The Canadian Field-Naturalist

VOLUME 81 JANUARY-MARCH 1967 NUMBER 1

OBSERVATIONS OF ROCKY MOUNTAIN GOATS ON MOUNT WARDLE, KOOTENAY NATIONAL PARK, BRITISH COLUMBIA

JOHN C. HOLROYD

National Parks Service, Banff, Alberta*

PROBABLY no large mammal in the Canadian Rockies has received less study than the Rocky Mountain goat (*Oreamnos americanus*). During 1962, 1963 and early 1964, I had the good fortune to live adjacent to a readily accessible goat range. During that period my duties as District Park Warden brought me into frequent contact with goats and I was able to spend a considerable amount of time observing them, often at close range, and recording their activities. The more significant of these observations are recorded here in the hope that they will help to further our knowledge of this unique species.

DESCRIPTION OF THE STUDY AREA

Location

The study area is bisected by the 51st parallel of latitude and the 116th meridian. Mt. Wardle occupies the southern extremity of the Vermilion Range which is the second mountain range west of the continental divide, in Kootenay National Park, British Columbia. It lies about five miles north of the confluence of the Vermilion and the Kootenay Rivers and divides the two watersheds. Goats on this range occupy an area about five miles long and four miles wide, extending along both the north-east and south-west slopes of the mountain (Figure 1). In altitude their distribution extends from about 4000 feet on the valley floor to the summit of Mt. Wardle which is about 9200 feet.

Nature of the range

Most of this goat range is quite open. Much of it was once covered with Douglas fir (*Pseudotsuga menziesii*), which was largely destroyed by fire many years ago. Some isolated clumps of mature Douglas fir remain and some second growth fir along with second growth lodgepole pine (*Pinus contorta* var. *latifolia*) and aspen poplar (*Populus tremuloides*) have become established on some of the lower slopes. The north-east facing part of the area is very rough, rocky and precipitous, with broken ledges, cliffs, avalanche slopes and little timber over 5000 feet. The south-west slope of the range is less steep and rugged, consisting of scree and talus slopes and some grassed slopes which are interspersed with rock ridges and cliffs. Timber is also sparse here above the 5000 foot level.

*Present address: St. Lawrence Island National Park, Box 469, R.R. No. 1, Mallorytown, Ontario.

Mailing date of this number: 24th February, 1967.

TABLE 1.—Kid and yearling ratios on Mount Wardle, 1962, 1963 and 1964

Date	Total Seen	Kids	Yearlings	% Kids	% Yearlings
June 25, 1962	40	13	9	32.5	22.5
July 2	35	12		34.28	
April 9, 1963	14	7		50.	
May 24	21	3*	8	14.28*	38.09
May 25	19	1*	7	5.26*	36.84
May 25	47	9*	11	19.15*	23.40
May 26	53	14*	14	28.30*	28.30
May 27	63	18	16	28.57	25.39
May 30	40	11	10	27.5	25.
July 2	25	8	7	32.	28.
July 4	30	13		43.33	
July 4	8	2		25.	
Nov. 14	7	2		28.57	
Nov. 20	35	12		34.28	
Nov. 28	16	6		37.5	
Jan. 9, 1964	29	9		31.03	
Jan. 14	10	4		40.	
Jan. 20	43	14		32.55	
Jan. 23	53	17		32.07	
Feb. 3	50	15		30.	

*Counts made during kidding period and thus kid crop not complete

Climate

This range is fairly dry, receiving less moisture and more wind than much of the surrounding country. Both of these factors contribute to the suitability of the mountain as a goat range in spite of the sparseness of vegetation. Light snowfall and strong winds, which remove snow from the exposed sites, both contribute to the availability of forage in winter.

Temperatures in the area range between —40 degrees (or colder in a few instances), in winter to the high 80's and occasionally 90's in summer. Extreme cold periods are usually of short duration.

POPULATION SIZE AND COMPOSITION

Goat numbers

Counts were taken from the valley floor as well as while on foot patrol of the range. Binoculars (9 x 50) were used when needed. Counts were taken to determine population size at times when goat distribution was most concentrated.

A total of 50 goats was counted in the band on October 30, 1962. On May 6, 1963, 55 were counted, before any young of the year were born. On November 13, a total of 62 was counted and another count taken November 14 included seven not seen the day before, bringing the known population to 69. I interpret this increase in size of count to reflect an actual population increase rather than an increase in experience on the part of the observer in finding goats. If an absolute count could be taken, I doubt that there would be more than 75 in the band at the time of this writing.

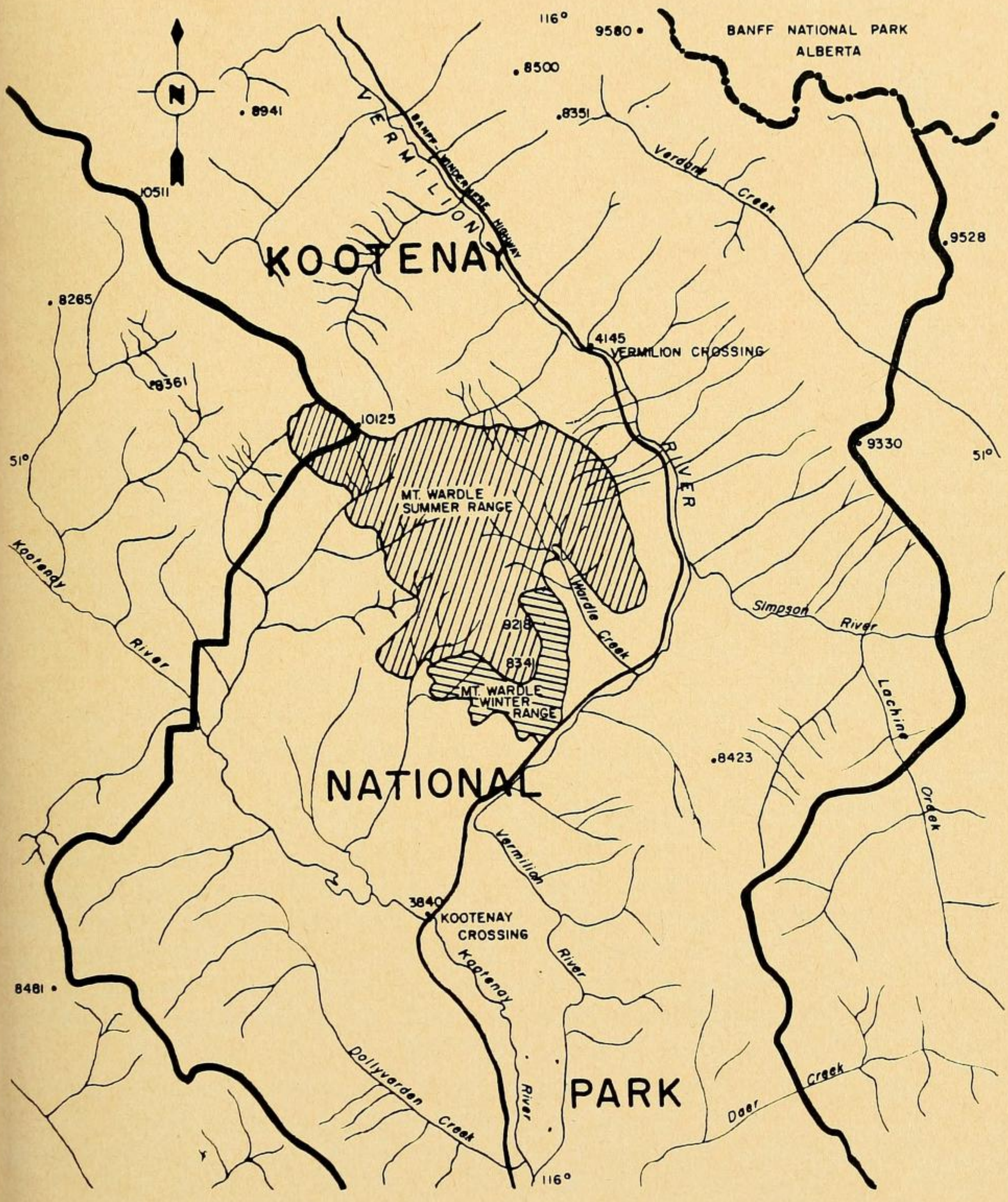

FIGURE 1. Map illustrates location of study area and approximate extent of summer and winter range. Scale: 2 miles to 1 inch.

Herd composition

The age classes of goats observed throughout the year are summarized in Table 1. In order to eliminate bias, identification of goats in groups was included only if every member of the group could be identified.

Yearlings made up 28.4 per cent, and kids 33.7 per cent of all recorded observations. The percentage of kids is computed with the exclusion of those

counts taken during kidding time. As the crop of kids was not complete such counts would be misleading.

The sexual composition of groups of goats is difficult to determine. It is almost impossible to determine sex of young kids from any distance. Mature goats are fairly easy to sex at close range, but almost every group contains an individual or two about which one cannot be certain, especially in the age groups from one to three years old. Thus a quantitative compilation of sex ratio data has not been attempted. However, the number of mature males is certainly less than that of mature females on this range.

GOAT CHARACTERISTICS

Pelage and molt

The goats in this area attained their full coats by late fall; by November guard hair was very long and wool undercoat was extremely heavy and thick. At that time they were very clean and white. Beards were long and thick as were the "knickers" which extend to the wrist joints and hocks. This coat was maintained throughout the winter into late spring and even early summer. In the month of June many goats were seen wallowing in dirt baths, and pawing dirt over their backs. They sometimes laid on one side and rubbed back and forth with legs and head, while at other times they laid upright, pawing dirt over themselves with a "side arm" movement of the front legs. The hair loosened gradually and began to come off on bushes, rocks, and in dirt wallows. If the weather is hot at this time they are obviously uncomfortable and can be seen panting, even when standing still or lying down. If there are any old snow banks in the area they will lie on them to keep cool.

Yearling goats were the first to shed completely. This is contrary to Casebeer, Rognrud and Brandborg (1950) who studied goats in Montana. Those authors found that yearling goats were later in shedding than older age groups. On June 25, 1962, yearling goats on Mount Wardle were completely shed while older animals still carried considerable winter hair. On July 13 two mature males had shed their winter coats with the exception of a few small patches of old hair.

Shedding starts around the head, neck, and shoulders, where rubbing and scratching is the easiest. During June and early July, goats on Mount Wardle are at their poorest in appearance, although they may have improved slightly in flesh since April. During shedding, great patches of hair and wool could be seen hanging from the legs and bodies of the goats and were frequently found snagged on bushes and trees where the goats had passed. The goats are very dirty at this time and often become so discoloured that they blend very well with the grey limestone and can be quite hard to see. When shedding is completed the goat is left with a very short fine coat of new hair which had started growing under the old winter coat. This new coat continues to grow all summer and fall until the full coat is attained again by late fall. The new coat appears surprisingly clean immediately after the loss of the dirty old one, but it soon yellows and remains quite yellow through the summer. Apparently snow in the fall and winter helps to clean it again.

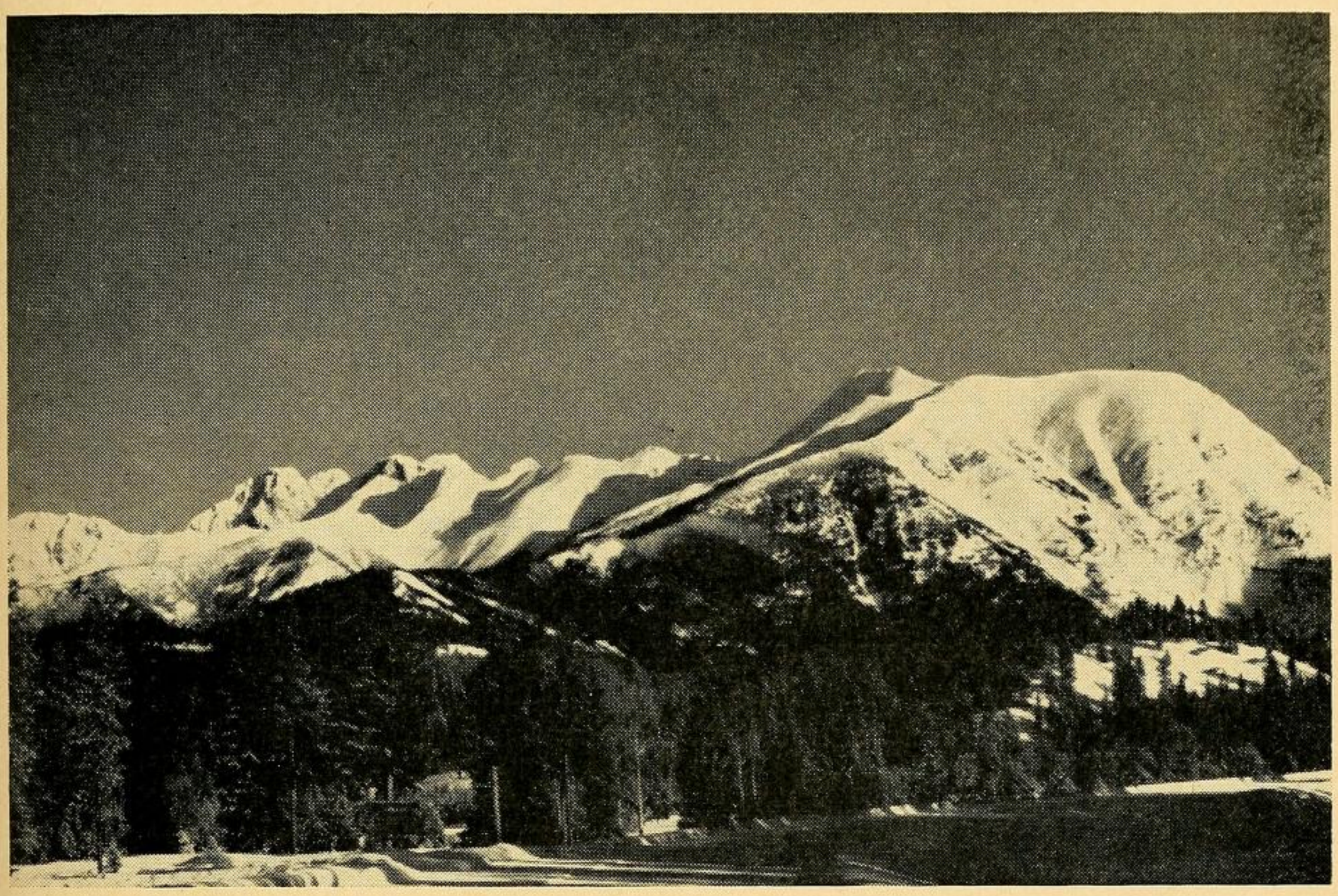

FIGURE 2. Mt. Wardle showing southern exposure of goat range.

Although goats are usually thought of as being all white, this is not always the case. Many young goats have some dark or black hair along the dorsal line of the tail and back, around the eyes and the hair line of the hooves. The dark hair in the tail is often noticeable enough to be seen from some distance. This dark hair seems to lessen with age and adult goats have little if any of it. Seton (1927) reported that many mountain goat hides at the American Museum of Natural History contained a number of coarse brown hairs along the back, rump and tail. Brandborg (1955) mentioned that a day old kid and a yearling in Idaho had dark hair along their backs and tails. Conversely, Casebeer *et al* (1950) stated that during a study of mountain goats in Montana, no such colouration was found.

Horns

It was possible to measure the horns of five goats from Mount Wardle. The horn of a male kid about 7 months old, which was killed in an avalanche in January, 1962, measured 2½ inches. Horns of a male kid about 6 months old, which I collected on November 21, 1963, measured 1⅝ inches. This kid had been sick for some time, which might have influenced horn growth. The horns of two billies which died after their fifth growing season were 8¼ and 9 inches long. A nanny horn of 9 growth seasons measured 9¼ inches. The last three measurements were of horns picked up on the range, causes of death were unknown. Ages were determined from annual growth rings on the horns, the nearest ring to the tip marking the end of the second growing season. There is no growth ring after the first growth season (Brandborg, 1955).

Deformities in horns were fairly common in the band. In some cases one shell was missing, in others the entire horn, both shell and core, had been broken off. In two of these cases the horn was of normal curvature with just the tip missing, but in one instance the broken horn had grown straight up from the head while its mate was curved normally. I observed this goat in the field on one occasion and found her head after she had died from unknown causes some time later. The normal horn was 9¼ inches long and the deformed horn was 6¼ inches. The core inside the deformed horn was almost perpendicular to the skull. It seems likely that the injury occurred at about the end of the first year and the resulting straight horn was grown thereafter. I also saw a live male goat with a similarly deformed horn.

Although goat horns are extremely sharp and make very formidable weapons, I have never seen goats actually fighting. In all seasons of the year I have seen goat threaten with their lowered horns and occasionally I have seen one goat pursue another with lowered head. Fights are probable and would likely result in fatal or near fatal wounds. On the other hand, their horns would seem to be an excellent defensive weapon to use against predators. Cahalane (1947) stated that goats have been known to kill black and grizzly bears by horn thrusts into the heart, lung or abdomen.

Hooves

The feet of the goat are particularly well adapted to their environment. The hoof is quite short and broad but also quite sharply pointed. The inner pad almost protrudes from the horny outer shell. This pad is of a tough rubbery material which affords excellent traction on steep rock while the outer shell is very hard and tough and will support the animal's weight even when standing on a very minute foothold, where only a small fraction of the hoof surface is bearing.

Voice

Young mountain goats have a very distinctive voice which they use a great deal. A young kid, separated from his mother by as little as eight or nine yards, will bleat almost continuously until reunited. This trait continues through the first year. Several times in the fall I have sat among widely scattered groups of as many as 40 or 50 goats and heard bleating among the kids almost continuously. I have often heard yearling goats bleat as well, sometimes when alarmed and other times for no apparent reason. In older goats the voice is rarely used. The call of the billy somewhat resembles that of a cow elk (*Cervus canadensis*) although more hoarse. On November 13, 1963, I heard two different billies bleat much the same as kids do, although with a much lower pitch. Both males were moving between groups at the time and it seems likely that this voice was associated with the rut, though more as a call than as a challenge. It has been described as a coarse grunt by Seton (1927). On three occasions I also heard females bleat with much the same sound as that made by male goats. On one of these occasions, in July 1963, I attributed the call of the goat to its having been startled by the observer. Two other times I have heard females bleat when separated from their young.

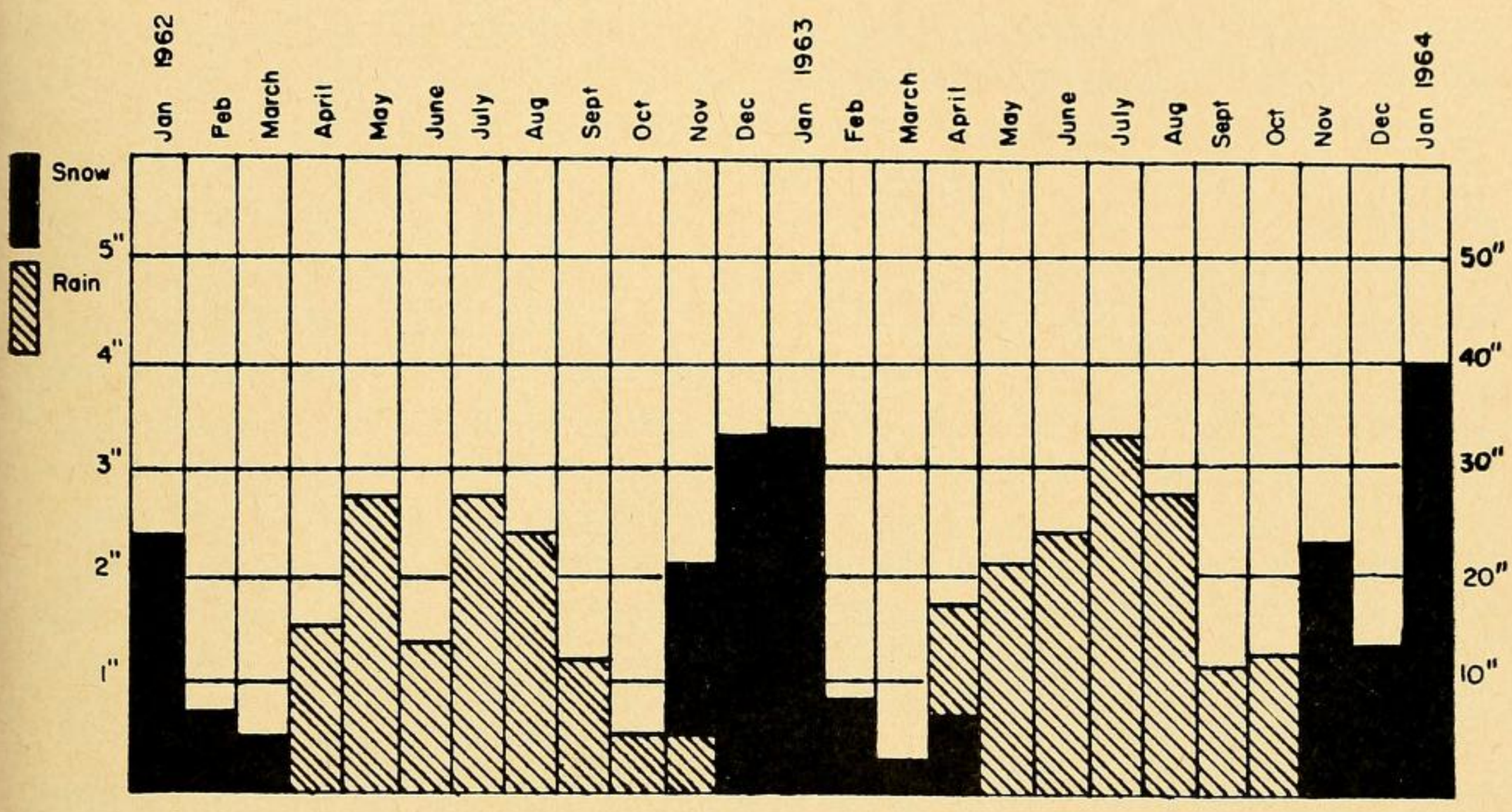

FIGURE 3. Weather records from Kootenay Crossing, five miles south of the study area, January 1962 to January 1964.

This vocalization was accompanied by lifted head and searching looks. In one of those instances the kid, which was a few days old at most, was lying down in the shelter of a rock overhang; the mother walked a few steps until able to see it and then returned to her feeding.

SENSES

Eyesight

The eyesight of goats seems to be very acute, probably comparable to that of bighorn sheep (*Ovis canadensis*). Like many mammals they detect moving objects much more readily than motionless ones. I have been able to stalk goats in the open quite closely as long as I remained motionless when the animal was looking in my direction. However, they would detect very slight movement from some distance. This characteristic was reported by Casebeer *et al* (1950) and Brandborg (1955). Like bighorn sheep, goats seem to have a very wide angle of vision. Even when facing at a 90 degree angle from the stalker, they are able to detect slight movement.

Hearing

Although the hearing of goats is good, it does not seem to be as highly developed as their eyesight. I have tested them with progressively louder noises and noted that they reacted only after the noise became comparatively loud. Movement of rock and shale does not unduly disturb them probably because they themselves are constantly dislodging rocks.

Smell

The sense of smell is well developed in mountain goats but in this band, which enjoys a large measure of protection from hunters, they usually confirm their suspicions by eyesight. Often a goat which had not seen me would approach upwind toward me until able to confirm what its sense of smell had told it. Smell seems to play a large part in mating activity. All advances by the male are accompanied by smelling of the female.

LIFE HISTORY OBSERVATIONS

Mating

Mating in this band of goats takes place in November. In 1963 I observed actual mating on November 13, 14, 20 and 24. Although I watched for some time each day after that, I saw no more rutting activity with the exception of the odd mature male wandering from group to group. After November 28 mature billies isolated themselves from the females and younger goats. In most cases they went slightly higher and farther west on the range than the rest of the band. They were observed singly and in pairs but rarely with more than two in a group through the following winter.

Male goats do not herd a band of females together as do elk. Rather, the females go their various ways and the billies roam from one group to another, looking for receptive females. As in most ungulates, the male goat seems to be able to tell when the female is approaching oestrus. Upon finding a nanny in this stage the billy will stay with her constantly, often attempting

to breed before she is ready. At times the nanny will avoid the male by running, only to be followed closely. At other times the female will lie down to avoid the billy, only to be prodded to her feet eventually. Another approaching billy is ignored until he comes within 25 or 30 feet. The defending male then threatens the intruder by strutting toward him with arched neck and lowered horns. In all such cases I witnessed, the intruder made a hasty retreat. The male continues to court the female with much rubbing, licking, nuzzling and smelling. Eventually the nanny reaches her receptive period and mating takes place. One nanny I observed was bred by the same male five times in less than an hour. The female lay down only to be prodded and nuzzled by the billy until she got to her feet again. She would no longer stand for the male after that, and moved away with each additional attempt he made to force his attentions on her.

During the rut mature billies often wallow in dirt. The male goat will sit on his rump, braced upright with one front foot, and paw dirt all over his underside and hind quarters. This behaviour is usually accompanied by frequent urination, with the result that the billies become much dirtier than the females and younger goats and are easy to distinguish at a distance.

Several times during the rut I saw five or six month old kids mounting others of the same age. This does not mean that mating took place, but may be an indication that the rutting urge starts quite early. More probably it is merely play. In no instance did I see a mature male show any interest in a yearling female, even when in the same group with one. Young billies of a year and a half, or two and a half, definitely show sexual interest during the rut although they were less aggressive than older males. They were often seen near an older goat which had possession of a female in heat. They did not paw the dirt and strut with arched neck in an obviously masculine way as did the older billies. I did not see any yearling or two-year-old males mounting females. I doubt that they participate in mating except in isolated cases where no older male is present. Mature males, if unattached, keep up a constant patrol of all goats on the nearby range and are aware of any female approaching oestrus, long before she is receptive. Evidence collected by Lentfer (1955) in the Crazy Mountains in Montana indicated that first breeding in females occurred at approximately two and a half years.

One incident recorded on November 22, 1963, illustrates the mating season behaviour of goats very well. A very large male was travelling in a southerly direction along the mountainside. Moving in the opposite direction on a converging course was a group consisting of two nannies, two kids and one young billy. Eventually the large billy met the group. The billy, visibly alert, ran over to the first nanny, smelled her genital region, ran to the second, smelled her similarily and then continued on his way south without so much as a backward glance. The young billy and the two kids moved off the trail as the old male went past.

On another occasion I made a lengthy observation of a young female, of two years plus, and a mature male. The nanny was in heat and, after some time, copulation occurred once. The male was distracted a great deal by another younger mature male and frequently rushed at him to chase him away.

The young male would flee and then immediately follow the older goat back again. In one instance the older goat chased him at a fast run for about 70 yards, only to be followed back to the female again. The younger male made no pretense of fighting. After an hour or more the female moved about 30 yards away from the old billy and the younger male immediately took possession of her, only to be chased away again before making any conquest. The nanny appeared to be equally content to be accompanied by either male.

Birth

Virtually all females bear their kids in the same area on this range. Fortunately for observation purposes, much of the kidding area can be observed from the highway with binoculars. The kidding area is very rough, with cliffs and ledges occasionally broken by gullies and benches.

Each nanny chose a high and inaccessible shelf, usually on a cliff face, and remained there until after her delivery. Most of the females isolated themselves not more than 24 hours before the birth of their young.

Although long since weaned, the yearling kids followed the nannies right up to within a very few days of the birth of the new kid. At this time they were driven off by their mothers and they formed temporary yearling groups. These groups of yearlings seemed particularly active, as though they had been liberated from strict discipline. They raced around quite precipitous cliffs with more careless abandon than I had seen in any other age group of goats at any other time.

The earliest date of parturition I have recorded on this range was May 24, 1963, and the latest date was June 3 in 1962. The arrival of the new crop of young takes place in a surprisingly short period of time. In 1962 all the kids appeared to be born within four days, so in 1963 I tried to confirm this by spending time watching each individual goat. In 1962 the first birth was observed on May 29 and in 1963 the first kid arrived on May 24, five days earlier than the previous year. By May 27, 1963, I was able to count 18 newborn kids and, although I watched carefully, I saw no new births after that and was never able to count more than 18 kids on the range through the following summer.

Among the 18 kids born in 1963, I felt positive in the identification of at least two sets of twins. Both the nannies involved gave birth on isolated ledges, quite remote from other goats. In both instances, I observed the nannies before and after parturition. They were isolated from the rest of the goats in the area nearly 24 hours before giving birth and remained isolated until the day following the birth of their twins. Both were seen carefully leading their young over very rough terrain, before being joined by other goats.

In 1962 I observed at very close range, one set of twins at an age of only a few hours. The nanny was still quite wet and disheveled from the delivery and the kids showed signs of having dried off only recently. The fact that the female allowed both kids to nurse appears to confirm their authenticity as twins. The following day they were still in about the same place and were still isolated from the rest of the herd.

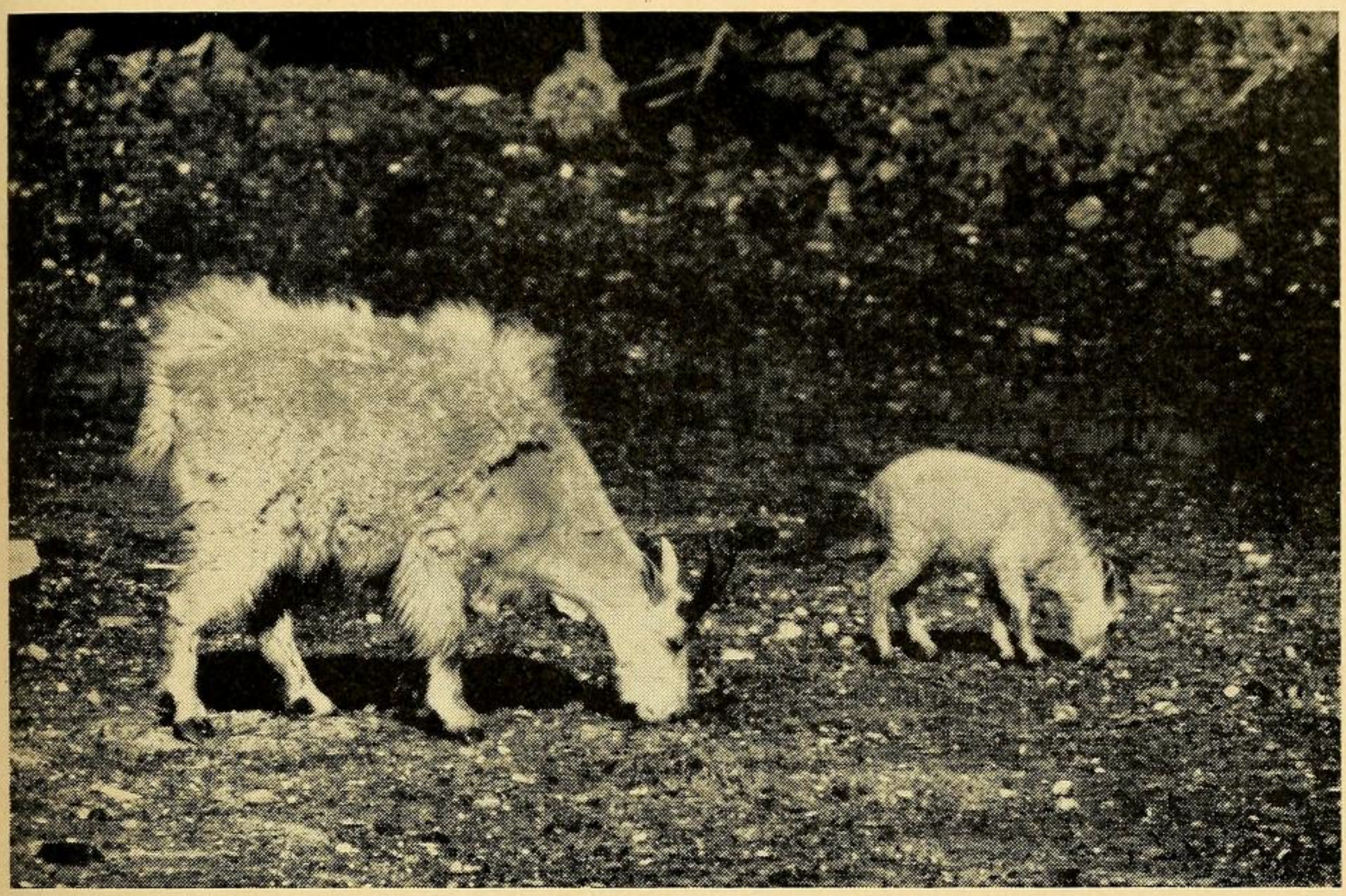

FIGURE 4. Nanny with young kid, taken in late June. Head and neck are shed of winter hair while rest of winter coat remains.

By using November 19 as an average breeding date (midway between the earliest – November 13, and the latest – November 24 – mating activity seen) and May 29 as an average kidding time (midway between May 24 – the earliest, and June 3 – the latest date of parturition seen) I have tentatively determined a gestation period of 191 days. This is almost two weeks longer than the 178 days reported by Seton (1927) and much longer than the 147 days reported by Keneth (*in* Rand, 1948). I believe the 191 day gestation period is probably accurate within a week in either direction for goats in this area.

Young

Very young goats closely resemble the young of bighorn sheep. Their coat is white but their size and appearance are similar. By the time the young goats are five or six weeks old, this resemblance has been lost and they begin to look like the adult goat.

Kids begin to make use of grass and browse soon after birth. It was not unusual to see kids two or three days old nibbling the same bush as their mothers. Brandborg (1955) also noted that kids took forage.

The first few days after their kids are born, the mothers remained constantly within a few feet of them. I never saw a mother goat go away and leave her young hidden during their first days of life as cow elk or doe mule deer (*Odocoileus hemionus*) will do. This agrees with observations of Casebeer *et al* (1950). When the nanny is feeding, her kid is immediately by her side or bedded within a few feet of her. Within two weeks, however,

the young are able to follow their mothers almost anywhere. The mothers remain quite attentive but no longer shepherd them quite so closely.

After a few days of isolation after parturition, sometimes only one or two, nannies were often rejoined by yearlings. These yearlings had lost their status as kids and were kept at a distance from the newborn young by the mother. On May 27, 1963, I observed a mother with a newborn kid followed by four yearlings. This was an extreme case, but I have often seen nannies followed by one or two yearlings, only two or three days after the birth of the new kid. Perhaps after a few days of being on their own the yearlings feel a need of being accepted back into the family. They are tolerated by the nanny but are treated no differently than any other intruder if the welfare of the newborn kid is threatened in any way.

Ability to travel in very precipitous and rugged country is not manifested immediately after birth in kids but is inborn to the extent that it can be learned very early. On May 29, 1962, I was able to approach very close to a nanny which had recently given birth to twins (mentioned previously in the section on birth). On my approach the nanny tried in vain to lead her young from their place of birth on a narrow rock shelf. The twins were quite able to walk but were unable to negotiate a step in the rock only 12 or 14 inches high. The mother finally climbed down to a spot below the twins and, while attempting to follow her, they fell and rolled a distance of 30 feet or more. Upon landing on a scree slope, both twins promptly got up and followed their mother along a fairly flat ledge and then back onto the scree and around a corner. Neither goat appeared harmed by the fall. The next day they were back on a continuation of the same ledge.

On May 27, 1963, I watched a mother goat which appeared to be teaching her single kid to climb and travel in precipitous terrain. Several times the nanny mounted a large rock and then jumped to another across a gap of about four feet. After each time the nanny did this, the kid would climb up and repeat the same jump, although much more awkwardly. This kid was not more than three days old since I observed the arrival of the first kids that spring on May 24.

BEHAVIOUR AND ACTIVITIES

Seasonal range use

Different parts of the range were utilized in different seasons. In winter goats were on lower extremities of range and confined largely to the southern end of it. During that time they were seldom above 5500 feet and their movement was quite restricted. A small group of goats may not move more than two or three hundred yards in a week. That remains the case well into May. With the approach of kidding time they sought slightly higher areas in the broken rugged part of the range on the east and north-east slopes. After kidding they gradually dispersed higher and farther afield until in mid-summer they were often found on the very top of the mountain and several miles both north and north-west of their winter range. They kept mainly to this high country until well into the fall when permanent snow arrived at the high

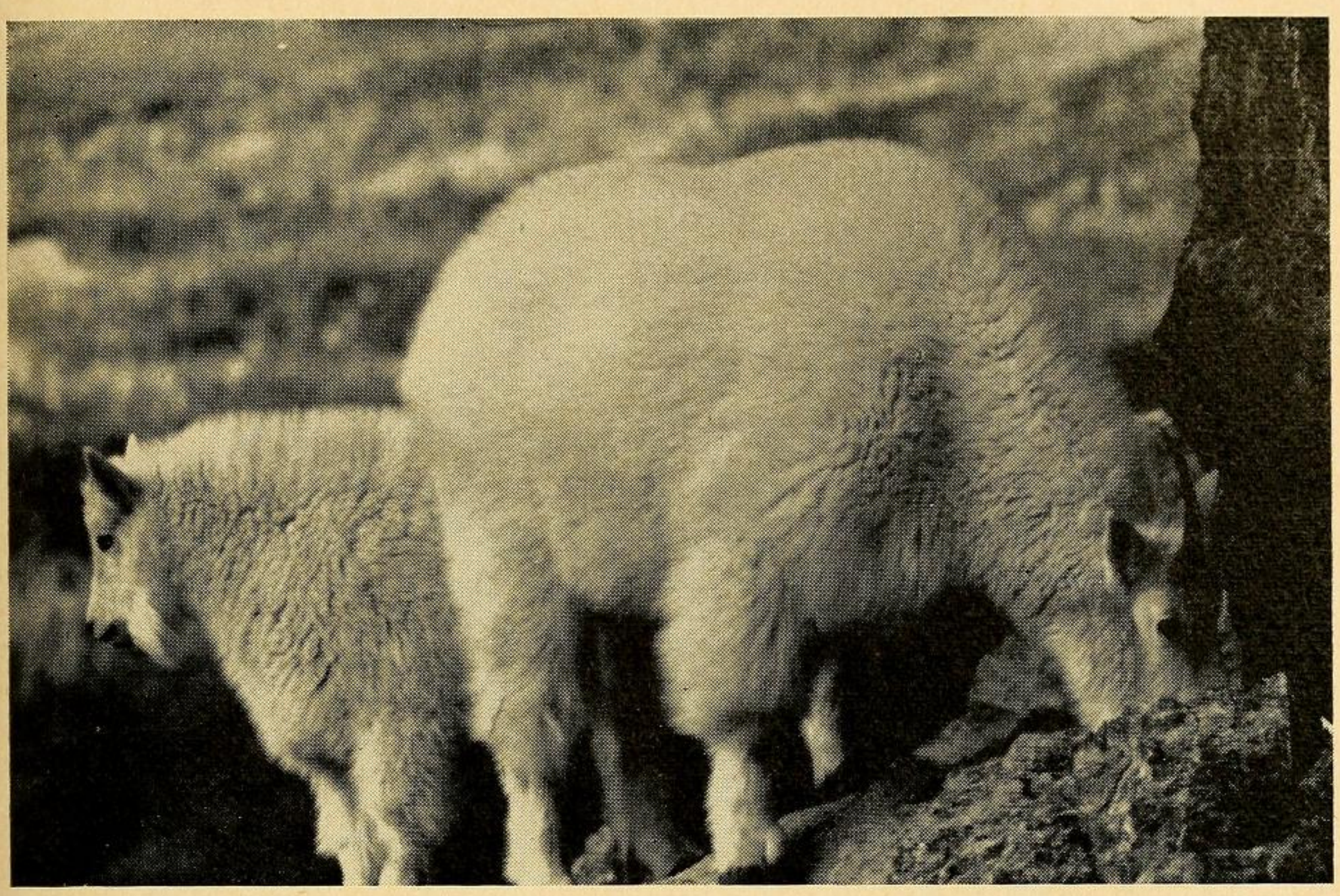

FIGURE 5. Nanny with five month old kid in October, showing heavy winter coat almost completely grown in.

elevations. As the snow line on the range gradually moves lower in the fall, the goats would move down with it until in late November or early December they would arrive back on their winter range at the lower levels.

From observations of feeding goats, it appears that the winter food is largely of browse while most of the summer forage is grasses and grasslike plants. Red ossier dogwood (*Cornus stolonifera*) was very heavily browsed in winter on the lower slopes while willow (*Salix petrophilia*), Douglas fir, aspen and buffalo berry (*Shepherdia canadensis*) were also utilized.

Availability of water on this range is little problem. Wind in the winter deposits huge snow banks and cornices which may last most of the summer, and there are a few seepage springs at high elevations. In the past two summers I have not known these goats to be forced to lower range because of lack of water.

Travel

I noticed that when kids are very young their mothers travel constantly below and beside them as if to protect them from a fall. By the time the kids were a week or ten days old, however, they could be seen trailing along close behind their mothers. Goats cannot climb where a man cannot go but in many cases it would take a competent climber to follow one. They appear to have the advantage of being absolutely unafraid of any height. Under normal travel conditions they are very deliberate about how and where they go. In

TABLE 2.—Sizes of mountain goat groups observed on Mt. Wardle

Group Size	Number of Observations	% of Total Observations
1	7	10.3
2	17	25.0
3	8	11.8
4	8	11.8
5	7	10.3
6	5	7.4
7	3	4.4
8 to 10	2	2.9
11 to 15	4	5.9
16 to 20	2	2.9
21 to 25	2	2.9
26 to 30	2	2.9
31 to 35	1	1.5

steep rock each step is carefully chosen and often they will retrace their steps and choose a new route rather than attempt a difficult place. However, I have seen them jump and bound when momentum was required to carry them from one secure spot to another some distance away, both in a traverse as well as climbing or descending. In a traverse they often bound and land once on a cliff face where they would be unable to stand, then immediately bound again, landing on safer footing the next time. This same method is employed when climbing up or down, with variations to suit the terrain. On narrow ledges goats often rub hair from their sides by crowding close to the face of the cliff.

In spite of their remarkable ability there are many places where a goat cannot go. Ordinarily they would not attempt to go in such places but under stress they sometimes try to climb beyond their abilities. On two occasions, upon surprising goats at very close range, I saw this demonstrated. In the first instance the goat attempted twice to climb an almost vertical cliff about 30 feet high with very little in the way of footholds. He fell and rolled down twice before giving up the attempt and running close by me to make his escape. In the other instance the billy was able to attain a stand about 12 feet above me but was unable to go higher. He remained in this position for several minutes, watching me until I moved off a short distance, allowing him to jump back down and move away on another route.

On one occasion I was watching and photographing a small group of goats at a lick. One goat was standing in the sun on the very brink of a cliff some 30 or more feet high. Suddenly the rotten rock on which he was standing gave away and he almost fell over the cliff. With much scrambling with his front feet he was able to save himself. This incident did not seem to frighten the goat. He simply went back to sunning himself in the same manner, still standing on the very brink of the cliff. Although goats seem to avoid snow as much as possible, it appears to impede their travel very little. Where possible they keep to the barest ground, but upon being confronted with a snow filled gully they do not hesitate to cross. I saw goats sink almost

TABLE 3.—Seasonal changes in grouping of mountain goats based on observations of 68 groups

Month	Mean Group Size	Number of Groups Seen
January	6.05	17
February	6.55	9
April	14.00	1
May	3.25	20
July	20.00	5
November	5.31	16

to their backs while moving across a soft snow cushion on a lee slope. The presence of snow on steep rock, which would make travel very difficult for a man, troubles a goat very little.

Travel for the most part seems slow and deliberate, often even when slightly alarmed. This can be very deceiving however, as a travelling goat can cover a surprising distance in a short time. They can gain 1500 feet in altitude on a mountain in about 20 minutes with little apparent effort. The same climb made by a good mountain walker would likely take an hour to an hour and a half.

Grouping

The frequency of observations of different sizes of groups is tabulated in Table 2. The average group size was 6.3 goats. Table 3 has been compiled to illustrate difference in size of groups in different seasons.

Grouping lacked cohesion with the exception of family groups consisting of nannies, kids, and perhaps, in summer months, yearlings. Largest groups observed were usually concentrated at licks in summer or during inclement weather in winter when on bedding grounds. This type of aggregation results from numerous single goats and small groups congregating on a common bedding area where shelter is the best available. This then is a common response to environmental conditions rather than an indication of gregariousness. There was a marked trend to larger groups in the summer months when females, kids, and immature goats grouped loosely together. These groups also lacked cohesion and changed from day to day and even from hour to hour in composition. Mature males were less social than other segments of the population. During most of the year they spent their time alone or in the company of another male. This is the usual situation but there are exceptions, as when an old male accompanies females and younger goats. In general there appeared to be a considerable amount of variability in sex and age composition of goat groups throughout the year.

Use of licks

The main season that goats visited licks was during May, June and July, with occasional visits at any other season. In spring and early summer they would often come in fairly large groups and sometimes spent hours on the

lick. One natural lick, or perhaps better called semi-natural, within one hundred yards of the Banff-Windermere Highway, is actually a quarry where rock has been taken for fill and construction for several years. Goats often stood on the face of this quarry and licked the exposed limestone for hours at a time, frequently watering at a small stream that runs through the bottom of the quarry. Another semi-natural lick, approximately half a mile south, is above the highway where a cut has been made and limestone exposed. Goats travelled through thick timber for about half a mile to reach this lick. It was used less frequently than the other. Cowan and Brink (1949) mentioned that goats travelled through miles of forest to reach natural licks in Jasper National Park.

Goats frequently came down two or three thousand feet to lick a block of stock salt which I put out. Even months after the salt was completely gone they licked the ground and rock where it had been.

Association with other species

Goats on Mt. Wardle are for the most part isolated from other ungulates. In the summer of 1963 two mountain sheep were on the higher part of the range for a few weeks but left the area by crossing the Vermilion River to the opposite watershed and did not return. There is a slight overlapping of elk and goat range in the late fall and winter. During both the winters of 1962 and 1963, there were up to a dozen elk on the gentler and lower southern slopes of the range. Although I have seen elk and goats feeding quite close together, there seemed to be no intolerance of one another. Elk, deer, and an occasional moose (*Alces americana*) sometimes frequented the goat licks in the spring and summer but at no time did I see two species together on these licks. Warden Coggins, of Banff National Park, reported that in June 1961 he saw goats mixed with both elk and sheep at a lick at Flints Park in the Cascade River drainage. I have often seen goats and sheep feeding in close association on the Palliser Range in the Cascade River drainage of Banff National Park. There seemed to be no intolerance or attraction between the two species in these instances. Usually the goats kept to the rougher more broken areas while the sheep kept to the better grassed areas. Casebeer *et al* (1950) reported that elk dominated goats at a lick and would drive them away while goats were dominant over deer at a lick.

Reaction to man

Reaction to man by this band of goats varied according to season, size of group, and circumstances under which they were encountered. At low elevation licks I often approached to within a few feet of goats without alarming them to any extent. On the other hand, I found them hard to get close to at high elevations. The months of March and April were the best times in which to approach closely, perhaps due to the poor condition of the goats at this time. The larger the group the less likely it was that they would allow me to get near them. When one animal fled in fright the others almost always followed. Goats of one or two years of age were usually the first

to show alarm. When alarmed or suspicious of something, goats invariably carried their very short tail erect. This was sometimes accompanied, in younger goats, by a sharp bleat.

When approached goats usually showed little or no animosity toward the observer. When newborn young are present this attitude sometimes differed. A nanny with newborn twins, which I approached quite closely, made it very obvious that it would be unwise to come any nearer her young. While trying to get her kids to follow her she made several abortive charges in my direction, stamped her front feet, and shook her head in anger. I was on a ledge a few feet above the goat and her young. Had I been between them, I'm sure by her actions that she would have attacked me.

One other incident of intolerance occurred on May 21, 1963, when I approached to within six feet of a large male. He was below me and when I came very near he faced me, stamped his front feet, pawed the ground, and arched his neck. He refused to be chased from his location.

If I encountered goats at close range and remained motionless, curiosity often caused them to come much nearer. Casebeer *et al* (1950) also observed this behaviour in goats.

The fact that this group of goats range most of the time in Kootenay National Park where hunting is prohibited may have an influence on their reaction to man.

Posture and bedding

Goats are the only ungulates I have seen that will remain for a period of time in a sitting position on their rumps, braced up with their front feet. Another apparently exclusive trait is their habit of lying down with their front legs extended in front of them rather than tucked under as most hooved animals lie. This is not the rule but it is quite commonly observed. While lying in this position they are capable of throwing dirt over their backs with a peculiar lateral motion of the foreleg.

During fine weather goats, like mountain sheep, picked bedding sites from which they could command a good view and often could not be seen very easily themselves. They pawed out small flat places and laid facing down hill with their backs to the mountain. During hot weather a snow bank was often used for bedding. In inclement weather they often sought shelter under overhangs or in shallow caves, behind trees, or anywhere that offered more protection than the exposed slopes. Many of these bedding places were used over and over until manure was built up to a depth of several inches. When small, kids often lay on the uphill side of their mothers, making it difficult to see them except from above.

MORTALITY FACTORS

Accidents

Probably the most frequently fatal natural hazard, aside from a hard winter, is an avalanche. The east and north-east face of Mt. Wardle is of sufficient steepness that, although snowfall is not heavy, avalanches occur frequently.

Ordinarily these slides are not large but they usually originate very high where wind cushion and cornice have added to the natural snowfall. By the time they have reached the lower elevations where goats are wintering, they are travelling very fast and a comparatively small avalanche is sufficient to overcome any goat in its path. On one occasion I found two goats, a young rising yearling male, and an older goat, probably his mother, melting out of a slide in April. They apparently were killed in a slide which occurred about January 8, 1962. In other instances I have found bits of hide and hair in avalanche areas, but, as those slide paths are regularly patrolled in the spring by scavengers such as coyotes and lynx, carcasses are not often found intact. I was often amazed at the lack of caution of goats in avalanche areas in winter. Often they waded across deep coulees which were filled with soft snow which was ready to slide at any time. It is possible that goats may trigger slides themselves. The fact that they are seldom closely bunched would probably result in only one or two being taken by a single slide rather than larger numbers. Warden Laurilla of Glacier National Park mentioned, in a game observation report, that on April 1, 1962, he found a female goat killed in an avalanche near the Trans-Canada Highway. Brandborg (1955) cited two instances of goats being caught in avalanches.

Although I have not seen goats injured or killed in a fall, I am convinced this sometimes happens. I have seen goats lose footing and fall without mishap under circumstances where, had they been higher on the cliff face, they most certainly would have been injured or killed. From watching young kids fall, I believe that it is possible for a goat to survive a fall that would prove disastrous for a human, simply because they are able to land in a relaxed state, rather than stiffened up with fright as a person would be.

Goats seem to view falling and rolling rock with little concern and take no pains whatsoever to avoid it in their travels. On several occasions, when climbing below them, I have had rocks roll past me quite closely. The law of averages would seem to make this somewhat of a hazard, probably occasionally resulting in a fatality or injury. Goats took alarm if a rock or land slide was extensive but their flight seemed in no way planned. They simply moved off to left or right and were about as likely to run into the path of the slide as away from it.

Fighting

I have seen no instances of goats being injured while fighting but this no doubt occurs. Seton (1927) cited a fight between two males in which fatal injuries occurred. Brandborg (1955) described a fight between two males in which he thought injury might well have been inflicted.

Weather

The most telling hazards goats face are severe winter weather and depletion of available range, the first often contributing to the second by covering forage. Of the two years I have observed this band, the winters would be classed as easy or good, with less than average snowfall and little extremely