THE IMPORTANCE OF MINERAL LICKS TO DALL SHEEP IN INTERIOR ALASKA AND ITS SIGNIFICANCE TO SHEEP MANAGEMENT

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The importance of mineral licks to Dall sheep populations was studied using marked individual Dall sheep at the main mineral lick in Dry Creek, Alaska Range. Sheep were captured by drop net, marked and released. Observations of marked sheep locations were made from aircraft and on foot. It was found that at least three populations of sheep utilize the main lick on Dry Creek. The populations of sheep inhabiting the study area overlap only at the mineral lick. The time of lick use corresponds with the time of movement to summer range, and sheep travel out of their way to use the lick at this time. The use of the lick by sheep is dictated by immediate and long-term weather conditions. Lactating sheep visit the lick more times throughout the course of the season, spend 1.6 times as much total time involved with the lick, and spend more time licking than others. Data on utilization with respect to time of year, weather conditions and daily licking activity pattern are presented. The probability of resighting sheep in successive years is calculated.

The predictable nature of utilization by sheep demonstrates the critical nature of mineral licks to Dall sheep in interior Alaska, and provides a unique situation for survey and inventory work. Mineral licks are foci of sheep activity and movement immediately following lambing. Consequently, a technique is presented for determining production, survival to yearling age and population composition by making observations at mineral licks.

INTRODUCTION

Investigations of general group movements and seasonal distribution of Dall sheep *(Ovis dalli)* have been conducted previously in various areas in Alaska (Viereck 1963, Palmer 1941, Scott 1951, Murie 1944, Gross 1963). These studies indicated that sheep were seasonally present in certain habitats, but failed to establish whether they were wandering animals which were attracted to a given area or residents that were there each year. In order to determine whether or not these are resident sheep, it was necessary to mark individuals so they could be identified year after year.

Mineral licks are known to exist and have apparent importance in most Dall sheep habitat in Alaska. It has been proposed that they have primary and profound effects on sheep distribution and movements (Pitzman 1970, Palmer 1941, Viereck 1963a and b, Erickson 1970). However, few specific data are available to support this seemingly reasonable idea.

In order to provide information on and to show the relationship between these two important aspects of Dall sheep biology, the Alaska Department of Fish and Game instituted an intensive study of the sheep influenced by the main mineral lick in Dry Creek, Alaska.

MATERIALS AND METHODS

Study area and general method: The Dall sheep study area is centered on the Dry Creek drainage in the Alaska Range south of Fairbanks and includes adjacent drainages (Figure 1). Animals for use in the study were captured and marked during June and July of 1968-71 at the main mineral lick on Dry Creek using the drop net method described by Erickson (1970a). In 1969 and 1970 large, safety-orange plastic collars with canvas backing and black numerals were used (Figure 2). In 1971 collars consisting of polypropylene rope strung through a numbered pendant and secured around the sheep's necks using hog rings were used. All collared animals were also marked with ear tags (Jumbo Rototag by Dalton Henley of England).

The large collars are visible at great distances; numbers on the pendants are discernible at distances of up to 250 or 300 meters using a 60x spotting scope in good light.

Sheep were identified on home ranges throughout the year, and locations were plotted on topographical maps. Most observations were made on foot surveys, but some aircraft surveillance was utilized. Success of aerial survey techniques was limited to occasional sightings of collars which were used in 1969 and 1970. The smaller pendant collars used in 1971 were impossible to identify from aircraft.

Observations of mineral lick utilization at the main mineral lick on Dry Creek were begun in 1969. In 1969 observations were made from June 16 through June 25 from 0300 to 1800 hours. In 1970 observations were made continuously from June 3 through June 12 and from June 29 through July 3. In 1971 no organized observations were conducted, but collared sheep were noted as they entered the lick. In 1972 continuous 24-hour per day observations of lick utilization were made from May 19 through July 5. During the eight hour observation shifts, observers were stationed in a plywood blind about 200 meters from the lick. In 1973 observations were made from 0400 to 1600 hours from May 26 through June 30.

In 1972 and 1973 all sheep coming into the lick were classified with respect to age and sex. Sheep within the lick were also classified and counted every 30 minutes. At these times weather conditions were also recorded. Returns of collared sheep to the lick allowed calculations of fidelity constants (Geist 1971) for sheep in different age and sex classes.

RESULTS

Collaring: The large collars used in 1969 and 1970 were the most effective means of identifying sheep. These collars appeared to cause no problem to the sheep, and were retained fairly well by the sheep. Considerable problems did result from lack of rigidity in the canvas backing on the collars. Insufficient stiffness resulted in the collars folding and rolling to the point that the numbers could not be read. During 1969 and 1970, 100 animals were marked with this type of collar. Forty of these animals were identified by collars and ear tags in the summer of 1973. Of these, the collar was still useful for identification of 35 animals (87.5 percent). This means that a high percentage of the collars had functioned well for four years. Those collars are, however, in very poor condition now and their usefulness will probably not exceed five years.

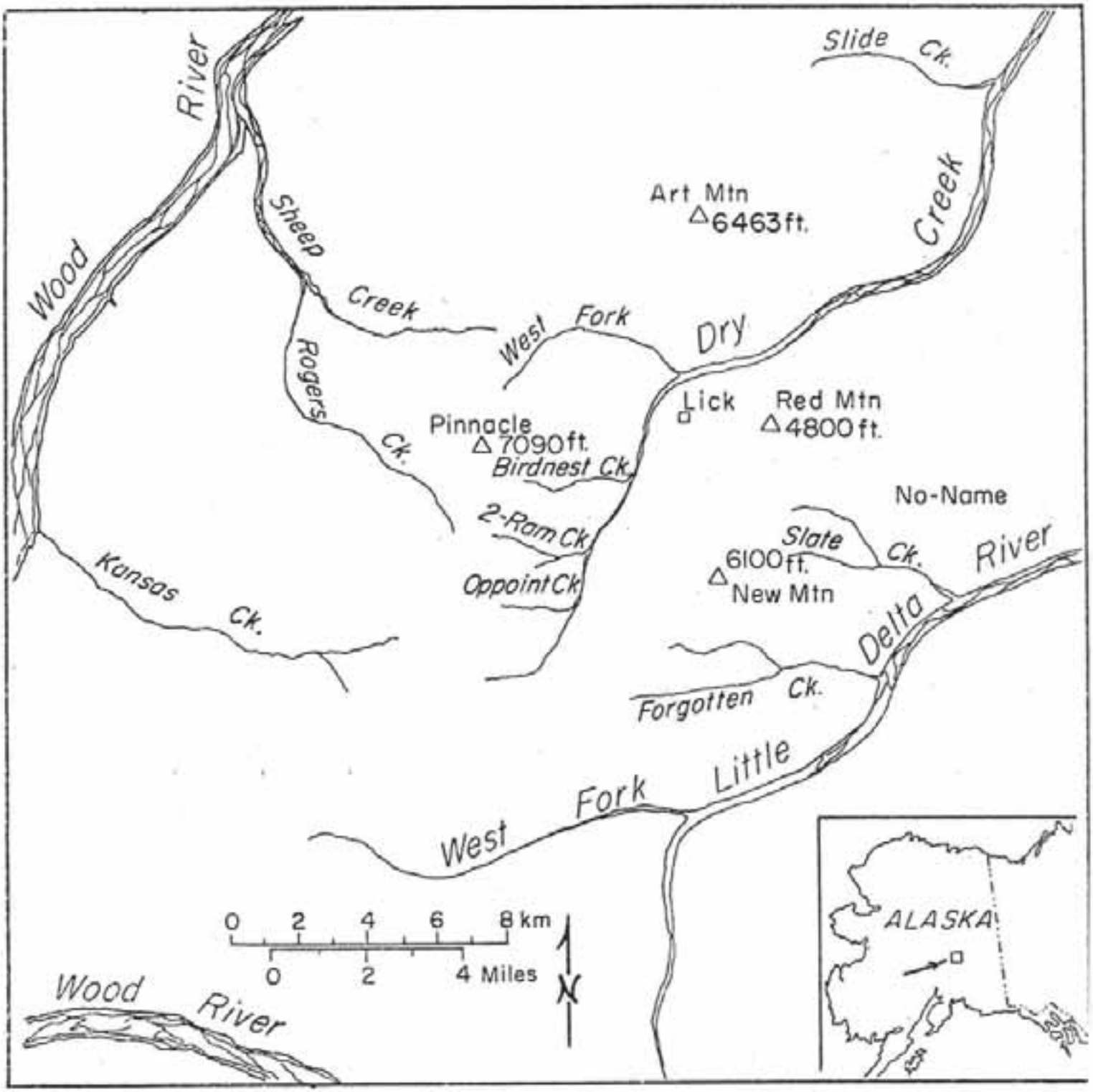

Fig. 1. Sheep study area in Dry Creek and adjacent drainages, about 70 miles south of Fairbanks, Alaska.

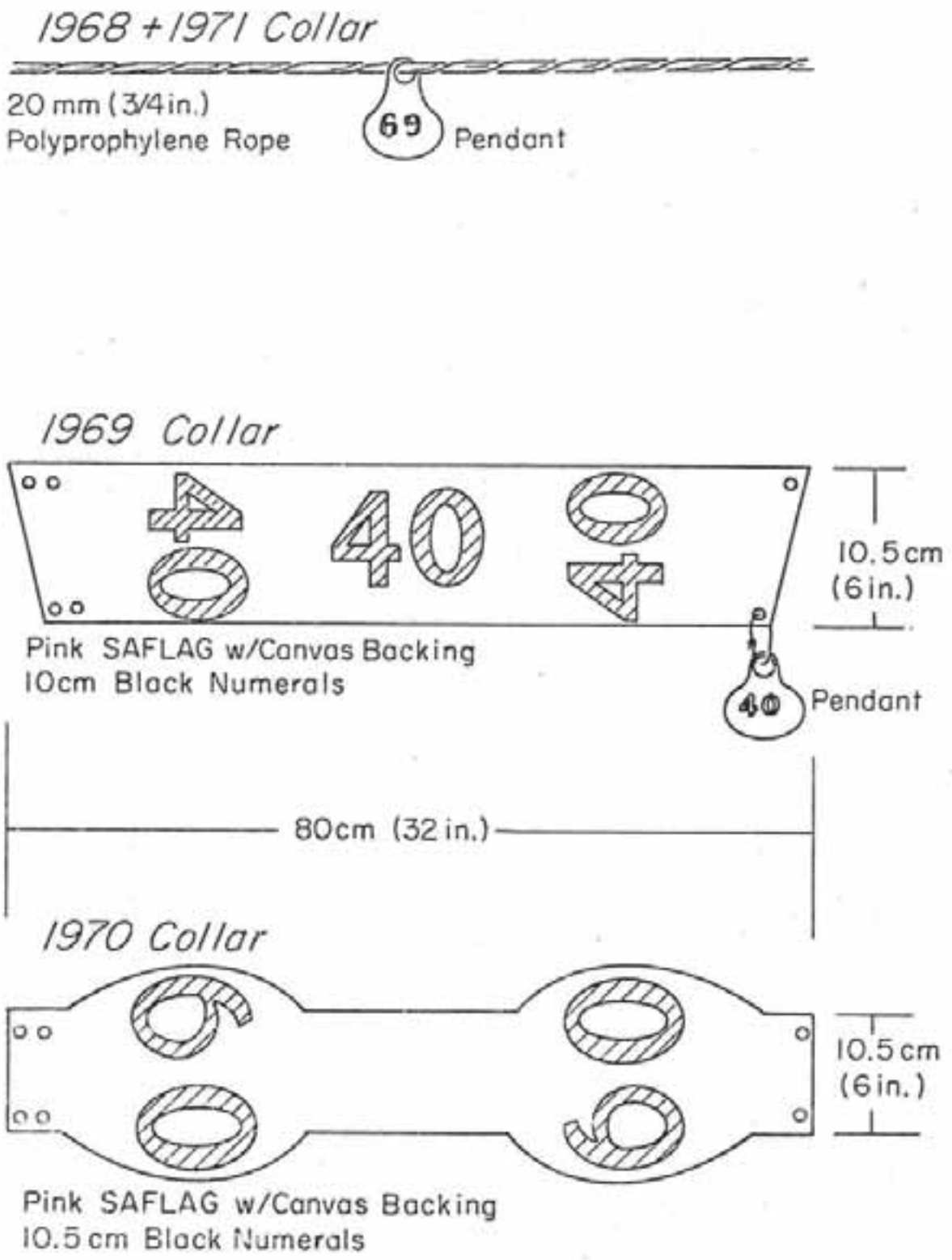

Figure 2. Collars used on Dall sheep captured during 1968, 1969, 1970 and 1971 at Dry Creek, Alaska Range.

In 1971, 95 animals were marked with the pendant and rope collars. During the summer of 1973, 53 of these animals were identified. Of these identified animals, only 26 (49 percent) still retained the collars. This type of collar does not appear to be as successful as the canvasbacked plastic. The most certain identification markers have been the ear tags. No animals are known to have lost ear tags, and damage to the tags has been minimal. This type of marker has the disadvantage of not being readily apparent and requiring close inspection of the sheep in good light with good optical equipment to make a positive identification.

Effect of mineral lick use on seasonal movement: The period of maximum lick use has been found to correspond to the movement of sheep from winter to summer ranges. During 1972 this period was observed to be from about the 16th to the 23rd of June. Other data indicate that movement may occur as early as the first week in June or as late as the last week in June. In any event, the time of maximal mineral lick use follows shortly after lambing and corresponds to the time of general movement from winter to summer range.

The traditional use of the main mineral lick on Dry Creek by the animals of all populations in the study area causes movement from winter range to be over much greater distance than the physical distance involved. For example, ewes wintering in Birdnest Creek and Two Ram Creek move to the lick and then to upper Dry and Kansas Creeks (Figure 3); consequently the distance traveled is increased from approximately 2 miles (3.2 km) to about 10 miles (16 km). Ewes wintering on the Slide-Exclosure-Bigfoot area on the other hand, pass through the vicinity of the lick on their way to summer range. Ewes wintering on the west side of Dry Creek may be considered to have the lick on the periphery of their ranges. Journeys of 4 miles (6.2 km) to summer range are extended to approximately 8 miles (12.8 km) for those on the Red Mountain - No-Name complex, while animals which winter on Slate Ridge increase their distance traveled from about 2 miles (3.2 km) to nearly 12 miles or 20 km (Figure 3).

It appears that several populations of sheep inhabiting the study area overlap or mingle only at the main mineral lick on Dry Creek. The time of lick use corresponds with the time of movement to summer range, and it appears that animals travel out of their way to spend time at the lick during this time.

Peak lick use: Peak use of the main mineral lick at Dry Creek has been observed to be in early summer. In 1970 the day of highest use was June 6, in 1972 the day of highest use was June 19 (Figure 4), and the day of highest use in 1973 was June 27 (Figure 5). These dates represent the times of migration from winter to summer range. The extent of use during the maximum period is apparently dependent on the manner in which winter snows disappear, the conditions of warming in the spring and the immediate weather conditions. In 1972 snow accumulation was great and melt-off was not complete until mid-June. Peak use that year was about mid-June, and corresponded quite closely with mean ambient temperatures which rose to averages of above 60 F at that time. In 1973 snow accumulation was light and melt-off was essentially complete by June 6. However, local ambient temperatures did not reach daily means of 50 F until the last week in June. Under these conditions, lick use was spread over a greater interval and the intensity was less than in 1972.

In 1972 barometric pressure correlated strikingly with lick use. In 1973 there was no apparent correlation between lick use and barometric pressure.

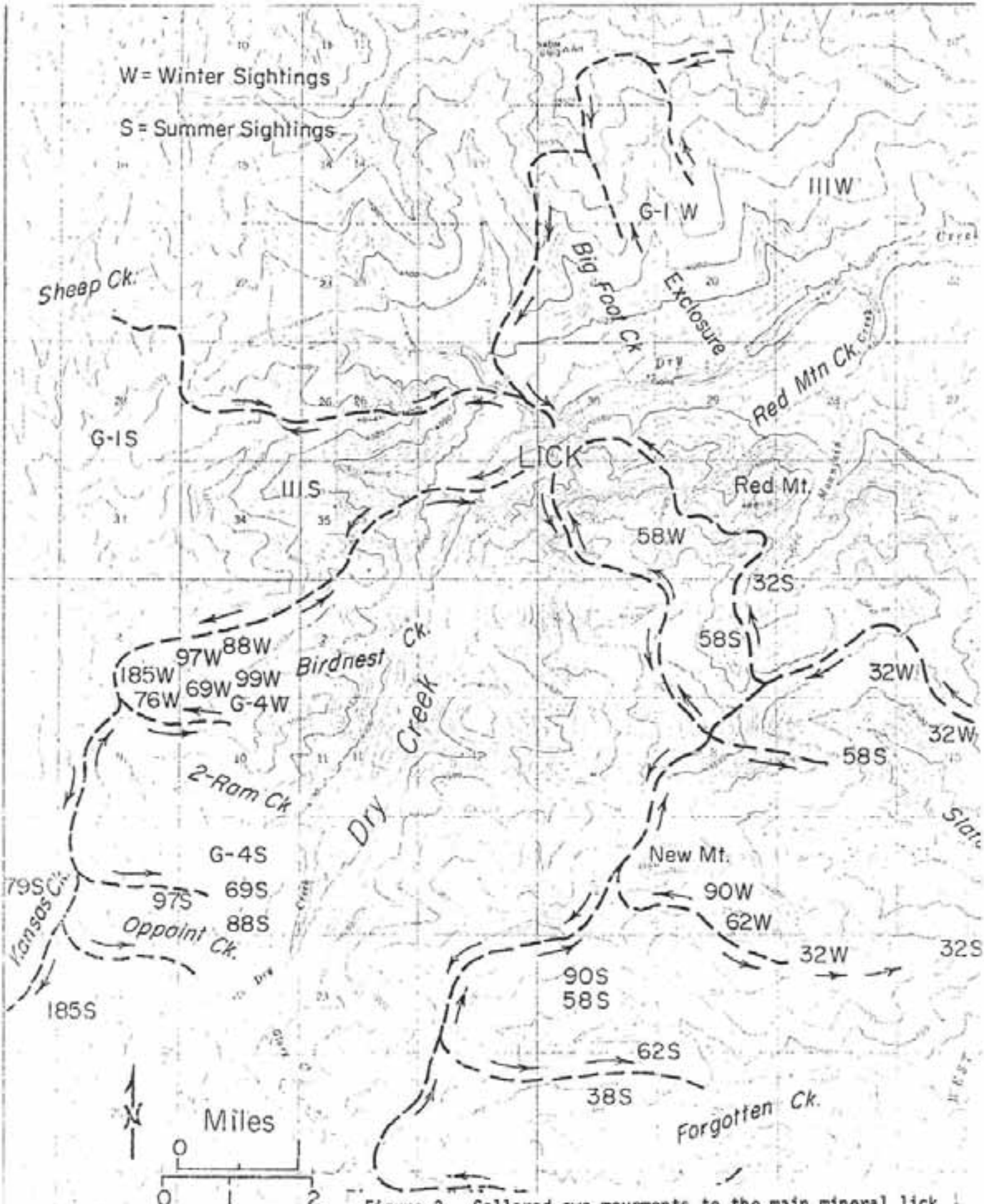

Figure 3. Collared ewe movements to the main mineral lick and summer ranges in Dry Creek, Alaska Range.

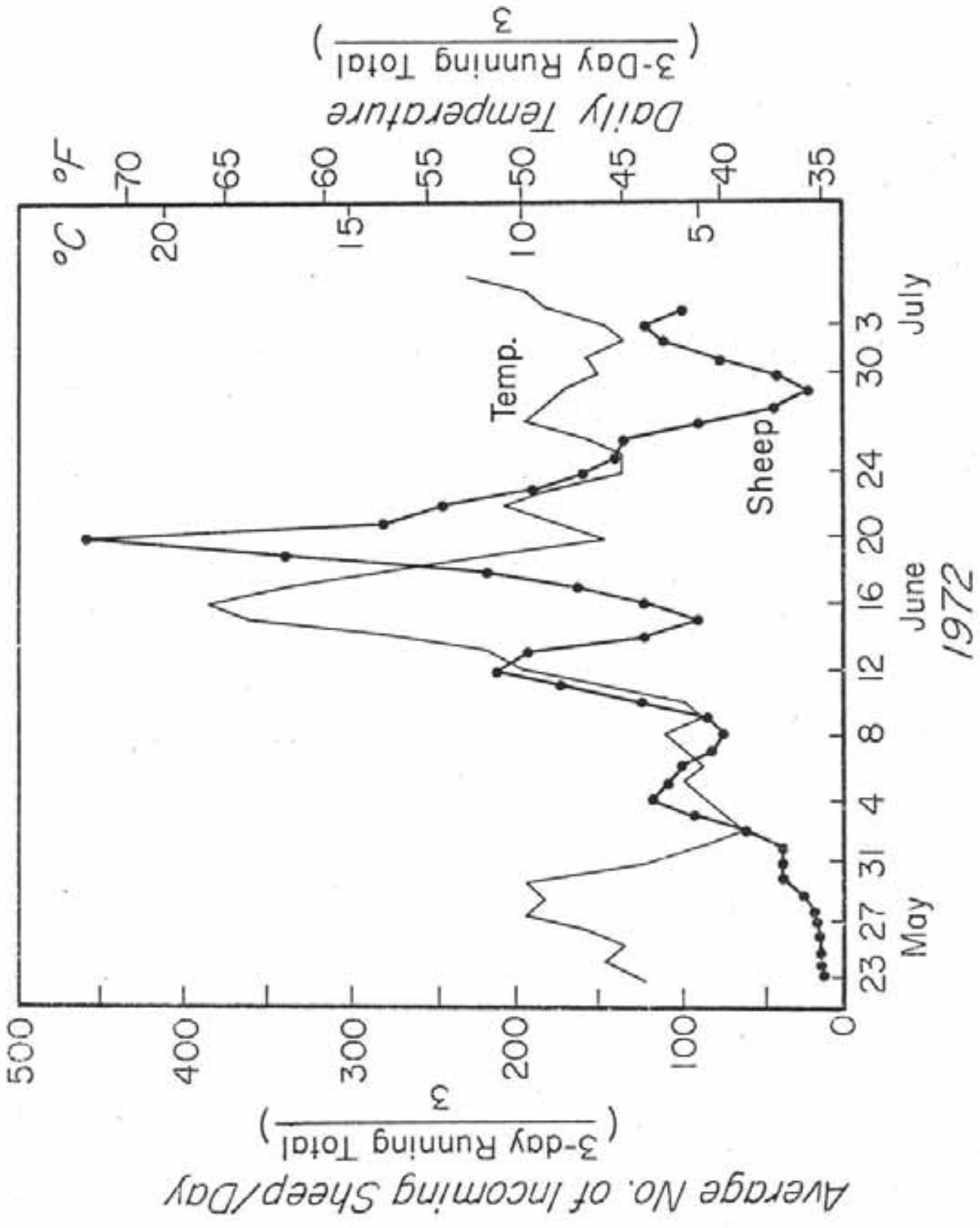

Figure 4. Temperature and lick use at Dry Creek 1972.

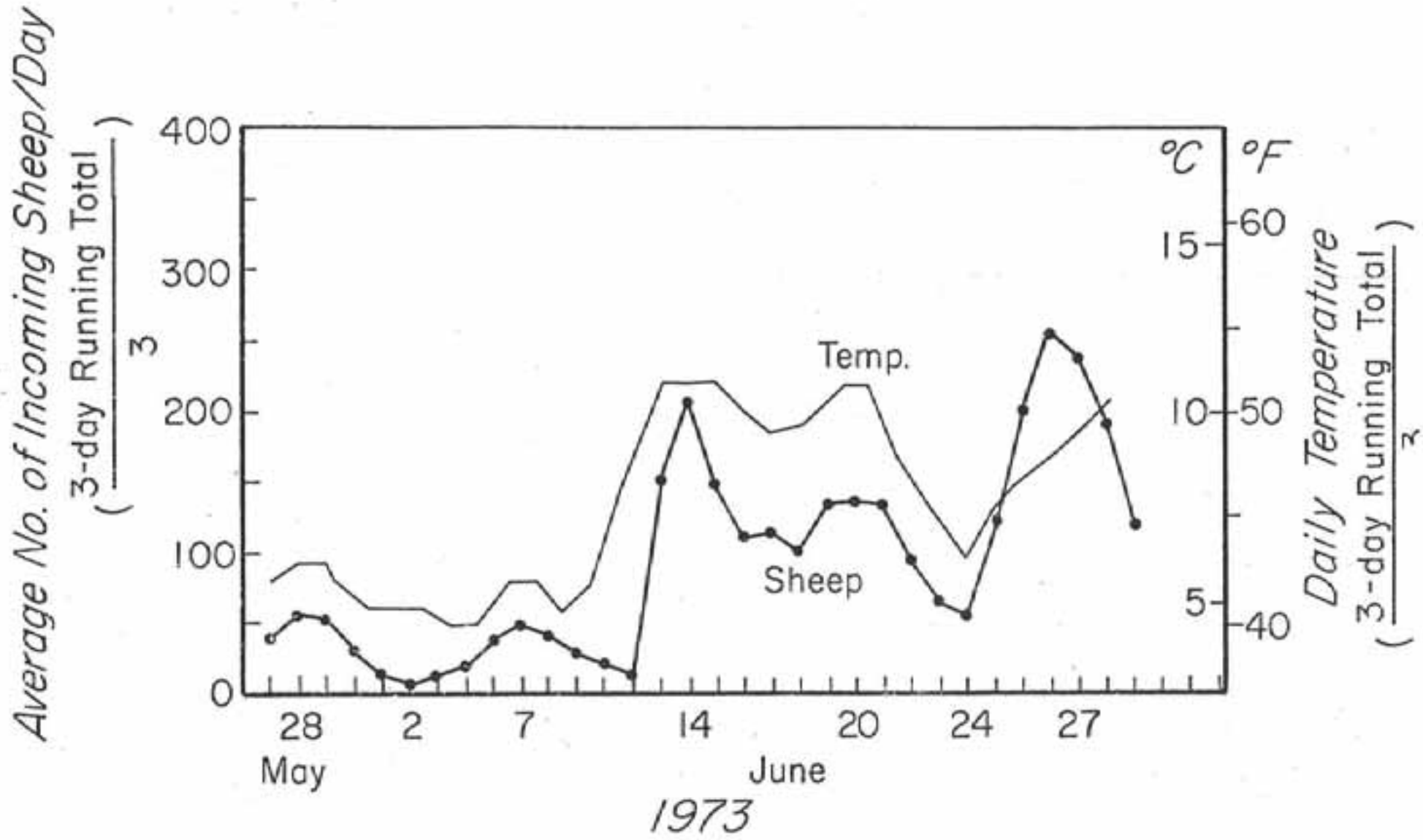

Fig. 5. Temperature and lick use at Dry Creek: 1973.

Intensity of lick use in 1972 was reflected by the entry of 580 sheep in one 24-hour period on June 19. In 1973 about 350 sheep entered the lick on June 27.

Time spent per visit and frequency of visitation: The length of time a sheep spends in the lick is a function of how many times it has been at the lick during the yearly cycle of lick utilization as well as the sex and reproductive status of the animal. Ewes that are nursing lambs appear to spend more time licking and visit the lick more than any other class of animals. Sheep spend virtually all of their time present in the lick eating soil or licking. In 1972 sheep spent 93 percent of their time in the lick licking (first visit of the year). On the second visit they spent 95 percent of the time licking, and all subsequent visits averaged 93 percent of the time in the lick spent consuming soil.

In 1972 a total of 70 collared sheep made 293 visits to the lick; an average of four visits per collared animal. Of these animals, 29 were rams; they accounted for 122 visits for an average of four visits per ram during the season. Thirty animals were ewes that were never seen to nurse a lamb. These ewes made 124 visits to the lick for an average of four visits per animal. The remaining animals were ewes that were seen to nurse lambs; they were 11 in number and made 57 visits for an average of five visits per sheep. Consequently, it appears that there is no difference in lick use between ewes which are not lactating and rams.

The collared rams which utilized the lick made 122 visits in 71 sheep days for an average of 1.7 or 2 visits per day. The average length of time which elapsed between visits for those rams visiting the lick on separate days was two days. The average number of visits per ram was four. This means that the average ram spent at least four days involved with the lick.

Ewes without lambs made a total of 124 visits in 79 days for an average of 1.6 or 2 visits per day. The average length of time which elapsed between visits of those sheep which revisited the lick was 198 days between 118 visits or 1.7 days between visits. The average number of visits by this group of ewes was four. Hence, the average ewe with no lamb spent four days involved with the lick as did the average ram.

By way of comparison, ewes with lambs made 57 visits in 36 days for an average of two visits per day. The average length of time which elapsed between visits of those sheep which revisited the lick was 69 days between 36 visits or 2 days between visits. The average number of visits made by the sheep in this group was five. Hence, these animals must spend six and one-half to seven days involved with the lick. This is approximately 1.6 times more than animals without lambs.

Ewes with lambs (lactating ewes) spent 25 to 50 percent more time than rams and ewes without lambs on their first visit of the year; ewes with lambs 93 minutes, ewes without lambs 75 minutes, and rams 63 minutes. During the second visit the situation was less well defined, with ewes with lambs spending 64 minutes, ewes without lambs 71 minutes, and rams 59 minutes. However, all other visits combined show that ewes with lambs had an average time of 76 minutes, ewes without lambs an average of 62 minutes and rams an average of 47 minutes.

Lactating ewes visited the lick more times throughout the course of the season, spent about 1.6 times as much total time involved with the lick, and spent more time licking on most visits than other ewes and rams.

Daily activity patterns: Figure 6 reveals that in 1972 cumulative lick use for the period of observation was at its lowest ebb from 2000 hours to 0200. From 0200 to 0600 there was an 11-fold increase to the time of maximal daily utilization. Then a decline occurred through the next three hours and another small peak occurred at 1000 hours. Use then declined to about half its maximal (0600 hours) use and remained at about that level until 1900 hours when it declined again to the low level described for 2000 to 0200.

Cumulative activity from 1972 is summarized in Table 1.

Table 1. Cumulative activity at the Dry Creek mineral lick 1972.

Hours Necessary to Observe	Percent of Daily Activity
0300-1400	67
0300-1430	69
0300-2100	90
0300-1000	50
0300-1600	75

Total sheep counted = 13,451 in 44 days

These data represent cumulative daily activity patterns and may be subject to some variance from those seen early or late in the cycle.

Fidelity to the mineral lick: Table 2 lists resightings and observed fidelities since 1969.

Table 4. Resightings and observed fidelity to the Dry Creek mineral lick.

	Ewes	Rams
Seen in 1969	28	26
Resighted in 1970	26	13
Observed fidelity	93 percent	50 percent
Seen in 1970	61	28
Resighted in 1971	44	17
Observed fidelity	72 percent	61 percent
Seen in 1971	100	55
Identified in 1972	78	37
Seen but not identified in 1972	6	4
Total resightings	84	41
Observed fidelity	84 percent	75 percent
Seen in 1972	84	41
Identified in 1973	77	27
Seen but not identified	-	2
Total resightings	77	29
Observed fidelity	92 percent	71 percent

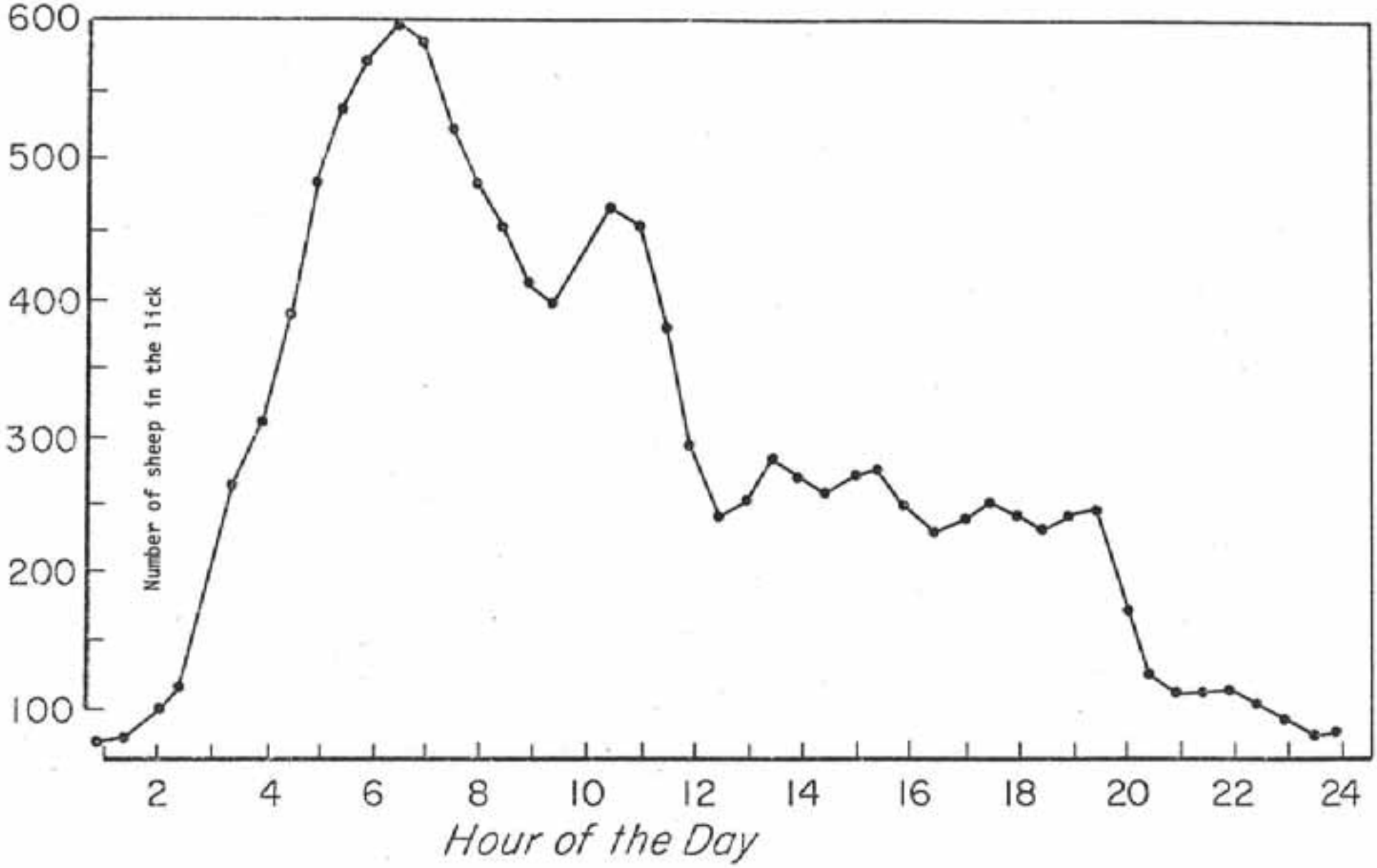

Fig. 6. Cumulative hourly mineral lick use at main mineral lick on Dry Creek, 1972.

The observation of 100 marked ewes in 1971 and 78 marked ewes in 1972 means that 22 individuals which visited the lick in 1971 did not visit the lick in 1972. All the marked animals which were not seen in 1972 are listed below:

142 age 3 years	6 animals were seen which had lost collars and whose ear tags could not be read. (Because of their young ages these animals are arbitrarily assumed to be the 6 ewes seen whose ear tags could not be read.)
162 age 3 years	
191 age 3 years	
164 age 4 years	
51 age 5 years	
147 age 5 years	
14 age 9 years	found dead
26 age 6 years	
33 age 12 years	collar found - no remains
43 age 7 years	
53 age 10 years	
63 age 8 years	last seen May 1972 with broken leg
64 age 9 years	
74 age 10 years	
86 age 8 years	
G-1 age 9 years	
111 age 13 years	
114 age 9 years	
121 age 10 years	
137 age 10 years	
180 age 10 years	
181 age 8 years	

The average age of these missing animals is 8.7 years.

Throughout the study 17 animals which would have been in this age class (9 years) were marked. Of these 17 animals, 11 were seen at the lick in 1972, and the average age of the six that were not seen was 10.5 or 11 years. Only one of these six animals can be demonstrated to be dead, but it is assumed that the others are dead because of their absence and advanced age. This means that the calculated, cumulative mortality in 1971 for ewes of the age class 9 years and above was 6/17 or 35 percent.

If it is assumed that animals 33 and 63 are dead and that the mortality of the remainder of the unaccounted-for animals listed above was 35 percent, then 0.35 x 13 = 4.6 or 5 of the animals were likely victims of mortality. This reduces the number of ewes which were not accounted for to 8 and brings corrected fidelity to 78 animals identified, plus 6 animals seen but not identified, plus 3 known dead, plus 5 presumed dead to 92 animals accounted for of the 100 seen in 1971. The result was a fidelity of 92 percent for 1972.

Because the winter of 1971-72 was harsh, and because the cumulative mortality calculated was averaged over the last 4 years, I think it is probable that 1971-72 winter mortality was higher than 35 percent in the 9 year and older class for ewes. Because fidelity is so high for ewes and could reasonably be higher, I think it is very reasonable to state that ewe fidelity to the Dry Creek lick is essentially 100 percent.

During 1973 seven ewes were not seen which were observed in 1972. These animals were considered to be no longer in the population.

In summary it appears that ewe fidelity is 100 percent. Animals which do not visit the lick in subsequent years may be considered dead.

Ram fidelity: Table 2 shows that 55 rams were seen at the lick in 1971. Thirty-seven identifiable rams were seen in 1972 as well as four unidentifiable tagged individuals. This brings the number of observed, tagged rams seen to 41. The apparent fidelity then becomes 41/55 or 75 percent.

The rams not accounted for are listed below:

34 age 5 years	108 age 3 years
40 age 9 years	118 age 3 years
45 age 9 years	152 age 3 years
55 age 10 years	157 age 3 years
65 age 5 years	161 age 5 years
81 age 4 years	184 age 3 years
101 age 4 years	195 age 3 years

When the heavy hunting pressure in the study area is considered, it is reasonable to predict that rams 40, 45 and 55 had been killed by hunters and not reported. This leaves eight, 3- and 4-year old rams which may have changed ranges. Young bighorn *(Ovis canadensis)* rams (2 year olds) are the most likely sheep to change traditional ranges (Geist 1971). This is thought to occur when they join the ram bands. Young males will follow any larger-horned male when they leave the juvenile and ewe groups. Because Dry Creek sheep grow slowly (Heimer and Smith 1973 unpubl. data), the possibility that this could occur among 3- and 4-year old Dall rams is most attractive. In any case, it must be noted that the fidelity of rams in the younger age classes is less than that of rams which have established home ranges, and that the fidelity of 2-, 3- and 4-year old rams at Dry Creek lick is low.

If it is accepted that the three old rams not seen in 1972 were probably dead, fidelity could be adjusted to 44/55 or 80 percent for rams. Here it should be noted that the average age of rams resighted in 1972 was less than 5 years. These animals usually occurred in ram bands, but were not yet legal to hunt. Also, fidelity may change as the animals mature.

DISCUSSION

The predictability of Dall sheep return to and utilization of the main mineral lick on Dry Creek as demonstrated by the fidelity constants of 1.00 for adult ewes and 0.80 for rams, coupled with the appearance of all populations of sheep which occupy the study area has several important consequences. First, it demonstrates that the mineral lick is of major importance to the population. It is not known whether the drive to utilize the lick is one born of tradition or physiological necessity. The more intensive use by lactating females seems to support the idea that the mineral lick is nutritionally beneficial.

The coincidental use of the lick by all segments of the study populations indicates that one important function served by the lick is maintenance of

genetic homogeneity among the several populations of the study area. When the loyalty of sheep to their traditional ranges is considered, it appears that the lick could serve as a sort of "clearing house" for the placement of young rams in the ram populations of the study area. Geist (1971) has shown that when a young bighorn ram is ready to enter ram society he will follow a group of larger-horned males. At the lick young rams are exposed by chance, it appears, to the opportunity to join any of the ram bands in the area depending on the coincidence of their arrival at the lick. This may work to prevent genetic drift among the otherwise isolated populations of ewes and the rams which traditionally rut with them and result in the preservation of genetic stability. For these reasons mineral licks should be considered critical habitat and protected from human encroachment and development.

Secondly, the predictable nature of Dall sheep movements to the mineral lick and their concentration at mineral licks immediately following lambing presents a unique opportunity for efficient survey and inventory work. Dall sheep production has been traditionally monitored from aircraft. This is both expensive and more dangerous than observation from the ground. The discovery that it is possible to yearly view large numbers of Dall sheep from the same populations at low risk and low cost may reduce the need for aircraft surveillance. The data presented indicate that in major licks such as the main lick on Dry Creek the build-up of activity can be followed, perhaps by aircraft, and when it is advantageous, an observer could be placed near the lick to gather information on production, yearling survival, and population composition. If marked individuals are present in the population it is also possible to estimate the total number of animals using the lick. Here it should be stressed that production can only be assessed by observations toward the end of the licking cycle.

The meteorological correlates of lick use appear to be important in the scheduling of mineral lick observations. Of these it appears that temperature has the most important role. Dall sheep use of mineral licks appears to correspond closely to ambient temperature with activity being greater when the weather is favorable. Consequently, observations should be scheduled for periods of fair weather and generally warm temperatures.

The data from 1972 also indicate that about 75 percent of daily activity can be seen in a 12 hour observation day. This procedure was followed in 1973 at the Dry Creek lick and worked rather well with two observers working six hour shifts. In a typical survey and inventory situation this would not be necessary, but it was called for in 1973. Total numbers of animals using the lick in 1973 were calculated using this approach and agreed well with the 1972 figures.

It was found that there is a preferential use of the lick by lactating Dall sheep ewes. This preferential use is reflected in more visits but not in more frequent visits. This could lead to an excessively high estimate of production if observations were prolonged. However, in a survey and inventory situation the observations should be made for less than 7 days. This should preclude excessive recounting of lactating ewes. Data gathered during these observations would probably accurately reflect the productivity of sheep populations in the surrounding area.

Even if this set of circumstances did not exist, the relative numbers gathered in this manner should be comparable from year to year, and as a relative index of production and survival, should provide better data than aerial

surveys. Furthermore, the danger and expense involved in mineral lick observations are far less than those in aircraft surveys, and the influences of weather on data gathering are much less.

Finally, because of the apparent importance of the Dry Creek lick to the sheep it influences, it is recommended that mineral licks be considered and designated critical habitat areas for all Dall sheep populations in interior Alaska.

ACKNOWLEDGMENTS

James A. Erickson was responsible for conception of, and the early performance of the Dry Creek study. His untimely death in 1970 left this major biological investigation without a leader. Tony Smith capably took charge of the study and guided it throughout the major portions of the trapping and preliminary data gathering phases. Numerous temporary assistants performed much of the routine data gathering at the Dry Creek lick, and without their contribution the utilization portion of the study could never have been completed.

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