22	12	0.78	1.88	11	0.0	0.0	6	0.0	0.0
TREES	12	0.54	1.26	12	5.57	17.49	11	0.50	1.16	6	13.62	11.57
Pinus	12	0.54	1.26	12	5.57	17.49	11	0.50	1.16	6	0.38	0.93
Pseudotsuga	12	0.0	0.0	12	0.0	0.0	11	0.0	0.0	6	13.24	11.95
OTHER	12	0.0	0.0	12	0.29	0.99	11	0.14	0.47	6	0.0	0.0
Equisetum	12	0.0	0.0	12	0.29	0.99	11	0.14	0.47	6	0.0	0.0

Table 19. Mountain goat forage species determined from direct observation of 15 feeding sites.

June-September	No. of Feeding Sites	October-November	No. of Feeding Sites
Arnica sp.	1	*Agropyron sp.*	1
Arnica mollis	1	*A. caninum*	1
Castilleja sp.	1	*Erigeron sp.*	1
Epilobium sp.	1	*Festuca idahoensis*	1
Erigeron sp.	4	*F. ovina*	2
Gentiana calycosa	1	*Galium sp.*	1
Hedysarum sulphurescens	1	*Pedicularis sp.*	1
Pedicularis sp.	2	*Phacelia hastata*	1
Phacelia hastata	1	*Rubus sp.*	1
Phleum alpinum	1		
Poa alpina	1	December	
Ranunculus sp.	1	*Bromus inermis*	1
Ribes sp.	2	*Festuca idahoensis*	1
Senecio sp.	2	*Pinus flexilis*	1
Trisetum spicatum	1	*Shepherdia canadensis*	2
		Trisetum spicatum	1

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