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SHEEP REPORT

by James A. Erickson

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Project W-17-1 and W-17-2, Jobs 5 & 7 and Jobs 6.1R and 6.2R

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: James A. Erickson

Project No.: W-17-1 and W-17-2 Project Title: Big Game Investigations

Job No.: 5 and 6.2R Job Title: Dall Sheep Horn Growth

Period Covered: January 1, 1969 to December 31, 1969

SUMMARY

A portion of the literature concerned with horn growth of wild sheep is reviewed. Horn segment lengths of Ovis dalli in Alaska are presented in partially analyzed form because data gathered thus far are insufficient to warrant detailed analyses.

BACKGROUND

To calculate yield or potential harvest of animals from a wildlife population, its size, productivity and natural mortality must be found. If the attributes sought in an animal for harvest are sex and age-related, such as large horns in Dall sheep rams (Ovis dalli), the time necessary for production (growth) of large horns becomes part of the yield calculations. It is hypothesized that Dall rams from different parts of their range in Alaska and Canada have different rates of horn growth, different horn morphology, and differences in the expected total cumulative growth. If these differences exist, calculations for yield of rams of a given age-related horn size require data on these differences. Scott (1951), Hemming (1967), Boone and Crockett Club (1964), and Erickson (1968; 1969) have collected data on horn size of Dall rams in Alaska. Taylor (1962), Wishart (1969) and others have written about horn growth of Ovis canadensis.

Scott (1951:76), who studied Dall sheep horn growth in Alaska, measured the "average number of inches by which the length of horn exceeded spread in each area.", and stated that "in Kenai rams, length exceeded spread by about 4 inches more than the average of all other areas. Between the other areas there is apparently little significant difference." Scott also stated (1951:79) "In the 230 [guide reports], the average ram taken had a length of curl of 34 inches. This figure is surprisingly close for all areas, and probably coincides with the average measurement of a full-curl ram." Scott went on to say (1951:79):

> A larger sample of 425 guide reports was examined to determine whether extra-large sheep heads were characteristic of any one area, and the frequency with which they were taken. Using 40" as a criterion it was found that there was no significant difference between the number of large heads taken years ago or today; nor did any one area provide significantly more large heads than was proportionate to the intensity of hunting. Only about 1 out of 10 hunters had succeeded in bagging a trophy 40 inches or larger. These and other records show a negligible amount of nonresident hunting in the Wrangell and Chugach Mountains and the Brooks Range.

Scott (1951) measured the lengths of growth segments between horn annuli for 31 sets of horns, and plotted the average lengths against age. Two of the conclusions made were (Scott 1951:80): "The annual rate of growth increases to a maximum in the third [segment] and then decreases each year throughout the life of the animal.", and, "An average ram will never grow horns as large as 40 inches in length." Both Taylor (1962), who studied horn growth of bighorn sheep from Montana, and Hemming (1967), who studied horn growth of Dall sheep from Alaska, reported that the maximum growth in horn length occurred during the second "summer" of the sheep's life. The bulk of my data (Erickson 1968; 69) has not been analyzed because sample sizes have been too small.

Taylor (1962) found that horn segment lengths and segment diameters were significantly larger (statistically) for bighorn rams from the Bison Range compared with rams from Wildhorse Island. Wishart (1969) found statistically larger horn segment lengths and segment diameters in bighorn sheep in Alberta south of Bow River as compared with those from north of Bow River. Soil and climate differences were hypothesized as being among the causes of these differences (Wishart 1969).

Boone and Crockett Club (1964) horn measurements, although numerous, are limited in usefulness because they are not age-specific.

OBJECTIVES

The objectives of this job are to compare and contrast the age-related measurements of Dall sheep rams' horns between and among sheep from seven mountain areas in Alaska.

PROCEDURES

Sheep horns (160 rams) from the 1969 harvest were measured at taxidermy shops in Anchorage and Fairbanks by J. A. Erickson with assistance from J. Ernest, D. Cornelius, J. Sexton, E. Kootuk, J. Trent, P. Berrie, and A. Johnson.

We attempted to measure all sheep horns that hunters brought to taxidermy shops in the Anchorage and Fairbanks areas, but over 100 sets went through Anchorage without being measured because of scheduling problems. Measurements taken included total length of each horn, horn spread; and on the longer horn, lengths of horn segments, diameters of horn segments, and degree of horn curl on the 90° -270° diameter.

A C-clamp was clamped on the skull between the horns, and then was clamped in a vice mounted on a ball and socket base which permitted the vice to swivel. The horns were measured while held securely in the vice. A flexible steel measuring tape was fastened to the horn with masking tape and the lengths of the growth segments were measured along the outside (orbital) curve, between horn annuli. By fastening the measuring tape to the horn, the tape could not slip during the measuring process. This assured that the sum of the segment lengths equalled the total length. The greatest diameter at the proximal end of each segment was measured in the groove of the annulus.

After linear measurements were made, the horns were tilted and swiveled until an observer about 4M away could sight along the axis around which the longer horn was coiling. When one sights on the axis, the outer surface of the horn is very nearly described by a circle. About 50cm from the opposite side of the horns from the observer was located a series of concentric circles from 20 cm to 36 cm in diameter engraved on a plexiglass plate. The outermost circle was divided into degree graduations. This plate was attached to the measuring device in a vertical plane as a background to the horns and was free to move up and down in a slot. The 0° - 360° radius was extended to a length of about 28 cm and a movable arm with an engraved radius extending to

28 cm was added to the apparatus. An observer, sighting along the axis of coiling, could have an assistant move the horns and the plexiglass "target" until the axis of coiling passed through the center of the circles on the plexiglass plate. The circle described by the horn could then be matched with one of the concentric circles on the plate. Maintaining his sighting along the axis of coiling to the circle centers, the observer would have an assistant move the 0-360° reference radius until it intersected the base of the horn on the orbital corner. Then the reference would be moved until it intersected the distal end of the horn, and the degrees of curl could be read directly from the scale on the outer circle. Finally the diameter of the coil (or curl) was measured on the 90° - 270° diameter at right angles to the axis of coiling with forestry-type calipers.

FINDINGS

Table 1 lists the mean lengths of annual horn growth, and the total cumulative growth (excluding lamb segments) for rams' horns from seven mountain areas in Alaska. All measurements represent total growth except (1) lamb segments have been worn an unknown amount and (2) those segments being formed at death may still have been growing in the August-September hunting season.

Because many samples are smaller than desirable, few analyses of available data have been made. The significance of findings (Table 1) has not been assessed in cases where analyses have been made. Conclusions have been withheld pending inclusion of measurements from the 1970 season.

RECOMMENDATIONS

If the apparent growth differences already quantified are real (some in Table 1 are statistically significant with present sample sizes), what causes these differences? Studies of hereditary and environmental effects on horn growth are among the follow-up research programs necessary to better understand horn growth and the possibilities of influencing it by special management practices.

PUBLICATION PLANS

Both technical and popular accounts of this study are planned.

LITERATURE CITED

Boone and Crockett Club. 1964. Records of North American big game. Holt, Rinehart and Winston. New York. 398 p.

Erickson, J. A. 1968. Hunter-harvest information, p. 21-37. In L. Nichols, Dall sheep report. Alaska Department of Fish and Game Annual Segment Report. Federal Aid Projects W-15-R-2 and 3, Work Plan N, Vol. 9. Mimeo.

Table 1. Mean annual length of rams' horn growth (mm) for seven mountain areas in Alaska as measured on the orbital curve of horns of rams killed in 1968 and 1969.

KENAI MOUNTAINS				CHUGACH RANGE			
	$\bar{y} \pm SD$ ($\bar{n}$)	Cumulative Total			$\bar{y} \pm SD$ ($\bar{n}$)	Cumulative Total	
Lamb	51 ± 24 (47)	51	Total Excluding Lamb	Lamb	36 ± 22 (67)	36	Total Excluding Lamb
1 yr.	199 ± 34 (47)	250	199	1 yr.	180 ± 30 (67)	216	180
2 yr.	188 ± 25 (47)	438	387	2 yr.	182 ± 30 (73)	398	362
3 yr.	146 ± 18 (46)	584	533	3 yr.	145 ± 27 (73)	543	507
4 yr.	115 ± 20 (44)	699	648	4 yr.	119 ± 23 (72)	662	626
5 yr.	77 ± 15 (39)	776	725	5 yr.	93 ± 19 (65)	755	719
6 yr.	62 ± 14 (23)	838	787	6 yr.	71 ± 18 (52)	826	790
7 yr.	49 ± 8 (14)	887	836	7 yr.	52 ± 15 (36)	878	842
8 yr.	34 ± 7 (8)	921	870	8 yr.	42 ± 7 (23)	920	884
9 yr.	24 ± 8 (5)	945	894	9 yr.	31 ± 6 (18)	951	915

Table 1. Con't. Mean annual length of rams' horn growth (mm) for seven mountain areas in Alaska as measured on the orbital curve of horns of rams killed in 1968 and 1969.

	TALKEETNA-CHULITNA MTNS. WATANA CREEK HILLS				WRANGELL-MENTASTA NUTZOTIN MTNS.			
	$\bar{y} \pm$ SD (n)	Cumulative Total			$\bar{y} \pm$ SD (n)	Cumulative Total		
Lamb	39 ± 23 (33)	39	Total Excluding Lamb		Lamb	43 ± 24 (57)	43	Total Excluding Lamb
1 yr.	167 ± 43 (33)	206	167		1 yr.	192 ± 47 (74)	235	192
2 yr.	177 ± 32 (35)	383	344		2 yr.	188 ± 29 (61)	423	380
3 yr.	139 ± 25 (35)	522	483		3 yr.	150 ± 24 (61)	573	530
4 yr.	111 ± 24 (35)	633	594		4 yr.	120 ± 20 (60)	694	651
5 yr.	85 ± 22 (32)	718	679		5 yr.	93 ± 22 (58)	787	744
6 yr.	72 ± 17 (20)	790	751		6 yr.	65 ± 13 (49)	852	809
7 yr.	54 ± 14 (14)	844	805		7 yr.	46 ± 9 (31)	898	855
8 yr.	41 ± 11 (11)	885	846		8 yr.	32 ± 10 (21)	930	887
9 yr.	38 ± 15 (5)	923	884		9 yr.	27 ± 7 (10)	957	914

Table 1. Con't. Mean annual length of rams' horn growth (mm) for seven mountain areas in Alaska as measured on the orbital curve of horns of rams killed in 1968 and 1969.

	ALASKA RANGE EAST OF McKINLEY PARK				ALASKA RANGE WEST OF McKINLEY PARK			
	$\bar{y} \pm$ SD (n)	Cumulative Total			$\bar{y} \pm$ SD (n)	Cumulative Total		
Lamb	41 ± 24 (72)	41	Total Excluding Lamb		Lamb	39 ± 29 (20)	39	Total Excluding Lamb
1 yr.	185 ± 39 (71)	226	185		1 yr.	164 ± 47 (20)	203	164
2 yr.	164 ± 31 (82)	390	349		2 yr.	163 ± 29 (25)	366	327
3 yr.	140 ± 23 (84)	530	489		3 yr.	143 ± 21 (25)	509	470
4 yr.	116 ± 20 (84)	646	605		4 yr.	119 ± 18 (25)	628	589
5 yr.	92 ± 21 (81)	738	697		5 yr.	96 ± 18 (25)	724	685
6 yr.	69 ± 15 (72)	807	766		6 yr.	76 ± 11 (20)	800	761
7 yr.	51 ± 16 (55)	858	817		7 yr.	60 ± 9 (18)	860	821
8 yr.	37 ± 11 (36)	895	854		8 yr.	44 ± 8 (13)	904	865
9 yr.	27 ± 8 (24)	922	881		9 yr.	33 ± 9 (8)	937	898
10 yr.	22 ± 7 (13)	944	903		10 yr.	28 ± 6 (5)	965	926
11 yr.	14 ± 6 (11)	958	917					

Table 1. Con't. Mean annual length of rams' horn growth (mm) for seven mountain areas in Alaska as measured on the orbital curve of horns of rams killed in 1968 and 1969.

BROOKS RANGE

	$\bar{y} \pm$ SD (n)	Cumulative Total	Total Excluding Lamb
Lamb	38 ± 28 (32)	38	
1 yr.	150 ± 36 (32)	188	150
2 yr.	148 ± 28 (42)	336	298
3 yr.	126 ± 22 (42)	462	424
4 yr.	104 ± 22 (42)	566	528
5 yr.	89 ± 20 (42)	655	617
6 yr.	72 ± 17 (41)	727	689
7 yr.	62 ± 15 (33)	789	751
8 yr.	46 ± 12 (28)	835	797
9 yr.	36 ± 13 (17)	871	833
10 yr.	28 ± 9 (9)	899	861
11 yr.	19 ± 7 (5)	918	880

_____ 1969. Harvest of Dall sheep, p. 4 and 5, 41-65. In L. Nichols and J. A. Erickson, Sheep report. Alaska Department of Fish and Game Annual Segment Report, Federal Aid Projects W-15-R-3 and W-17-1, Work Plan N, Vol. 10. Mimeo.

Hemming, J. E. 1967. Mandibular dentition and horn development as criteria of age in the Dall sheep, Ovis dalli Nelson. M. S. Thesis, Univ. of Montana, Missoula. 42 p.

Scott, R. F. 1951. Mountain sheep studies for period April 1 to September 30. U. S. Fish and Wildlife Service, Quart. Prog. Rept. P-R Project 3-4-6, Work Plan (f), Alaska. 6(1):64-95. Typewritten.

Taylor, R. A., Jr. 1962. Characteristics of horn growth in bighorn sheep rams. M. S. Thesis, Montana State Univ., Missoula. 129 p. Photocopy.

Wishart, B. 1969. Bighorns and little horns. Alberta, Lands-Forests-Parks-Wildlife. Fall, 1969. p. 4-10.

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JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Cooperators: James A. Erickson, A. C. Smith (Temp.), D. Cole, US Army (Temp.)

Project No.: W-17-1 and W-17-2 Project Title: Big Game Investigations

Job No.: 7 and 6.1R Job Title: Dall Sheep Movements and Lick Use

Period Covered: January 1, 1969 to December 31, 1969

SUMMARY

Collars were placed on 56 of 75 Dall sheep caught with a drop net at a natural mineral lick at Dry Creek, in the Alaska Range in 1968 and 1969. In 1969, 68 sheep were caught in 20 drops of the net during the period 30 May to 7 June. About 8 air miles is the greatest distance collared sheep have been seen from the point of capture. Twelve of the 56 collared sheep have not been identified since their release. Collared sheep used a natural mineral lick in Dry Creek 38 to 332 minutes ($\bar{y}$ = 149.1; SD = 77.0) per day of use. Each day's use consisted of from 1 to 3 visits ($\bar{y}$ = 1.6; SD = 0.8) during the period 16-26 June 1969. Ewes first brought lambs to the lick on 31 May. Lambs suckled ewes from 3 to 31 seconds ($\bar{y}$ = 16.2; SD = 1.9; n = 33) per suckling observed from 16 to 26 June 1969. Lamb:ewe and yearling:ewe percentages, as calculated from observations at the lick from 16 to 26 June 1969, were 63.5 and 31.4, respectively.

BACKGROUND

The inevitable solution to sheep management problems generated by increased hunting pressure, as I see it, is to establish area kill quotas. Although restricting hunting to inefficient means or shortening seasons may curb the increasing hunting pressure, the general effects of this management would be undesirable. A necessary prerequisite to establishing area kill quotas is to identify sheep populations and the area each uses. Is a population of sheep a small, fairly well defined unit occupying one or two creek drainages or one mountain? Is interchange along a main mountain range common enough that very large areas are used by one large mobile population? Are rams more mobile than ewes? Is a younger age class more mobile than older age classes? Does mobility differ significantly by season? These are some of the questions which must be answered before management plans involving area kill quotas can be a long term success.

Distribution of sheep in June, July and early August 1962 in the Dry Creek area was studied by Viereck (1963b). He combined daily observations into half-month groups and plotted their locations. His data show an up-valley and up-slope movement trend from June through early August and also a shift from the westward limit of Dry Creek below West Fork Dry Creek to the eastward limit between Lick Creek and the head waters of Dry Creek, including the adjacent Slate Creek and Forgotten Creek drainages. (See Fig. 1). Viereck (1963b) also plotted the locations of major trails used by sheep in Dry Creek. Palmer (1941) listed drainages and portions of drainages that sheep used at different seasons in Dry Creek, Little Delta, and Wood River areas. Scott (1951) outlined seasonal ranges and connecting trails in the Indian Creek area of Kenai Mountains, and Viereck (1963a) described summer and winter range locations in Tonzona River area, Alaska Range. Murie (1944) described sheep movements between seasonal ranges in McKinley Park and described generally the place on one seasonal range to which a sheep from the other seasonal range would travel. Gross (1963) described seasonal movements on Victoria Mountain and Mt. Schwatka in the White Mountains. All of this information refers to general group movements and seasonal distributions. The movements of significant numbers of individually marked Alaska Dall sheep have yet to be described.

General group movements of bighorn sheep (Ovis canadensis) have been described from various parts of their range (Couey 1950; Smith 1954; Devan 1958; Welles and Welles 1961; Simmons 1961; and others). Currently Morgan (1969) is studying the movements of individual bighorn sheep in Idaho with the aid of radio telemetry.

One of the factors which may influence sheep population distribution is the presence of mineral licks. The use of a large natural mineral lick by sheep is being studied in conjunction with the movements study because previous observations by Palmer (1941), Scott (1953) and Viereck (1963b) suggested that the mineral lick has considerable influence on sheep movements and distribution. Viereck (1963b) recorded the number of sheep at Dry Creek Lick per day for June and July on a non-systematic basis and hypothesized that there was a direct relationship between temperature and the number of sheep in the lick.

Seven sheep, captured with a 60 x 60-foot drop net, were collared in

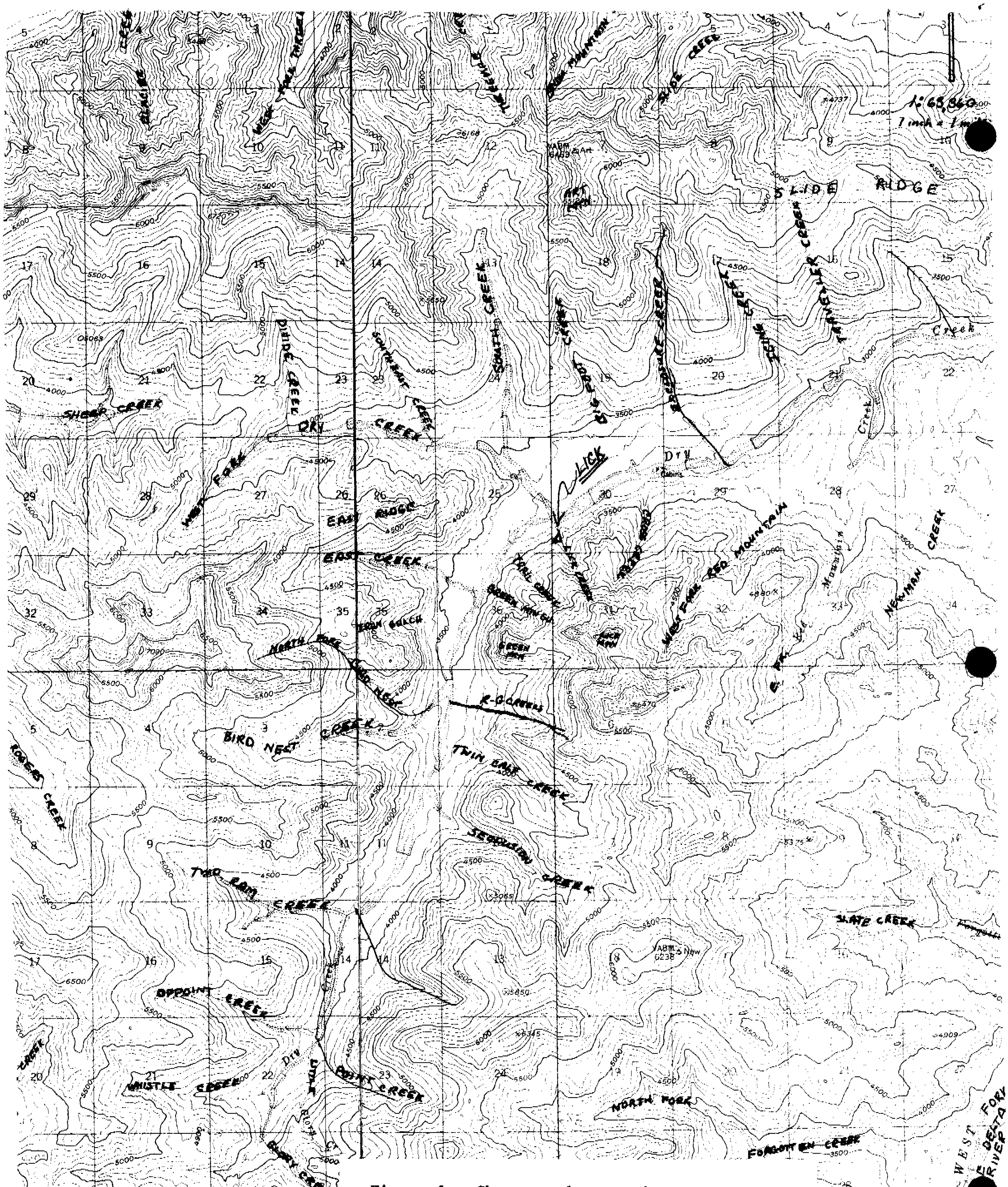


Figure 1. Sheep study area in Dry Creek and adjacent drainages, about 70 miles south of Fairbanks, Alaska.

June 1968 at Dry Creek mineral lick. Yellow, "3/4-inch" polypropylene rope collars were put on six of them, and a 1.75-inch-wide nylon cargo webbing collar was put on one. All collars were fastened with hog rings. Red pendants with white numerals were attached to each collar (Erickson 1969).

OBJECTIVES

To determine the extent of the area used by sheep collared at Dry Creek mineral lick.

To outline daily and seasonal movement patterns of the collared sheep.

To determine if there is a sex, age or seasonal difference in mobility of sheep.

To describe mineral lick use patterns in relation to age and sex of sheep at different seasons.

PROCEDURES

The sheep study area is centered on the Dry Creek drainage in the Alaska Range south of Fairbanks but also includes adjacent drainages.

Sheep were captured and immobilized for collaring with a 60 x 60-foot net which dropped on them when blasting caps in supporting ropes were triggered electrically from a blind about 100 M away. The net was contructed of No. 72 knotless nylon, 3.5-inch square mesh, and was dyed black (Nichols Net and Twine, East St. Louis, Illinois). Four corner posts of 2-inch steel pipe 13 feet long and a 15-foot, 1-inch diameter center post supported the net off the ground. The methods and materials used were similar to those used by Glazener et. al. (1964) and Ramsey (1968) in trapping turkeys (Meleagris gallopavo) and deer (Odocoileus), respectively.

Captured sheep were measured (hind foot, left horn, right horn), ear-tagged, and collared, and their age was estimated from counts of horn annuli. Notes were made on stage of molt, external parasites, incoming and outgoing directions from trap, sex and age composition of the group sheep was in, and behavior at lick. The collar consisted of 6-inch-wide "aurora pink" "Saflag" backed with canvas. Each collar was numbered in three places with 4-inch numerals and a numbered pendant was attached to all collars except numbers 51-57.

Locations of collared sheep, as seen from the ground, were recorded whenever possible. Collar numbers could be read up to a distance of one mile with a 48X telescope. Time spent at the mineral lick was recorded for all collared sheep and any other individually identifiable sheep from 12 June 1969 (drop net removed 8 June 1969) until 26 June 1969.

Regular survey flights were scheduled once a month beginning July 1969, to locate and record locations of collared sheep. Collar numbers were read

when possible from the PA-18-150 aircraft, and locations were plotted on 1:63,360-scale maps.

A ground trip was made into Dry Creek from 24 November 1969 to 8 December 1969 to record daily movements of collared sheep.

FINDINGS

In 1969, 49 sheep were collared. The information recorded at time of capture for sheep collared and/or ear tagged is listed in Appendix 1. From 30 May 1969 to 7 June 1969, 68 sheep were caught in 20 drops of the net.

Resightings of collared sheep are listed in Appendix II. As of 31 December 1969, 12 of the 56 sheep that were collared had not been identified since their release. Of 51 collared sheep seen from the air only 18 have been identified. Streams and place names listed in Appendix II are shown in Fig. 1. The opportunities, as of 31 December 1969, for Alaska Department of Fish and Game personnel to see collared sheep were as follows: on the ground in Dry Creek drainage 27 May 1969 to 26 June 1969 and 24 November 1969 to 8 December 1969; aerial surveys of Dry Creek and portions of adjacent drainages 10 July 1969, 2 October 1969, 15 October 1969, and 19 November 1969. In addition, guides and hunters were contacted and asked to report sightings of collared sheep. This effort resulted in two specific reports of one collar each, one report that several written records had been made but were lost, and three reports from peripheral areas in Wood River and West Fork Little Delta River that no collared sheep were seen.

The greatest distance collared sheep have been seen from the point of collaring is about eight air miles. No collared sheep have been reported west of Wood River or east of West Fork Little Delta River.

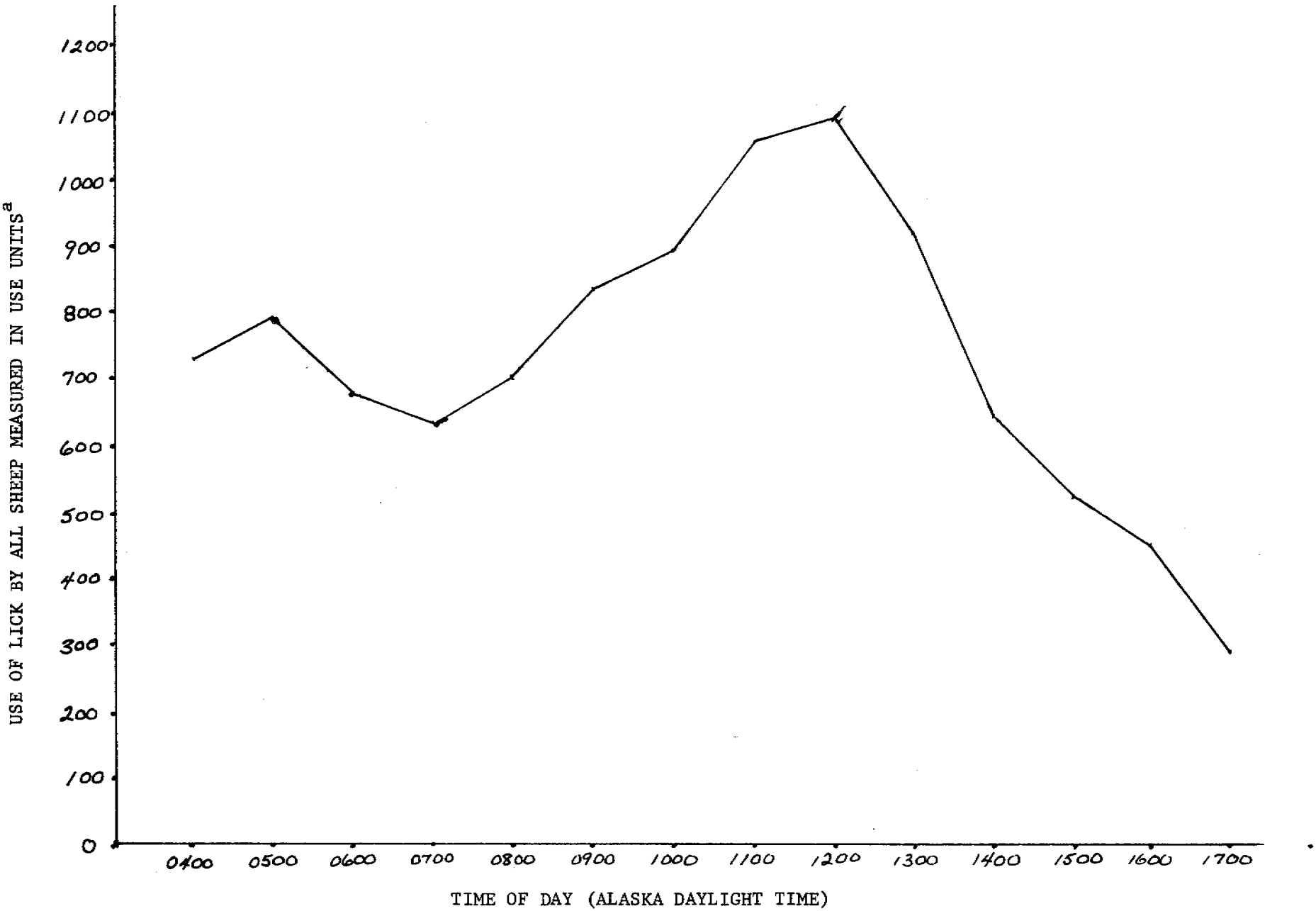
The mineral lick in Lick Creek (Fig. 1) was watched from a distance of about 100 M for 15 hours per day in three 5-hour shifts from 0300 or 0400 to 1800 or 1900 ADT from 16 June 1969 to 26 June 1969. Nearly all use of the lick is made during this period each day, but occasionally sheep use the lick after 1900 and before 0300 hours. Table I shows individual times spent at the lick by collared sheep. We assume that all use of the lick by each collared sheep each day was observed. Fig. 2 shows the number of sheep in the lick as counted every 15 minutes and summed for the four counts (the hour, and 15, 30 and 45 minutes past the hour) for the period 16 to 26 June 1969. Based on observations of collared sheep, a sheep fed in the lick 38 to 332 minutes ($\bar{y}$ = 149.1; SD = 77.0) each day it was in and around the lick, and made 1 to 3 visits to the lick ($\bar{y}$ = 1.6; SD = 0.8) during the period 16-26 June 1969. Use of the lick by ewes, lambs, yearlings, rams (2 yrs. +) and all sheep is graphed by "use units" per class per 15-hour day in Fig. 3. (Table 2 contains these and other data in tabular form). A "use unit" is defined as one sheep observed in the lick during one of the 15-min interval counts. For example, total "use units" per 15-hour day for rams on 17 June 1969 was the sum of ram observations at 61 recording times 15 min apart beginning 0400 ADT and ending 1900 ADT.

Table 1. Time spent by sheep at a natural mineral lick at Dry Creek, Alaska Range, from 16 to 26 June 1969.

Date	Age	Sex	Collar No.	Minutes Per Visit in Lick		Daily Total
16 Jun 69	9 yr	F	50	160	=	160
	5 yr	F	41	151 + 125	=	276
17 Jun 69	3 yr	F	22	66 + 57	=	123
	5 yr	F	41	96 + 23	=	119
18 Jun 69	5 yr	F	41	25 + 56	=	81
	3 yr	F	22	42	=	42
	2 yr	F	51	12 + 21 + 5	=	38
	1 yr	M	39	160 + 9	=	169
	6 yr	F	31	205 + 35	=	240
19 Jun 69	6 yr	F	31	185	=	185
	2 yr	F	7	66 + 146 + 32	=	244
	2 yr	F	15	154	=	154
	5 yr	F	41	121 + 75	=	196
	3 yr	F	22	60	=	60
	1 yr	M	39	54	=	54
	2 yr	F	51	54 + 10 + 22	=	86
	6 yr	F	14	144	=	144
	7 yr	F	52	91 + 26 + 145	=	262
	6 yr	F	38	120 + 134	=	254
20 Jun 69	7 yr	F	52	92	=	92
	6 yr	F	38	105	=	105
	3 yr	F	24	197	=	197
21 Jun 69						
22 Jun 69	6 yr	F	20	147	=	147
23 Jun 69						
24 Jun 69	6 yr	F	38	131	=	131
	9 yr	F	33	78 + 74	=	152
	9 yr	F	50	57	=	57
25 Jun 69	2 yr	F	5	86	=	86
26 Jun 69	9 yr	F	33	80 + 5 + 54	=	139
	1 yr	M	48	332	=	332
				4325/48		4325/29
				$\bar{y}$ = 90.1		$\bar{y}$ = 149.1

Range = 38 - 332

Figure 2 Diurnal use of a natural mineral lick by sheep at Dry Creek, Alaska Range, from 16 to 26 June 1969, expressed as total use units per hour.



[a] "Use unit" = one sheep observed in the mineral lick at one of the 61 - 15 min-interval counts made each day on the hour, and 15, 30 and 45 past the hour from 0300 to 1800 or 0400 to 1900 hours ADT.

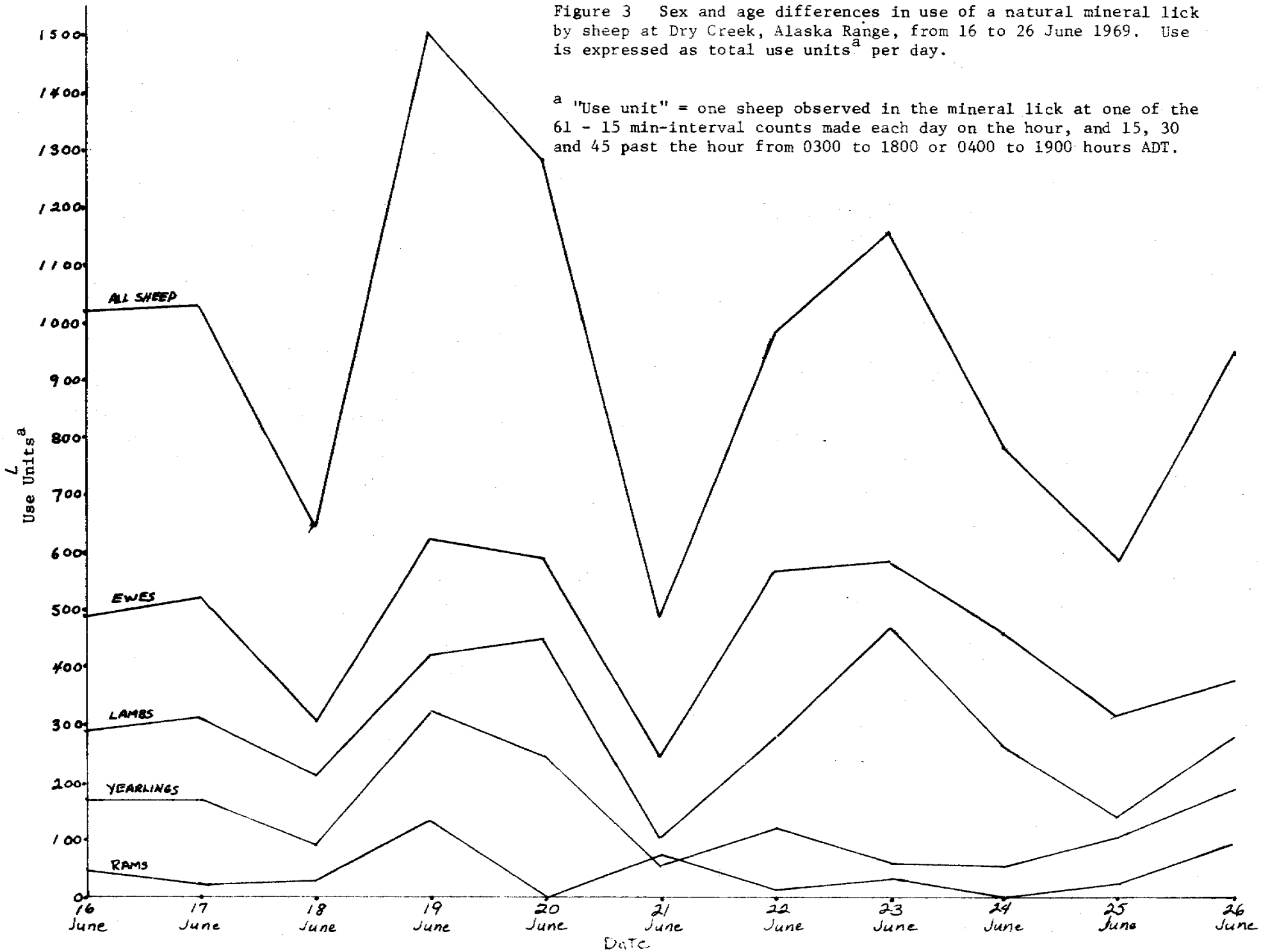


Figure 3 Sex and age differences in use of a natural mineral lick by sheep at Dry Creek, Alaska Range, from 16 to 26 June 1969. Use is expressed as total use units[a] per day.

[a] "Use unit" = one sheep observed in the mineral lick at one of the 61 - 15 min-interval counts made each day on the hour, and 15, 30 and 45 past the hour from 0300 to 1800 or 0400 to 1900 hours ADT.

Table 2. Use of a natural mineral lick by sheep at Dry Creek, Alaska Range, from 16 to 26 June 1969, expressed as use units[a] per day.

Date	Use Units[a] Total	Ewes	Lambs	Yearlings	Rams	Percent Lambs:Ewes	Percent Yearlings:Ewes
16 Jun 69	1020	491	298	177	54	60.6	36.0
17 Jun 69	1034	521	313	178	22	60.0	34.1
18 Jun 69	649	309	218	95	27	70.5	30.7
19 Jun 69	1505	625	421	324	135	67.3	51.8
20 Jun 69	1281	591	446	244	0	75.4	41.2
21 Jun 69	496	250	110	58	78	44.0	23.2
22 Jun 69	984	570	280	118	16	49.1	20.7
23 Jun 69	1154	586	471	60	37	80.3	10.2
24 Jun 69	782	461	265	56	0	57.4	12.1
25 Jun 69	588	319	142	104	23	44.5	32.6
26 Jun 69	946	381	279	191	95	73.2	50.1
	10439	5104	3243	1605	487	63.5	31.4

[a] "Use unit" = one sheep observed in the mineral lick during one of the 61 - 15 min-interval counts made each day on the hour, and 15, 30 and 45 minutes past the hour from 0300 to 1800 or 0400 to 1900 hours ADT.

The actual number of different sheep using the lick each day cannot be determined unless all were individually identifiable. But this number can be estimated by dividing the total recorded incoming sheep by the mean number of visits by collared sheep. For 16 June 1969, 136 recorded incoming sheep divided by 1.65 visits per sheep gives an estimate of 82 different sheep using the lick that day. When more records of use by collared sheep are available, the value of these estimates will be better known.

Rams 2 years-old and older are thought to comprise about 20 percent of the population at Dry Creek (Nichols 1969). However, calculations from lick observations in Table 2 show that rams over 2 years-old comprise only 5 percent of the sheep using this lick. This suggests strongly that this age class uses the lick relatively less than other classes. The proportions of ewes, lambs, and yearlings are thought to occur in the lick about the same as they occur in the population, although a sufficiently large sample of sheep in the drainage was not obtained for comparison in 1969.

Observations at the lick provided the opportunity to record the duration of 33 suckling periods by lambs from 16 to 26 June 1969. These periods ranged from 3 to 31 seconds in duration (as estimated without the aid of a watch) with a mean time of 16.2 seconds and a standard deviation of 1.9 seconds.

RECOMMENDATIONS

No specific management recommendations may be made from preliminary results of this sheep movements study.

PUBLICATION PLANS

The capture and marking techniques will be presented to the meeting of the Northern Wild Sheep Council in May 1970. The transactions of this meeting may be published. The abstract of this presentation is included as Appendix 3.

LITERATURE CITED

Couey, F. M. 1950. Rocky Mountain bighorn sheep of Montana. Montana Fish and Game Comm. Bull. No. 2. 90 p.

Devan, G. A. 1958. Daily movement and activity of the bighorn. Trans. Desert Bighorn Council 2:67-72.

Erickson, J. A. 1969. Movements of Dall sheep, p. 5, 6, 65, and 66. In L. Nichols and J. A. Erickson, Sheep report, Alaska Dept. Fish and Game, Annual Segment Report, Federal Aid Projects W-15-R-3 and W-17-1, Work Plan N, Vol. 10. Mimeo.

Glazener, W. C., A. S. Jackson, and M. L. Cox. 1964. The Texas drop-net turkey trap. J. Wildl. Mgmt. 28(2):280-287.

Gross, J. E. 1963. Range and use of range by Dall sheep (Ovis dalli dalli) on Victoria Mountain and Mount Schwatka, Alaska. M. S. Thesis, Univ. of Alaska, College. 89 p.

Morgan, J. K. 1969. Movements and migrations of bighorn sheep in central Idaho. Abstract of Paper Presented at the Meeting of the Northwest Section of the Wildlife Society, Victoria, B. C. March 28-29, 1969. Mimeo.

Murie, A. 1944. The wolves of Mount McKinley. U. S. Nat. Park Service, Fauna Series No. 5. 238 p.

Nichols, L. 1969. Life history and ecology, p. 1, 2, 6-36. In L. Nichols and J. A. Erickson, Sheep report. Alaska Dept. of Fish and Game Annual Segment Report, Federal Aid Projects W-15-R-3 and W-17-1, Work Plan N, Vol. 10. Mimeo.

Palmer, L. J. 1941. Dall sheep in the Mount Hayes Region. U. S. Fish and Wildl. Service. Prog. Rep. 27 p. Typewritten.

Ramsey, C. W. 1968. A drop-net deer trap. J. Wildl. Mgmt. 32(1):187-190.

Scott, R. F. 1951. Mountain sheep studies. U. S. Fish and Wildl. Service, Quart. Prog. Rep. Work Plan No. 9, 5(3):11-21. Typewritten.

Scott, R. F. 1953. Mountain sheep studies. U. S. Fish and Wildl. Service, Quart. Prog. Rep. Work Plan (F), 8(1):45-50. Typewritten.

Simmons, N. M. 1961. Daily and seasonal movement of Poudre River bighorn sheep. M. S. Thesis, Colorado State Univ., Fort Collins. 180 p.

Smith, D. R. 1951. The life history and ecology of the bighorn sheep in Idaho. M. S. Thesis, Univ. of Idaho. 113 p.

Viereck, L. A. 1963a. Range survey, p. 8-27. In F. F. Jones, R. F. Batchelor, H. R. Merriam, and L. A. Veireck, Sheep and goat investigations. Alaska Dept. of Fish and Game Annual Segment Rep. Federal Aid Project W-6-R-3, Work Plan E. Vol. 3. Mimeo.

Viereck, L. A. 1963b. Survey of range ecology, p. 6-28. In F. F. Jones and H. R. Merriam, Sheep and goat report. Alaska Dept. of Fish and Game Annual Project Segment Report, Federal Aid Project W-6-R-4, Work Plan E., Vol. 4. Mimeo.

Welles, R. and F. Welles. 1961. The bighorn of Death Valley. U. S. Nat. Park Service, Fauna Series No. 6. 242 p.

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Appendix 1. Information recorded for sheep captured at Dry Creek, 30 May to 7 June 1969.

Date	Number	Tag No.	Sex	Age	Hind Foot(mm)	Horn Length L	Horn Length R	Lactating	Percent Coat Shed
30 May 69	7	028L	F	2	375	150	140	No	1
30 May 69	-	099	M	1	340	95	95	--	1
31 May 69	5	026	F	2	360	125	-	--	-
31 May 69	10	100L	M	2	375	195	200	--	1
31 May 69	8	98	M	2	375	270	265	--	-
31 May 69	9	97R	M	2	400	297	292	--	-
1 Jun 69	-	022L	F	1	358	65	67	No	-
1 Jun 69	2	090L	F	14+	370	281	288	No	-
1 Jun 69	6	027R	M	1	360	100	98	--	-
1 Jun 69	1	089L	M	2	390	279	278	--	10
2 Jun 69	-	093L	F	1	344	32	32	--	-
2 Jun 69	-	092R	F	1	348	80	83	--	-
2 Jun 69	12	095R	F	2	-	114	115	--	10
2 Jun 69	3	024L	F	5	360	227	238	Yes	5
2 Jun 69	30	023R	F	5	404	234	231	No	15
2 Jun 69	14	086L	F	6	400	211	210	Yes	-
2 Jun 69	15	087R	M	2	402	276	-	--	15
2 Jun 69	4	025R	M	4	421	-	494	--	5
2 Jun 69	13	078L	M	6	460	-	668	--	-
2 Jun 69	11	084R	M	6	403	-	697	--	-
2 Jun 69	29	094R	M	6	414	-	668	--	10
2 Jun 69	17	076R	M	7	394	-	752	--	10
3 Jun 69	-	090L	F	1	324	21	23	--	-
3 Jun 69	-	096R	F	1	341	59	-	--	10
3 Jun 69	19	077L	F	2	360	-	122	--	-
3 Jun 69	57	081L	F	2	376	121	-	--	-
3 Jun 69	43	062L	F	(3,4,5)	381	192	193	No	-
3 Jun 69	32	-	F	6	370	259	-	No	15-20
3 Jun 69	50	063L	F	9	378	206[a]	259	No	10
3 Jun 69	33	059	F	9	373	-	275	Yes	10
3 Jun 69	-	061R	M	1	348	-	78	--	-
4 Jun 69	-	053R	F	1	352	-	33	--	-
4 Jun 69	-	051L	F	1	346	32	-	--	-

Appendix 1 (Con't). Information recorded for sheep captured at Dry Creek, 30 May to 7 June 1969.

Date	Number	Tag No.	Sex	Age	Hind Foot(mm)	Horn Length L	Horn Length R	Lactating	Percent Coat Shed
4 Jun 69	56	057R	F	1	389	88	-	--	-
4 Jun 69	20	056L	F	6	391	205	-	--	-
4 Jun 69	53	054R	F	7	365	-	208	--	-
4 Jun 69	18	058L	M	2	382	177	-	--	-
5 Jun 69	36	032L	M	2	398	247	242	--	20
5 Jun 69	34	029R	M	2	376	-	211	--	5
5 Jun 69	47	030L	M	5	402	456	-	--	5
5 Jun 69	45	083L	M	6	413	617	-	--	10
5 Jun 69	44[b]	064L	M	6	396	731	-	--	5
5 Jun 69	40	052R	M	6	400	782	-	--	5
6 Jun 69	-	033	F	1	334	23	-	No	10
6 Jun 69	-	082R	F	1	338	-	61	No	-
6 Jun 69	51	031	F	2	357	112	-	No	5
6 Jun 69	54	035L	F	3	387	176	-	No	10
6 Jun 69	41	079L	F	5	-	-	-	No	5
6 Jun 69	16	021R	F	5	-	-	-	No	10
6 Jun 69	31	011L	F	6	-	-	-	Yes	5
6 Jun 69	38	080R	F	6	-	-	-	Yes	10
6 Jun 69	52	016L	F	7	-	-	-	Yes	5
6 Jun 69	46	034L	M	1	-	-	-	--	30
6 Jun 69	39	091R	M	1	-	-	104	--	10
6 Jun 69	35	019R	M	1	-	-	122	--	10
6 Jun 69	48	017R	M	1	348	-	106	--	20
6 Jun 69	37	055R	M	5	411	609	-	--	20
7 Jun 69	44	018L	M	1	358	119	-	--	10
7 Jun 69	55	015R	M	7	398	-	731	--	50
7 Jun 69	42	020R	M	8	403	-	822	--	20

[a] Horn was broken.

[b] Sheep was killed and collar reassigned 7 June 69.

Appendix II. Resightings of sheep collared at Dry Creek mineral lick, Alaska Range.

Collar No.	Age & Sex	Date Collared	Resightings....					
1	2 M	1 Jun 69						
2	14-16 F	1 Jun 69	13 Jun 69 Trail Gulch	19 Oct 69 Exclosure Creek	26 Nov 69 Icing Creek	28 Nov 69 Exclosure Creek		
3	5 F	2 Jun 69	3 Jun 69 Lick					
4	4 M	2 Jun 69	12 Jun 69 Lick					
5	2 F	31 May 69	11 Jun 69 Cross Creek	12 Jun 69 Cross Creek	13 Jun 69 Red Mtn Creek	25 Jun 69 Lick	19 Nov 69 Two Ram Creek	
6	1 M	1 Jun 69	2 Jun 69 Seclusion Creek					
7	2 F	30 May 69	19 Jun 69 Lick					
8	2 M	31 May 69	9 Jun 69 East Creek					
9	2 M	31 May 69	10 Jul 69 Icing Creek	15 Oct 69 Traveller Creek	26 Nov 69 Icing Creek	28 Nov 69 Exclosure Creek	2 Dec 69 Big Foot Creek	3 Dec 69 Big Foot Creek
10	2 M	31 May 69	12 Jun 69 Trail Gulch	13 Jun 69 Trail Gulch				
11	6 M	2 Jun 69	10 Jul 69 Two Ram Creek					

Appendix II (Con't). Resightings of sheep collared at Dry Creek mineral lick, Alaska Range.

Collar No.	Age & Sex	Date Collared	Resightings....				
12	2 F	2 Jun 69	31 Aug 69 Three-mile Creek				
13	6	2 Jun 69	13 Jun 69 Lick				
14	6 F	2 Jun 69	11 Jun 69 Slate Creek	19 Jun 69 Lick	10 Jul 69 Seclusion Creek		
15	2 M	2 Jun 69	19 Jun 69 Lick	15 Oct 69 South Creek			
16	5 F	6 Jun 69					
17	7 M	2 Jun 69					
18	2 M	4 Jun 69	9 Jun 69 East Creek				
19	2 F	3 Jun 69	11 Jun 69 R Creek				
20	6 F	4 Jun 69	22 Jun 69 Lick	23 Jun 69 Lick			
21	1 F	2 Jun 69	3 Jun 69 Lick	9 Jun 69 East Creek			
22	2 F	23 Jun 68	11 Jun 69 Trail Gulch	16 Jun 69 Lick	17 Jun 69 Lick	18 Jun 69 Lick	19 Jun 69 Lick

Appendix II. (Con't). Resightings of sheep collared at Dry Creek mineral lick, Alaska Range.

Collar No.	Age & Sex	Date Collared	Resightings....				
23	1 M	23 Jun 68	4 Jun 69 Lick	11 Jun 69 Trail Gulch	13 Jun 69 Lick		
24	2 F	23 Jun 68	24 Jun 68 Lick	26 Jun 68 Lick	14 Jun 69 Lick	20 Jun 69 Lick	
25	1 M	23 Jun 68	4 Jun 69 Lick				
26	2 F	23 Jun 68	14 Jun 69 Lick	16 Jun 69 Lick			
27	3 F	24 Jun 68	10 Aug 68 Forgotten Creek	12 Jun 69 Trail Gulch			
28	5 M	26 Jun 68	Found dead Slide Creek Aug 1969				
29	6 M	2 Jun 69	15 Jun 69 Cross Creek	2 Oct 69 Red Mtn. Creek			
30	5 F	2 Jun 69	11 Jun 69 R Creek				
31	6 F	6 Jun 69	18 Jun 69 Lick	19 Jun 69 Lick	15 Oct 69 Rogers Creek		
32	6 F	3 Jun 69	12 Jun 69 Cross Creek	13 Jun 69 Cross Creek	19 Nov 69 Slate Creek		
33	9 F	3 Jun 69	11 Jun 69 Cross Creek	12 Jun 69 Lick	24 Jun 69 Lick	26 Jun 69 Lick	19 Nov 69 Slate Creek

Appendix II. (Con't). Resightings of sheep collared at Dry Creek mineral lick, Alaska Range.

Collar No.	Age & Sex	Date Collared	Resightings....			
34	2 M	5 Jun 69	9 Jun 69 East Ridge	13 Jun 69 Trail Gulch		
35	1 M	6 Jun 69	27 Aug 69 Sheep Creek	28 Aug 69 Sheep Creek		
36	2 M	5 Jun 69				
37	5 M	6 Jun 69	10 July 69 Forgotten Creek	19 Nov 69 Red Mtn Creek		
38	6 F	6 Jun 69	19 Jun 69 Lick	20 Jun 69 Lick	24 Jun 69 Lick	
39	1 M	6 Jun 69	18 Jun 69 Lick	19 Jun 69 Lick		
40	6 M	5 Jun 69	25 Nov 69 South Creek			
41	5 F	6 Jun 69	16 Jun 69 Lick	17 Jun 69 Lick	18 Jun 69 Lick	19 Jun 69 Lick
42	8 M	7 Jun 69	11 Jun 69 Forgotten Creek			
43	(3-5) F	3 Jun 69				
44	1 M	7 Jun 69				

Appendix II. (Con't). Resightings of sheep collared at Dry Creek mineral lick, Alaska Range.

Collar No.	Age & Sex	Date Collared	Resightings....		
45	6 M	5 Jun 69	19 Nov 69 A. Creek		
46	1 M	6 Jun 69			
47	5 M	5 Jun 69	10 Jul 69 Snow Mtn. Gulch		
48	1 M	6 Jun 69	26 Jun 69 Lick	15 Oct 69 Rogers Creek	
49	Not Used				
50	9 F	3 Jun 69	13 Jun 69 Slate Creek	16 Jun 69 Lick	24 Jun 69 Lick
51	2 F	6 Jun 69	18 Jun 69 Lick	19 Jun 69 Lick	
52	7 F	6 Jun 69	19 Jun 69 Lick	20 Jun 69 Lick	
53	7 F	4 Jun 69			
54	3 F	6 Jun 69			
55	7 M	7 Jun 69			

Appendix II. (Con't). Resightings of sheep collared at Dry Creek mineral lick, Alaska Range.

Collar No.	Age & Sex	Date Collared	Resightings....
56	1 F	4 Jun 69	11 Jun 69 Trail Gulch
57	2 F	3 Jun 69	

Appendix III.

USE OF DROP NET AND COLLARS IN STUDY OF DALL SHEEP

James A. Erickson

ABSTRACT

A drop net similar to that used by Ramsey (J. Wild. Mgmt., 32:187-190. 1968), has been used to capture Dall sheep in Alaska. Twenty drops of a 60 X 60 foot, 3.5 inch square mesh net of No. 72 knotless nylon dyed black (Nichols Net & Twine, East St. Louis, Ill.) caught 68 sheep at a natural mineral lick 30 May - 7 June 1969. Sheep usually fell and could not get up again when the net dropped on their backs. Most sheep thrashed about one minute, and then laid still. Violent struggling was rare. Rapid heart beats, audible several meters away, were characteristic of captured sheep. Despite the lack of struggling, sheep were fatigued when released, but they recovered rapidly. Only 1 of 75 sheep caught to date was injured seriously; the femur of a 6-year old ram was broken, probably from falling against a sharp rock in the trap zone. The mean time required to reset the net, including processing animals, was 77.8 minutes for the 19 resets. Two men have dropped and reset the net four times per day. About eight sheep per drop is the most two men can handle. Sheep lick use patterns did not appear to be altered by the trapping activities. Although sheep use the mineral lick throughout the snow-free period, greater use is made from late May through mid July than at other times. Considering that 68 sheep were caught in 8 days, 40 or 50 days of trapping during the above period could result in large scale data collections.

Collars of 6-inch wide "aurora pink" "Saflag" backed with canvas and numbered in three locations with 4-inch black "Saflag" numerals were placed on captured sheep. They were fastened with two metal clips through grommets arranged to allow 23-inch maximum neck girth for females and 25-inch for males. Most males and some females had sufficient head and horn size at 12 months of age for collars to stay on. Other sheep did not appear to have a lasting behavior change toward collared sheep. The collars were visible with an unaided eye about one mile away. The numbers could be read up to one mile with a 48X telescope. Folded collars, smallness of numbers, pilot's lack of skill in mountain flying, and the cover-seeking habit of sheep have prevented the positive identification of 43 of 63 (68%) collars seen from a PA-18-150 aircraft. Larger numerals and stiffer backing material of the collars, and careful selection of a survey pilot would improve the percentage of collars positively identified.