ALASKA DEPARTMENT OF FISH AND GAME JUNEAU, ALASKA

STATE OF ALASKA William A. Egan, Governor

DEPARTMENT OF FISH AND GAME Wallace H. Noerenberg, Commissioner

DIVISION OF GAME Frank Jones, Acting Director Donald McKnight, Management-Research Coordinator

SHEEP REPORT

by

Lyman Nichols and Arthur Smith

Volume XII Project Progress Report Federal Aid in Wildlife Restoration Project W-17-2, Jobs 6.1R and 6.2R (2nd half) Project W-17-3, Jobs 6.1R, 6.2R, 6.3R, 6.4R, 6.5R and 6.6R (1st half)

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(Printed June 1971)

JOB PROGRESS REPORT (RESEARCH)

State:	<u>Alaska</u>		
Cooperators:	Arthur C.	Smith, James A. En	rickson and Various Temporaries
Project No.:	<u>W-17-2</u>	Project Title:	Big Game Investigations
	<u>W-17-3</u>	Job Title:	Dall Sheep Movements and
Job No.:	<u>6.1R</u>		Mineral Lick Use

Period Covered: January 1, 1970 to December 31, 1970

SUMMARY

Collars were placed on 105 of 170 Dall sheep captured with a drop net at a natural mineral lick at Dry Creek, Alaska Range during 1968, 1969 and 1970. In 1970, 102 sheep were captured in 23 net drops from June 12 -June 21. The majority of resightings have been within 6.5 miles of the capture site. One young ram was seen 16.6 miles from the capture site. No sightings were made outside of the area described by the east bank of the Wood River and the west bank of the West Fork of the Little Delta River. During the study period 100 percent of the sheep captured in 1968 and 76 percent of the sheep collared in 1969 were resighted.

First observed use of the mineral lick occurred May 24, 1970. Maximum use of the lick occurred during the period June 5 - June 8, 1970, with maximum use during a day occurring between 0400-0900 ADT. The time all sheep spent in the lick per visit averaged 64 minutes (SD = 46.4) and the number of visits per day of use ranged from 1 to 5 (\overline{Y} = 1.7, SD = 1.0). The time spent in the lick per visit was longer during the period 2400-1200 ADT (\overline{Y} = 70.2 min.) than the period 1200-2400 ADT (\overline{Y} = 54.7 min.). The time per visit and the number of visits per day of use were not sighificantly different for males and females.

Lamb:ewe and yearling:ewe percentages, as calculated from observations at the lick from June 3 - June 12, 1970, were 55 and 31, respectively.

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BACKGROUND

General group movements and seasonal distributions of Dall sheep in various areas of Alaska have been investigated.

Distribution of sheep in June, July and early August 1962 in Dry Creek area was plotted by Viereck (1963b). 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 area between Lick Creek and the headwaters of Dry Creek, including adjacent Slate Creek and Forgotten Creek drainages (Fig. 1). Palmer (1941) listed areas used by sheep at different seasons in Dry Creek, Little Delta River and Wood River areas. Scott (1951) outlined seasonal ranges and trails in the Indian Creek area of the Kenai Mountains. Viereck (1963a) described seasonal range in the Tonzona River area. Murie (1944) described sheep movements in McKinley Park. Gross (1963) described seasonal movements on Victoria and Schwatka Mountains in the White Mountains.

The movement of significant numbers of individually marked Alaska Dall sheep has not been described. Before separate populations can be identified and meaningful management programs instituted, this must be done.

One factor which may influence sheep population distribution is the presence of mineral licks. The use of a natural mineral lick by sheep is therefore being studied in conjunction with the movements study.

OBJECTIVES

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

To outline daily and seasonal movement patterns of individually marked 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 and includes adjacent drainages (Fig. 1).

In June 1968, 7 sheep were captured with a drop net at the Dry Creek mineral lick, as described by Erickson (1969). Rope collars with pendants were placed on the sheep (Figure 2). Locations of collared sheep were recorded whenever possible. Pendant numbers could be read from 300 yards with a 20X spotting scope. Aerial identification was not possible (Erickson, 1970).

In June 1969, 60 sheep were captured with a drop net at the same site. Forty-nine sheep were collared (Fig. 2) as described by Erickson (1970). Aerial and ground observations identified collar numbers whenever possible. These observations were plotted on topographic maps of the area (Erickson, 1970). The mineral lick in Lick Creek (see Figure 1) w as observed from a distance of 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.

In 1970, 102 sheep were captured at the same site with the drop net. The procedure was as described by Erickson (1970).

Captured sheep were weighed and measured (total contour length, tail length, shoulder height, chest girth, horn lengths and horn spread), ear tagged and 49 sheep were collared. The age of captured sheep w s estimated from horn annuli. Notes were made on stage of molt, external parasites and behavior upon trapping. The collars consisted of aurora pink Saflag material backed with canvas. An oval piece of linoleum was sewn between the Saflag material and the canvas, beneath the side numbers to act as a stiffener. Each collar was numbered in two places with 6-inch numerals (Figure 2).

Locations of collared sheep were subsequently recorded whenever possible. Several field trips in the area provided opportunity for sightings. Regular survey flights were scheduled once a month beginning July 1970 to record locations of collared sheep. Survey flights, conducted with a PA18-150 hp aircraft, were flown during July, August, September and October.

The main natural mineral lick was observed 24 hours a day from June 3 to June 12, 1970 and June 29 to July 3, 1970. Four men, each observing the lick for 6 hours, recorded the time a sheep or a group of sheep entered or left the lick, the sex and age of observed sheep, and once every 15 minutes a total count and classification of sheep in the lick \forall s made. At the time of these 15-minute observations the temperature and sky cover was recorded. Observations at the main lick and at other licks within the study area for less than 24 hours a day were recorded in a similar manner.

The observations were made with a 20X spotting scope with occasional use of a 48X spotting scope from a blind 250 M from the lick. The sex of lambs could not be determined. Yearlings were identified by their smaller size, conformation and small horns. Male yearlings were identified by presence of the penis sheath. Older sheep were classified as adult ewes and adult rams.

27"

1968 Collar 3/4" yellow



polyprophylene rope with pendant

1969 Collar 6" pink Saflag material backed with canvas 4" black numerals, pendant



1970 Collar 6" pink Saflag material backed with canvas 6" black numerals stiffner beneath numerals



Figure 2. Collars used on Dall sheep captured during 1967, 1969, 1970 at Dry Creek, Alaska Range.

FINDINGS

One hundred and two sheep were captured and immobilized in 23 net drops from June 12-23, 1970 at the capture site on Dry Creek. The information recorded at the time of capture for these sheep, and those captured in 1968 and 1969, is listed in Appendix I. Mean measurements of hind foot length, total contour length, shoulder height and mean weight in pounds for rams and ewes are presented in Fig. 3 and Fig. 4, respectively. Although more data are needed, it appears that hind foot and shoulder height stabilize at 2-3 years of age, while weight and total contour length continue to increase throughout life. More information is needed before meaningful conclusions can be reached regarding growth characteristics and morphology of Dall sheep from the central Alaska Range. Comparison of morphological characteristics between the Dry Creek sheep and those collected by Lyman Nichols on the Kenai Peninsula should be accomplished.

The year class and sex of sheep captured during 1968, 1969 and 1970 are presented in Table 1. Poor survival of the 1965 and 1966 year class is suggested. The number of rams (2) from the 1964 year class is interesting. Most of the rams from this year class would not have entered the legal hunting crop until August of 1970, yet the year class of 1963 rams (older and therefore assumed more desirable trophies) shows 11 captives. The ewe segment of the 1964 year class does not indicate low survival. More information on the survival of each age class from the capture data will be valuable for future management decisions.

Resightings of all collared and ear tagged sheep are listed in Appendix II and Appendix III respectively. Streams and place names listed in Appendix II and Appendix III are shown in Fig. 1.

Most resightings have been within 6.5 air miles of the capture site (Fig. 5). One young ram was seen 16.6 miles from the capture site. No collared sheep have been observed east of the west bank of the West Fork on the Little Delta River, or west of the east bank of the Wood River. During the study period 100 percent of the sheep collared in 1968 and 76 percent of the sheep collared in 1969 were resignted. Three rams, two captured in 1969 and one in 1970, were killed by hunters during 1970.

General group movements for the Dry Creek sheep, Viereck (1963a) are indicated from resightings. Individual movements have proved difficult to monitor. As originally planned, the collars were to be identified from a PA-18 150 hp. aircraft. Problems with terrain, turbulence, sheep behavior and folded collars have prevented many accurate collar identifications from the air. The information on individual movements will be gathered by more extensive ground observation throughout the coming year.

The mineral lick at Lick Creek was observed 24 hours a day during the period June 3 - June 11, 1970 and June 29 - July 3, 1970. On other dates during the field season the Lick Creek lick and other licks (Fig. 6) throughout the study area were observed for less than 24 hours a day. Lick use times for collared sheep gathered from these observations are presented in Table 2 and Table 3. Lick use units by hour and by day, as calculated from observations every 15 minutes at the Lick Creek lick from June 3, 1970 to June 11, 1970, are presented in Tables 4 and 5, respectively.



Length (mm)



Year Class	Rams	Ewes*	Total
1955	0	1	1
1956	0	0	0
1957	. 0	1	1
1958	0	0	0
1959	0	0	0
1960	0	4	4
1961	2	4	6
1962	3	4	7
1963	11	12	23
1964	2	14	16
1.965	1	4	5
1966	1	6	7
1967	15	12	27
1968	20	19	39
1969	14	8	22
1970	4	6	_10
	73	95*	168

Table 1. Year class and sex of Dall sheep captured at Dry Creek during 1968, 1969 and 1970.

* Two ewes not included due to uncertain age.



O denotes location of collared sheep sightings*

denotes capture site.

*Duplicated sightings not plotted. Figure 5. Map showing locations of collared sheep resightings.



Date	Collar No.	Age	Sex	Minutes Per V 2400-1200 ADT	visit in Lick 1200-2400 ADT	Day Total	No. of Visits
	····· ·····			(0.100	<u>, tu <u>– – – – – – – – – – – –</u> – – – – – – –</u>	160	 0
6/3/70	22	5	F ·	40, 123	40	102	2 1
	32	/	F		40	40	
	33	10	F _		41.	41 70	1
	43	4-6	F		45, 15, 18	78	د د
	45	7	·M		130, 2	1.32	2
6/4/70	2	15-17	F	105,20,9	93,57	284	5
	22	4	F				
	32	7	F	(1)*	(1)*	Unk	2
	33	10	F	(1)	(1)	Unk	2
6/5/70	31	7	T	25		25	1
0/1/10	50	10	т Т	312		312	1
	50	10	T.	52		52	1
	22	0	Г	JZ		52	
6/6/70	5	3	F	50		50	1
	12	3	F	126	(1)	Unk	2
	25	2	M	122		122	1
	31	7	F	(1)		Unk	1
	32	7	F	73		73	1
	33	10	Ŧ	42		42	1
	38	-0	- F	(1) + (1)	(1) + 20.8	Unk	5
	40	7	- M		120, 18, 2	140	3
	43	4–6	F	47 + (1)	71,40	Unk	4
	45	6	M	145	20	165	2
	50	10	F	33		33	1
	52	10	ג ד	(1)		Unk	1
	32	0	Г			0	· · -
6/7/70	5	3	\mathbf{F}	(1) + 84	36	Unk	' 3
	33	10	F	37 + (1)		Unk	2
	38	7	F	13, 52		65	2
	43	4-6	F	34		34	1
	51	3	F		52	52	1
6/8/70	5	3	F	71, 10		81	2
0,0,10	- 7	3	- 7	· _ , _ ·	102 + (1)	Unk	2
	32	7	F	102	·····	102	1
	22	10	F	115		115	1
	41 41	+0 6	т Т	89		89	1
	47	6	M	77	18, 45	140	3
< 1 1		-		200 00	·	201	2

Table 2. Lick use times by collared Dall sheep at Dry Creek lick, June 3, 1970 -July 3, 1970. Mineral lick observed 24 hrs. per day.

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Table 2.	(Continued)
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Date	Collar No.	Age	Sex	Minutes Per 2400-1200 ADT	Visit in Lick 1200-2400 ADT	Day Total	No. of Visits
6/11/70	3	6	F	125		125	1
	7	3	F		1.27	127	1
	19	3	F		182, 37, 30	249	3
6/29/70	7	3	F	54		54	1
	26	4	F		73	73	1
	52	8	F	107		107	1
	53	8 /	F	150	12	162	2
	77	11-13	F	40		40	1
	91	8	М	16, 63	82	161	3
	98	3	F	107		107	1
	G2	3	F	115, 4		119	2
	G6	6	F		73, 12, 27, 56	168	4
	544	2	F		73	73	1 ·
6/30/70	26	4	F		44	44	1
	53	8	F	12, 21		33	2
	56	2	F		31, 9	40	2
	69	6	F		76	76	1
	71.	10-11	F	36		36	1
	97	3	F		123	123	1
	Gl	, 7	F		137, 47, 73	257	3
	G6	6	F	80	71	151	2
7/1/70	54	4	F	93		93	1
	70	6	F	50		50	1
	96	3	F	47		47	1
	Gl	7	F	15 + (1)		Unk	. 2
7/3/70	9 6	3	F		33	33	1

* Number in parenthesis indicates known visits to lick. The length of the visit is unknown.

	Collar			Minutes Per V	isit_in_Lick
Date	No.	Age	Sex	2400-1200 ADT	2100-2400 ADT
7/5/70	19	3	F	67	
	20	7	F	73	3,12,29,3,47
	33	10	F	56	
	47	6	M		51
	57	3	F	10 2	
	67	6-7	F	67	07
	79	5	F	68	97
,	97	3	F	92	4.0
	G4	4	F	52	42
7/6/70	19	3	F	26	
	20	7	F	54	
	56	2	F	23	20
	68	2	F	73	22
	74	8-9	F	242	
	88	3	F	/8	
	G5	2	М	97	
7/7/70	51	3	F	30	15
	67	6-7	F	61	
	79	5	F	43	
	88	3	F	36	
7/8/70	11	7	М	80	
	64	7	F	51	
	65	3	М		74 ,
7/9/70	5		F	139, 18	
•••	32		F	76	
	60			49, 17	51,147,23,31
	64			21	
	68		F	123	64
	70		· F		87
	74		F	96	
	92			71, 17	-
	G3				76
7/12/70	61	2	М	20 2	
7/13/70	61	2	М	96,43,39,20	
7/20/70	20	7	F		97
	79	5	F	100,30	

Table 3.	Lick use times by collared sheep at Dry Creek lick, Upper Dry
	Creek lick and Kansas Creek lick, July 5, 1970 - July 27, 1970.
	Mineral licks not observed 24 hrs. per day.

	Collar			Minutes Per Visit in Lick					
Date	No.	Age	Sex	Before Noon	After Noon				
7/21/70	20	7	F	66					
	32	7	F	75, 11	1				
	56	2	F	119, 5, 216	50				
	79	5	F	3, 33, 45, 3	93				
	88	3	F	76					
	90	9	F	86	40				
	97	3	F	88					
	G1	7	F	137	21, 30				
	G2	3	F	90	60				
7/22/70	7	3	F	59, 81	47				
4	29	7	М	61	24				
	56	2	F	53					
	73	1	м	102, 79					
	79	5	F	60					
	88	3	F	65					
	90	9	F	64					
	97	3	F	88					
	Gl	7	F	32					
	G2	3	F	68					
	G8	7	F	60					
7/23/ 7 0	75	6	F	60	139				
7/24/70	73	1	М	60					
	97	3	F	69					
7/25/70	50	11	F	49, 9					
	69	6	F	73	4				
	73	1	М	109					
	81	2	М	50					
	97	3	F	46					
7/27/70	36	3	М	122					

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Table 3. (Continued)

Hour	Ewe	Lamb	Yearling	Ram	Total
0100	32	16	29	47	124
0200	82	33	56	61	232
0300	262	98	102	81	543
0400	529	245	206	81	1061
0 50 0	1023	542	387	100	2052
0600	645	256	330	110	1341
0700	684	298	350	115	1447
0800	777	303	398	142	1620
0900	587	239	266	165	1257
1000	229	86	150	121	586
1100	335	125	191	144	795
1200	453	230	197	169	1049
1300	456	226	190	110	· 982
1400	481	267	215	97	1060
1500	523	276	226	122	1147
16 0 0	359	193	229	172	953
1700	240	126	162	166	694
1800	329	167	204	94	794
1900	196	111	113	91	511
2000	207	159	108	114	588
2100	266	116	1 7 7	124	683
2200	278	115	170	74	637
2300	200	110	116	55	481
2400	102	54	63	16	235

Table 4. Sheep use units by hour, sex and age of animals for the period June 3 to June 11, 1970 at Lick Creek lick, Dry Creek, Alaska Range.

Date		Ewe	Lamb	Yearling	Ram	Total
June	3	308	112	332	335	1087
June	4	512	213	347	125	1197
June	5	493	218	242	341	1294
June	6	1476	581	685	556	3298
June	7	1378	622	749	272	3063
June	8	1110	513	557	238	2418
June	9	419	117	270	91	896
June	10	264	124	61	57	506
June	11	850	496	236	94	1673

Table 5.	Sheep use	units by	day,	sex and	age of animals	for the period
	June 3 to	June 11,	1970	at Lick	Creek lick, Dr	y Creek, Alaska
	Range,					

Table 6 indicates the temperatures recorded at each 15-minute observation period during the same period.

First observed use of the mineral lick occurred May 24, 1970 with the maximum use period occurring between June 5 - June 8 (Fig. 7). Observations of the lick were interrupted by the trapping operation June 12 - June 21, 1970. Because of this interruption no conclusion can be drawn regarding the period of maximum use. Maximum lick use for the period between June 3 and June 11, 1970 correlates relatively well (CORR. COEF. - .72) with mean temperatures for the same period of observation (Fig. 8). Maximum use period during a day occurred between 0400-0900 ADT, with a lower peak around noon (Fig. 9). In 1969 the lick was observed from 0400-1700 ADT and maximum use occurred around noon (Erickson, 1970). Daily use of the lick does not correlate with mean hourly temperature (CORR. COEF. = .15) (Fig. 10).

The total time in the lick per visit averaged 64.4 minutes for all sheep (Fig. 11). Males with a mean of 69.1 minutes per visit were not significantly different from females with a mean of 64.2 (Fig. 12). Mean lick use periods were significantly longer during the period 2400-1200 ADT at 70.2 minutes than during the period 1200-2400 ADT at 54.7 minutes (Fig. 13). The number of visits to the lick per day for the observation period averaged 1.7 visits per day. Mean number of visits to the lick per day for males at 2.3 (SD = .8) was not significantly different than females at 1.6 (SD = 1.0) (Fig. 14).

The mineral lick at Lick Creek has been observed for portions of two summers. Each year's observations have been interrupted by our trapping operations. Conclusions regarding the total use patterns for the two sexes, and the various age classes, cannot be drawn until the lick is observed for one summer season without interruption.

Observations at the lick provided the opportunity to evaluate the survival of the 1969 year class to yearling age and to evaluate initial production in 1970. Lamb:ewe and yearling:ewe percentages, as calculated from our observations from June 3 - June 12, 1970 were 55 and 31, respectively.

RECOMMENDATIONS

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

Time (ADT)	June 3	4	5	6	7	8	9	10	11	x
·							····			
0100	31	41	44	39	47	31	27	- 36	42	
	34	41	44	39	48	29	28	36	42	
	37	41	44	37	48	28	28	.35	42	
	34	40	44	35	46	33	30	36	42	37.8
0200	30	39	44	36	46	32	28	36	42	
	32	37	44	33	47	32	27	36	42	
	32	37	44	35	45	30	27	36	42	
7	32	37	44	36	40	32	27	35	42	37.5
0300	31	35	44	_	46	30	26	35	42	
	30	36	44	35	44	32	27	36	42	
	30	40	45	_	44	31	27	35	42	
	32	38	45	34	43	31	27	33	43	36.3
0400	32	41	45	36	44	32	28	33	42	
	34	39	44	38	43	32	27	33	43	
	34	36	44	40	44	31	29	33	42	
	34	38	44	-	45	32	29	34	42	37.1
0500	34	35	44	42	44	32	29	34	42	
	34	39	45	43	46	33	30	34	42	
	34	41	45	44	51	35	30	32	43	
	35	44	45	44	51	36	30	32	43	38.8
0600	38	44	45	46	_	37	31	36	42	
0000	43	44	45	-	54	38	32	37	43	,
	41	44	45	52	55	39	34	37	44	
	42	46	45	50	53	40	34	38	44	42.3
0700	44	49	47	50	54	-	46	40	44	
0700	41	52	48	-	_	41	48	40	44	
	41	_	49	52	56	_	38	40	44	
	43	52	52	52	54	40	39	43	45	44.6
0800	42	52	52	48	60	40	37	43	46	
0000	43	54	54 54	40 7.8	50	41	34	45	47	
	45	54	52 52	40	52	40	35	45	46	
	45	54	52	47	52	39	-	46	47	46.7
0000	1.6	57	51	/, 9	59	40	34	43	49	
0900	40 //6	54	20	40 50	52	40 //1	29	4.J 1/7	72 50	
	40	57	50	50	52	ላ ት ተ	20 70	47	51	
	4/ 50) 50	00	50	در ۲۰	40	40	50	52 52	48 0
	52	23	49	53	54	40	44	50	23	48.U

Table 6. Temperatures in °F recorded at Lick Creek lick, Dry Creek, Alaska Range, every 15 minutes from 0000 ADT June 3 to 2400 ADT June 11, 1970.

Table 6 (Continued).

Time (ADT)	June 3	4	5	6	7	8	9	1.0	11	x				
1000	51	60	48	53	55	40	46	49	51					
	49	54	48	54	56	41	43	51	51					
	-	52	48	52	57	44	46	54	50					
	-	54	49	52	54	42	47	56	52	50.3				
1100	50	54	48	57	56	42	42	-	52					
	49	57	50	-	57	41	48	49	53					
	47	57	49	58	57	41	52	49	54					
	46	61	50	56	61	41	54	48	53	51.1				
1200	48	65	_	57	57	40	49	47	52					
	50	55	53	62	57	40	50	47	52					
	58	57	50	55	56	42	53	46	51					
	-	57	52	59	-	44	55	47	54	52.1				
1300	-	57	-	61	53	46	55	4 5	60					
	52	59	54	58	51	44	51	43	53					
	52	59	56	64	50	41	51	42	-					
	51	59	57	59	50	42	57	43	53	52.4				
1400	51	56	57	63	50	45	58	41	52					
	54	55	58	59	46	45	54	42	50					
	56	55	59	63	50	43	55	41	53					
	59	54	57	62	46	43	60	42	54	52.4				
1500	54	57	58	66	46	46	49	42	54					
	55	55	56	65	47	44	51	43	55					
	54	54	60	65	46	46	54	44	55					
	54	53	59	66	49	42	57	46	55	52.8				
1600	54	52	55	63	50	43	59	46	56					
	58	56	56	63	50	45	57	45	59					
	59	54	57	63	55	46	53	47	54					
	60	56	58	63	52	45	51	48	5.3	53,9				
1700	63	58	59	63	51	47		50	55					
	60	53	62	64	50	48	53	49	56	-				
	62	52	64	64	_	49	54	47	55					
	59	52	65	64	49	42	52	47	55	55.6				
1800	56	51	64	64	50	38	50	46	55					
7000	59	50	59	63	49	36	49	47	53					
	55	52	54	63	48	-	49	47	52					
	54	51	52	-	47		51	47	53	51.9				
	27		24		··· ()			••	~~					

Table 6 (Continued)

									· · · ·	
Time										
(ADT)	June 3	4	5	6	7	8	9	10	11	X
1900	52	50	51	· _	52	36	49	47	53	
	50	50	55	-	50	36	49	46	50	
	48	50	52	70	50	33	48	46	49	
	53	49	51	70	55	33	47	45	49	49.2
2000	51	49	50	70	52	36	46	44	48	λ
	54	48	50	67	52	34	46	44	48	
	59	48	-	65	50	36	46	44	47	
	50	48	49	69	48	-	42	43	47	49.4
2100	53	48	50	64	46	36	41	42	-	
	46	48	49	65	44	32	41	42	46	
	44	50	-	58	51	31	42	42	46	
	40	48	47	52	45	33	41	42	46	45.6
2200	41	48		52	41	33	41	42	44	
	41	47	47	-	40	32	_ ·	40	44	
	41	46	_	50		-	40	40	42	
I.	40	46	46	51	35	31	40	39	43	42.3
2300	38	46	46	49	34	31	39	39	43	
	42	46	46	45	31	31	40	39	42	
	42	45	45	45	33	31	38	38	41	
	42	44	44	45	30	30	38	39	41	39.9
2400	41	44	44	-	30	30	_	38	41	
	42	45	40	43	31	-	37	39	40	
	42	44	40	46	30	29	36	39	36	4
		44	40	· · · · · · · · · · · · · · · · · · ·	30	29	36	40	40	39.2
	15 6	/0.1	(0 C			07 /	20.4		17 0	
x =	45.6	49,1	49.9	53.3	48.3	37.4	39.4	42.0	47.8	



Creek, Alaska Range, from June 3, 1970-June 11, 1970. Data from Table 5.













Figure 12. Individual lick use periods for 186 sheep at Dry Creek lick, June 1970. Mean, range. standard deviation and sample size are indicated. Data are from Table 2 and Table 3.



Figure 13. Daily lick use patterns 2400-1200 ADT, 1200-2400 ADT, and 2400-2400 ADT for 196 sheep at Dry Creek lick June 1970. Mean, range, standard deviation and sample size are indicated. Data are from Table 2 and Table 3.



range, standard deviation and sample size are indicated. Data are from Table 2.

PUBLICATION PLANS

- 1972 "Daily and seasonal movements patterns of Dall sheep on the Dry Creek vicinity, Alaska Range."
- 1973 "Correlation between body growth and horn growth for Dall sheep rams in the Dry Creek vicinity, Alaska Range."
- 1974 "Survival patterns for Dall sheep in the Dry Creek vicinity, Alaska Range."

ACKNOWLEDGMENTS

James Erickson initiated this study and was responsible for the major portion of the field work during which data for the present report were gathered. I have attempted to summarize the procedures and findings of the past year. Only Jim could have written the comprehensive in depth discussion of the possible conclusions that the data warranted.

I would like to thank Oliver Burris and John Burns for the direction and help I have received in continuing this project since Jim's death.

I would also like to thank Charles Jensen of the U. S. Army; Bob Piorkowski, a temporary Game Technician IV; James Dunlap, a biometrician; and all others for the assistance given this project.

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Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks
м	\mathbf{L}	6/14/70			845	45	470	500	18		268					70	
М	L	6/17/70			645	35	425	360	10		221					70	
М	L	6/17/70			920	45	560	530	25		280					70	
М	L	6/20/70			825	40	535	490	20		261					70	
F	L	6/14/70			800	35	420	500	18		258					70	
F	\mathbf{L}	6/14/70			855	50	485	460	18		255					70	
F	L.	6/15/70			795	50	495	445	15		245					70	
F	L	6/17/70			890	50	480	505	21		255					70	
F	\mathbf{L}	6/18/70			810	50	450	445	16		255					70	
F	L	6/19/70	<u> </u>		920	50	555	500	25		278					70	
M	1	6/23/68	25	010L					• •	-						6/	
M	1	6/23/68	23	000						1	210		05	05		60	
M	1	5/30/69 6/1/có	6	099 0970						T	340		90 100	95		00 68	
ri M	1	6/3/69	0	027K 061D							3/8		100	70 78		68	
M	1	6/6/69	46	03/1						30	540			70		68	
M	1	6/6/69	39	091R						10				104		68	
M	1	6/6/69	35	019R						10	-			122		68	
M	ī	6/6/69	48	017R							348			106		68	
M	ī	6/7/69	44	018L						10	358		119			68	
M	1	6/12/70		044L	1230	6 9	745	792	70	50	361		140	142	127	69	-
М	1	6/12/70		510R	1365	65	785	810	75	5	379	-				69	
				071L													
М	1	6/12/70		512R	1390	75	740	830	80	15	375		167	181	230	6 9	
				070L													
М	1	6/13/70		515R 066L	1270	55	735	810	70	60	363		91	81	250	69	

Appendix I. Sex, age and measurements of Dall sheep captured 1968, 1969, 1970 at Dry Creek, Alaska Range.

Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks	
M	1	6/13/70		516R 065L	1300	60	770	800	70	60	380		175	170	242	69		
М	1	6/14/70		521R 074L	1280	75	700	800	65	50	357		134	132	162	69		
М	1	6/16/70		025R 527L	1320	55	740	790	70	70	350		95	90	100	69		
М	1	6/16/70		530R	1280	60	745	830	78	75	355		145	140	192	69		
М	1	6/18/70		540L	1345	60	715	860	881	40	367		200	199	270	69		
М	1	6/19/70			1125	50	695	735	65	90	333		110	115	175	69	Dead	
М	1	6/19/70	-	562R	1330	70	690	830	46	95	354		152	145	200	69		
М	1	6/20/70		566R	1250	65	695	730	65	95	350		140	136	185	69		
М	.1.	6/20/70		565L	1280	70	670	790	75	55	355		139	143	215	69		
М	1	6/20/70		570	1290	80	780	780	71	25	360		152	156	206	69		
F	1	6/4/69	56	057R							389		88			68		
F	1	6/6/69		033						10	.334	N	23			68		
F	1	6/6/69		082R							338	N		61		68		
F	1	6/12/70		501 046	1252	60	775	820	70	50	340	N	89	95	102	69		
F	1	6/13/70	·	518 049	1180	50	642	710	60	60	333	N	42	42	70	69 ⁻		
F	1	6/16/70		068	1210	55	635	740	60		330	N	23	22	70	69		
F	1	6/19/70		545	1315	65	705	790	70	40	348	N	45			69		
F	1	6/20/70		578	1340	60	740	805	75	90	350	N		90		69		

Appendix I (Continued).

Appendix I (Continued).

Sex	Аде	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks
F	1	6/20/70		573	1115	60	655	720	50	30	315	N	26	28	65	69	
F	ĩ	6/20/70		574	1220	55	655	740	58	10	325	N	43	73		69	
F	1	6/21/70		589	1290	60	665	750	67	40	346	N	115	108	132	69	
М	2	5/31/69	10	100L						1	375		195	200		67	
М	2	5/31/69	8	98			•				375		270	265		67	
М	2	5/31/69	9	97R							400		297	292		67	
М	2	6/1/69	1	089L						10	390		279	278		67	
М	2	6/2/69	15	087 R						15	402		276			67	
М	2	6/4/69	18	058L					•		382		177			67	
М	2	6/5/69	36	032L						20	398		247	242		67	
М	2	6/5/69	34	029R			~			5	376		~~~	211		6/	
Μ	2	6/12/70	59	042L 509R	1400	65	875	880	100	50	400		335	355	434	68	
М	2	6/12/70	G3	048L 508R	1400	80	790	970		-5*	395		405	400	440	68	
М	2	6/13/70	81	040L	1390	65	780	870	95	75	390		282	286	370	68	
М	2	6/19/70	G5	551L	1380	55	752	840	80	60	387		275	282	350	68	
М	2	6/19/70	61	548L	1510	75	775	940	100	10	400		299	.300	380	68	. '
М	2	6/20/70		579L	1340	70	728	845	100	40	375		262	242	331	68	
М	2	6/20/70		580R	1305	80	770	840	90	95	379		280	296	355	68	
М	2	6/20/70		581R	1490	60	770	910	115	95	394		339	336	384	68	
М	2	6/20/70		583R	1460	75	792	960	95	30	392		266	313	389	68	
М	2	6/20/70	87	575L	1380	65	770	870	100	75	386		324	3 35	418	68	
М	2	6/20/70	85	576R	1530	75	820	980	118	50	405		390	39 0	470	68	
М	2	6/21/70		590L	1490	90	735	870	107	80	385		383	390	. 485 .	68	
F	2	6/23/68	24	008L												66	
				007R													

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Appendix I (Continued).

Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks	
F	2	6/23/68	22													66		
F	2	6/23/68	26				· · ·					Y				66		
F	2	5/30/69	7	028L						1	375	N	150	140		67		
F	2	5/31/69	5	026							360		125			67		
F	2	6/2/69	12	095R						10			114	115	-	67		
F	2	6/3/69	19	077L							360			122		67	· · · · ·	
F	2	6/3/69	57	081L							376		121			67		
F	2	6/6/69	51	031						5	357	N	112			67		
F	2	6/13/70	84	514L 092R	1370	75	762	860	75	-5*	360	N	142	134	90	68		
F	2	6/17/70		536R	1370	60	795	850	90 .	90	365	N	158	135	145	68		
F	2	6/18/70	68	538R	1340	75	770	810	70	-5*	365	Y	142	140	140	68		
F	2	6/18/70	72	539R	1420	75	751	840	85	85	376	N	125	150	150	68		
F	2	6/18/70		544L	1455	60	815	880	95	80 🕔	375	Ν	141	170	180	68		
F	2	6/19/70		553L	1450	75	770	870	90	-5*	365	N	147	140	165	68		
F	2	6/20/70		567R	1480	80	771	890	110	40	378	Ν	165	160	156	68		
F	2	6/20/70		563L	1320	50	770	860	80	~ 5*	368	Y	130	165		68	• •	
F	2	6/20/70		569L	1410	70	710	860	81	5	367	Ŷ	145	154	170	68		
М	3	6/17/70	65	537L 088R	1465	55	818	880	110	30	395		431	435	495	67		
М	3	6/19/70	89	552L	1480	80	870	970	130	90	410		465	468	475	67		
М	3	6/21/70		587 R	1560	80	835	960	135	90	401		589	582	510	67		
М	3	6/21/70		585	1450	70	825	980	120	75	443		471	463	534	67		
F	3	6/24/68	27	012R			-	-		-		Y				65		
F	3	6/6/69	54	035L						10	387	N	176			66		
F	3	6/12/70	G2	036L 511R	1480	60	770	900	90	-5*	368	Y	188	220	250	67		
Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks	· · ·
--------	--------	--------------	------------	---------------	----------------------	-------------	-----------------	-------------	-------------------	------------------	-----------	-----------	------------------	-------------------	-------------	------------	------------	-------------
F	3	6/14/70	88	522L	1445	65	800	920	105	-5*	375	N	211	185	175	67		
F	3	6/15/70	96	067L 523R	1485	70	772	890	85	5	385	Y	140	140	115	67		
F	3	6/17/70	98	534L	1420	55	780	890	82	-5*	375	Y	195	152	175	67		
F	3	6/19/70	92	546L	1420	70	800	900	90	-5*	355	Y	200	205	275	67		
F	3	6/19/70	97	559L	1445	55	740	900	80	-5*	370	Y	180			67		
М	4	6/2/69	4	025R						5	421			494		65		
М	4	6/19/70	83	550R	1460	75	880	1000	145	40	402		578	590	535	66		
F	4	6/12/70	G4	045L 502R	1420	75	772	930	95	-5*	368	Y	209	210	250	66		
·F	4	6/17/70	78	531L	1380	75	850	920	115	40	370	Y	187	190		66	See photo	
М	5	6/28/68	28										640	410		63		
М	5	6/5/69	47	030L						5	402		456			64		
М	5	6/6/69	37	055R						20	411		609			64	Hunter kil	1 1970
F	-5	6/2/69	3	024L						5	360	Y	227	238		64		
F	5	6/2/69	30	023R						15	404	N	234	231	÷	64		
F	3,4,5	6/3/69	43	062L						F	381	N	193	192		64		
F	5	6/6/69	41	079L						2		N				64 67		
۲ T	2	0/0/09	10	UZIK F2.07	1400	60	705	020	105	T0 T0	270	N V	210	212	102	04 65		
r F	5 5	6/18/70	30 70	ЭЭ∠L 5/1т	1400	00 60	790 810	920 010	100	~ر~ **	375	v .	210 226	213	194 266	65		
ר ד	י 5	6/10/70	70	561D	1475	00 60	770	970	105	- <u>)</u> 80	366	Ŷ	210	211	213	65		
M	6	6/2/69	13	0781	THIN	~~~	110	500	100		460	*	~10	668		63		
M	6	6/2/69	11	084R							403			697		63		
м	6	6/2/69	29	094R						10	414			668		63		

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Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks
M M M F	6 6 6	6/5/69 6/5/69 6/5/69 6/2/69	45 44 40 14	083L 064L 052R 086L						10 5 5	413 396 400 400	Y	617 731 782 211	210		63 63 63 63	Dead
F F F	6 6 6	6/3/69 6/4/69 6/6/69	32 20 31	056L 011L					1	5–20 5	370 391	N Y	259 205	- 20		63 63 63	<i>,</i>
F	6 6	6/6/69 6/12/70	38 G6	080R 043L 505R	1525	75	870	960	110	10 -5*	380	Y Y	294	326	314	63 64	
F	6	6/14/70	86	050L 519R	1535	85	789	940	115	-5*	390	Y	225	234		- 64	See photo
F	6	6/17/70	82	528L	1465	50	815	885	105	-5*	385	Y	215	215	225	64	
F	6	6/18/70	69	542L	1570	70	830	935	120	30	372	Y	215	215	175	64	
F	6	6/18/70	67	543L	1560	60	800	900	100	5	370	Y	199	170	140	64	
F	6	6/19/70	66	547L	1535	65	820	940	101	10	365	Y	240	230	212	64	
F	6	6/19/70	63	560R	1485	50	790	970	115	-5*	380	Y	273	250	395	64	
\mathbf{F}	6	6/19/70	75	557L	1405	70	750	850	85	5	343	Y	248	254	190	64	
F	6	6/20/70		564R	1410	65	770	880	95	-5*	360	Y	221	213	155	64	
F	6	6/21/70	-	586R	1510	80	766	915	111	5	372	Y	217	226	197	64	
М	7	6/2/69	17	076R						10	394			752		62	Hunter kill 1970
М	7	6/7/69	55	015R						50	398			731		62	· · · · ·
М	7	6/12/70	G7	037L 504R	1610	75	800	1000	145	30	400		6 9 2	694		63	
м	7	6/19/70	99	549T	1680	75	925	1070	185	90	415			816		63	
M	7	6/19/70	93	558R	1635	65	915	1070	150	80	420		735	764	555	63	
M	7	6/20/70	95	582L	1650	80	939	1040	163	99	399		715	702	540	63	

Appendix I (Continued).

Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks	_
F	7	6/4/69	53	054R							365			208		62		
- ד	7	6/6/69	52	016T.						5		Y				62		
F	7	6/12/70	G1	041L 503P	1520	75	830	915	103	30	367	Ŷ	281	274	195	63		
F	7	6/12/70	G8	047L	1515	77	835	1020	100	5	376	Y	255	256	342	63		
F	7	6/13/70	60	038L 513R	1560	70	812	940	110	50	38 2	Y	249	228	307	63		
Я	7	6/16/70	64	5291.	1565	65	830	935	115	10	370	Y	275	232	335	63		
F	7	6/16/70	76	525L 069R	1420	70	830	950	129	-5*	380	N	272	258	165	63		
F	7	6/17/70	62	535L	1460	55	845	940		50	380	Y	201	194	212	63		
۔ F	7	6/20/70		571R	1430	70	820	8 20	106	-5*	365	Y	227	221	307	63		
M	8	6/7/69	42	020R						20	403			822		61		
M	8	6/19/70	91	554L	1557	80	930	940	140	95	400		678	692	635	62	Hunter ki	111 1970
F	8	6/16/70	80	072L 542R	1530	70	875	1005	125	25	380	N	265	257	242	62		
F	8	6/14/70	74	526L 073R	1470	70	850	920	95	-5*	360	Y	244	210	180	62		
м	9	6/21/70		600L	1788	100	925	1100	184	70	416		915	892	624	61		
 न	9	6/3/69	50	0631						10	-	N	206	259		60		
• म	9	6/3/69	33	059						10		Y		275		60		
F	9-10	6/14/70	94	013L 520R	1470	70	755	970	105	-5*	370	Y	310	323	398	61		
F	9	6/17/70	90	533L	1550	60	845	950	120	60	375	Y	239	249	145	61		
F	9	6/20/70		572L	1500	75	810	961	120	30	367	Y	255	246	298	61		

Sex	Age	Capture Date	Collar No.	Ear Tag	Total Contour Length	Tail Length	Shoulder Height	Chest Girth	Live Whole Weight	% of Coat Shed	Hind Foot	Lactating	Left Horn Length	Right Horn Length	Horn Spread	Year Class	Remarks	
FFFFFF	9 10 10 11-13 <u>+</u> 13 14+	6/20/70 6/20/70 6/21/70 6/19/70 6/23/70 6/1/69	71 77 2	568R 571L 584L 556L 591L 090L	1450 1540 1559 1555 1530	70 60 80 75 80	815 810 839 793 800	940 960 1010 940 935	120 120 125 118 123	15 -5* 5 -5* 30	383 370 372 365 381 370	Y Y Y N N	273 248 229 275 223 281	275 250 199 264 239 288	342 217 256 282 272	61 60 60 57 56	Dead	

-* Indicates less than.

			Resigh	tings
Collar No.	Age & Sex	Date Collared	Date	Location
1	2 – M	6/1/69	6/19/70	Lick
2	14 - 16 - F	6/1/69	6/13/69	Trail Gulch
			10/19/69	Exclosure Creek
			11/26/69	Icing Creek
			11/28/69	Exclosure Creek
			5/22/70	Icing Creek
			6/4/70	Lick
3	5 – F	6/2/69	6/3/69	Lick
		v	6/11/70	Lick
4	4 – M	6/2/69	6/12/69	Lick
5	2 – F	5/31/69	6/11/69	Cross Creek
			6/12/69	Cross Creek
			6/13/69	Red Mountain Creek
			6/25/69	Lick
•			11/19/69	Two Ram Creek
			6 /6 /70	Lick
			6/7/70	Lick
			6/8/70	Lick
			6/15/70	Lick
			6/20/70	Lick
			7/2/70	Lick
			7/9/70	Lick
			7/20/70	Lick
			7/21/70	Lick
6	1 – M	6/1/69	6/2/69	Seclusion Creek
7	2 – F	5/30/69	6/19/69	Lick
			5/20/70	Exclosure Creek
			6/8/70	Lick
			6/11/70	Lick
			6/12/70	Lick
			6/25/70	Lick
			6/29/70	Lick
			7/2/70	Lick
			7/22/70	Lick
0	0 14	r 101 100	//23//0	LICK
8	Z - M	5/31/69	0/9/09	
У	2 - M	5/3T/0A	//IU/07 10/15/00	ICING ULCEK
			11/26/69	Traveller Greek
			11/20/09 11/20/60	Torng Greek
			12/2/07 12/2/40	EXCLOSULE Creek
			12/2/07	Dig FOUL Creek
			12/3/09 1/20/70	Dig root Greek
			4/20/70	Compan Basin
			5/19//0	spruce pasin

Appendix II. Resightings of collared sheep near Dry Creek, Alaska Range.

		-	Resign	tings
Collar No.	Age & Sex	Date Collared	Date	Location
10	2 – M	5/31/69	6/12/69 6/13/69	Trail Gulch Trail Gulch
			6/9/70	Lick
11	6 – M	6/2/69	5/10/69	Two Ram Creek
			7/8/70	Lick
12	2 – F	6/2/69	8/31/69	Three-Mile Creek
			6/6/70	Lick
			6/11/70	Lick
			6/12/70	Lick
13	6 – M	6/2/69	6/13/69	Lick
			4/28/70	Rogers Creek
			6/19/70	Lick
14	6 – F	6/2/69	6/11/69	Slate Creek
		, ,	6/19/69	Lick
.• · · · ·			7/10/69	Seclusion Creek
			6/12/70	Lick
			7/2/70	Lick
15	2 – M	6/2/69	6/19/69	Lick
<i></i>		-, -, -, -,	10/15/69	South Creek
16	5 - F	6/6/69	,,	
17	7 - M	6/2/69	5/19/70	Spruce Basin
±1	, 	-, -,	8/70	Hunter Kill - Slate Cre
18	2 – M	6/4/69	6/9/69	East Creek
19	2 - F	6/3/69	6/11/69	R Creek
1)		0,0,0,00	6/11/70	Lick
			6/12/70	Lick
			6/21/70	Lick
			6/25/70	Lick
			7/2/70	Lick
			7/5/70	Lick
			7/6/70	Lick
			7/21/70	Lick
20	6 – F	6/4/69	6/22/69	Lick
	~ *	~, ,, ~,	6/23/69	Lick
			7/5/70	Lick
			7/6/70	Lick
			7/20/70	Lick
			7/21/70	Lick
21	1 – F	6/2/69	6/3/69	Lick
e ±		-, -, -, -,	6/9/69	East Creek
			6/12/70	Lick
			6/13/70	Lick
22	2 – F	6/23/68	6/11/69	Trail Gulch
<u> </u>		0, 20, 00	6/16/69	Lick
20 21 22	6 - F 1 - F 2 - F	6/4/69 6/2/69 6/23/68	7/5/70 7/6/70 7/21/70 6/22/69 6/23/69 7/5/70 7/6/70 7/20/70 7/21/70 6/3/69 6/9/69 6/12/70 6/13/70 6/11/69 6/16/69	Lick Lick Lick Lick Lick Lick Lick Lick

Appendix II (Continued).

Collar		Date	Resigntings						
No.	Sex	Collared	Date	Location					
			6/17/69	Lick					
			6/18/69	Lick					
			6/19/69	Lick					
			6/3/70	Lick					
			6/20/70	Lick					
	,	,	7/2/70	Lick					
23	1 - M	6/23/68	6/4/69	Lick					
			6/11/69	Trail Gulch					
			6/13/69	Lick					
			6/1/70	Lick					
			6/19/70	Lick					
24	2 – F	6/23/68	6/24/68	Lick					
			6/26/68	Lick					
			6/14/69	Lick					
			6/20/69	Lick					
			6/19/70	Lick					
		-	6/24/70	Lick					
25	1 – M	6/23/68	6/4/69	Lick					
			6/6/70	Lick					
			6/20/70	Lick					
			6/21/70	Lick					
			6/21/70	Slide Creek					
26	2 - F	6/23/68	6/14/69	Lick					
			6/16/69	Lick					
			6/29/70	Lick					
			6/30/70	Lick					
			7/22/70	Lick					
27	3 – F	6/24/68	8/10/68	Forgotten Creek					
			6/12/69	Trail Gulch					
			7/18/70	Seclusion Creek					
	_		7/23/70	Lick					
28	5 – M	6/26/68	8/27/70	Sheep Creek					
29	6 - M	6/2/69	6/15/69	Cross Creek					
			10/2/69	Red Mountain Creek					
			4/23/70	Red Mountain Creek					
A			7/22/70	Lick					
30	5 – F	6/2/69	6/11/69	R Creek					
			5/24/70	Lick					
			6/10/70	Lick					
			6/21/70	Lick					
			//1/70	Lick					
			//2/70	Lick					
			7/27/70	Forgotten Creek					

e

	×	Res_ightings								
Collar No.	Age & Sex	Date Collared	Date	Location						
31		6/6/69	6/18/69	Lick						
			6/19/69	Lick						
		,	11/15/69	Rogers Creek						
			4/23/70	N. Fork Forgotten Creek						
			6/5/70	Lick						
			6/6/70	Lick						
			7/1/70	Lick						
		ι,	7/2/70	Lick						
32	6 - F	6/3/69	6/12/69	Cross Creek						
ť			6/13/69	Cross Creek						
			11/19/69	Slate Creek						
			6/3/70	Lick						
			6/4/70	Lick						
			6/6/70	Lick						
			6/8/70	Lick						
			6/15/70	Lick						
			6/20/70	Lick						
			7/8/70	Lick						
			7/9/70	Lick						
			7/21/70	Lick						
33	9 – F	6/3/69	6/11/69	Cross Creek						
			6/12/69	Lick						
			6/24/69	Lick						
			6/26/69	Lick						
			11/19/69	Slate Creek						
			6/3/70	Lick						
			6/4/70	Lick						
			6/6/70	Lick						
1			6/7/70	Lick						
			6/8/70	Lick						
			6/15/70	Lick						
			7/2/70	Lick						
			7/5/70	Lick						
34	2 – M	6/5/69	6/9/69	East Ridge						
			6/13/69	Trail Gulch						
35	1 - M	6/6/69	8/27/69	Sheep Creek						
			8/28/69	Sheep Creek						
			6/13/70	Lick						
36	2 – M	6/5/69	4/28/70	Kansas Creek						
			7/27/70	Kansas Creek						
37	5 – M	6/6/69	7/10/69	Forgotten Creek						
			11/19/69	Red Mountain Creek						
			8/70	Hunter Kill - Slate Cre						

Appendix II (Continued).

			Res ightings						
Collar No.	Age & Sex	Date Collared	Date	Location					
38	6 – F	6/6/69	6/19/69	Lick					
			6/20/69	Lick					
	,		6/24/69	Lick					
			4/23/70	Forgotten Creek					
			6/6/70	Lick					
			6/7/70	Lick					
			6/15/70	Lick					
			7/1/70	Lick					
			7/2/70	Lick					
			7/27/70	Forgotten Creek					
39	1 - M	6/6/69	6/18/69	Lick					
		-, -,	6/19/69	Lick					
40	6 - M	6/5/69	11/25/69	South Creek					
40	• ••	-/0/0-	3/4/70	Slide Ridge					
			4/28/70	Icing Creek					
			6/6/70	Lick					
			6/8/70	Lick					
41	5 - F	6/6/69	6/16/69	Lick					
47	51	0,0,05	6/17/69	Lick					
			6/18/69	Lick					
			6/19/69	Lick					
			6/8/70	Lick					
			6/13/70	Lick					
42	8 - M	6/7/69	6/11/69	Forgotten Creek					
42	3-5 - F	6/3/69	6/3/70	Lick					
-J		0,0,02	6/3/70	East Creek					
			6/6/70	Lick					
			6/7/70	Lick					
44	1 – M	6/7/69	-, -,						
45	6 – M	6/5/69	11/19/69	A Creek					
12	• ••	-,_,	4/28/70	Icing Creek					
			6/3/70	Exclosure Creek					
			6/3/70	Lick					
			6/4/70	Lick					
			6/12/70	Lick					
			6/13/70	Lick					
46	1 – M	6/6/69							
47	5 - M	6/5/69	7/10/69	Snow Mountain Gulch					
			3/4/70	Slide Ridge					
			6/3/70	Exclosure Creek					
			6/6/70	Lick					
			6/19/70	Lick					
			7/5/70	Lick					
4.8	1 _ M	6/6/69	6/26/69	Lick					
40	<u> </u>	-, 0, 02	10/15/69	Rogers Creek					

0-11-		, · · ·	Resign	ntings
Collar No.	Age & Sex	Date Collared	Date	Location
50	9 - F	6/3/69	6/13/69	Slate Creek
			6/16/69	Lick
			6/24/69	Lick
			4/23/70	Red Mountain Creek
			6/5/70	Lick
			6/6/70	Lick
			6/12/70	Lick
		1	7/2/70	Lick
			7/25/70	Lick
51 ⁷	2 – F	6/6/69	6/18/69	Lick
			6/19/69	Lick
			6/7/70	Lick
			7/7/70	Lick
			7/21/70	Lick
52 .	7 – F	6/6/69	6/19/69	Lick
			6/20/69	Lick
			6/5/70	Lick
	x		6/6/70	Lick
			6/17/70	Lick
			6/21/70	Lick
			6/25/70	Lick
			6/29/70	Lick
			7/2/70	Lick
53	7 – F	6/4/69	6/29/70	Lick
		-, ,	6/30/70	Lick
			7/1/70	Lick
54	3 – F	6/6/69	4/23/70	Forgotten Creek
5.		-, -,	6/6/70	Lick
			6/15/70	Lick
			6/21/70	Lick
			7/1/70	Lick
			7/3/70	Lick
			7/29/70	Two Ram Creek
55	7 – M	6/7/69	6/13/70	Lick
56	1 - F	6/4/69	6/11/69	Trail Gulch
50		0/1/02	6/18/70	Lick
			6/30/70	Lick
			7/1/70	Lick
			7/6/70	Lick
			7/21/70	Lick
			7/22/70	Lick
57	2 – F	6/3/69	7/5/70	Lick
	- -	0,0,0,0	7/21/70	Lick
58	5 - F	6/17/70	7/2/70	Lick

			Resightings						
Collar No.	Age & Sex	Date Collared	Date	Location					
			7/9/70	Lick					
59	2 – M	6/12/70	7/15/70	Kansas Creek					
60	7 - F	6/13/70	6/21/70	Lick					
			7/9/70	Lick					
			8/26/70	Slate Creek					
61	2 – M	6/19/70	7/12/70	Upper Dry Creek Lick					
		, ,	7/13/70	Upper Dry Creek Lick					
62	7 or 8 - F	6/17/70	7/2/70	Lick					
63	6 - F	6/19/70	6/20/70	Lick					
(6/21/70	Lick					
64	7 - F	6/16/70	7/1/70	Lick					
		, ,	7/8/70	Lick					
			7/9/70	Lick					
			7/10/70	Lick					
			7/18/70	Seclusion Creek					
65	3 – M	6/17/70	7/8/70	Lick					
66	6 - F	6/19/70							
67	6 or 7 - F	6/18/70	7/2/70	Lick					
••		-// / -	7/5/70	Lick					
			7/7/70	Lick					
			7/10/70	Seclusion Creek					
68	2 - F	6/18/70	7/6/70	Lick					
		-, 2-, , , +	7/9/70	Lick					
			7/10/70	Lick					
			9/24/70	Sheep Creek					
69	6 - F	6/18/70	6/30/70	Lick					
~ -		•, =•, ••	7/1/70	Lick					
			7/2/70	Lick					
			7/25/70	Lick					
			7/29/70	Two Ram Creek					
70	5 – F	6/18/70	6/29/70	East Creek					
		-,,	7/2/70	Lick					
			7/3/70	Lick					
			7/9/70	Lick					
			7/10/70	Lick					
			8/27/70	Rogers Creek					
71	10 or 11 - F	6/21/70	6/25/70	Lick					
_		.,,	6/30/70	Lick					
			7/2/70	East Creek					
72	2 - F	6/18/70	6/25/70	Lick					
_	_	-,,	6/29/70	East Creek					
73	1 – M	6/18/70	7/22/70	Lick					
		<i><i><i>v</i>, <i>10</i>, <i>iv</i></i></i>	7/23/70	Lick					
			7/24/70	Lick					
			7/25/70	Lick					

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Collar Age & Date No. Sex Collared Date Location 74 8 or 9 - F $6/14/70$ $7/6/70$ Lick 75 6 - F $6/19/70$ $7/23/70$ Lick 76 7 - F $6/16/70$ $7/23/70$ Lick 77 11-13 - F $6/16/70$ $7/23/70$ Lick 7/9 5 - F $6/19/70$ $11ck$ 7/9/70 Elast Creek 7/9/70 Lick 7/10/70 Lick 7/21/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 7/22/70 Lick 80 8 - F $6/16/70$ $7/16/70$ Seclusion Creek 8/27/70 G Creek 9/25/70 Lick 9/25/70 Lick 8/27/70 Lick 8/27/70 Lick 8/27/70 Lick 8/27/70 Lick 8/27/70 Lick 8/27/70 Lick 9/24/70 Lick 7/27/70 Lick 8/26/70 Right Limit Forgotten Creek 83 4 - M $6/19/70$ 84 2 - F $6/13/70$ $6/25/70$ Southeast Creek 85 2 - M $6/20/70$ $8/27/70$ Rogers Creek 86 6 - F $6/14/70$ $7/6/70$ Lick 7/21/70 Lick 7/22/70 Lick 7				Resightings					
74 8 or 9 - F $6/14/70$ $7/6/70$ Lick 75 6 - F $6/19/70$ $7/23/70$ Lick 76 7 - F $6/19/70$ $7/24/70$ Lick 76 7 - F $6/19/70$ $7/24/70$ Lick 77 11-13 - F $6/19/70$ $6/19/70$ Lick 77 11-13 - F $6/19/70$ $6/19/70$ Lick $7/2/70$ Lick $7/9/70$ East Creek $7/2/70$ Lick $7/2/70$	Collar No.	Age & Sex	Date Collared	Date	Location				
75 6 - F $6/19/70$ Lick 75 6 - F $6/19/70$ Lick 76 7 - F $6/16/70$ Lick 77 11-13 - F $6/19/70$ Lick 7/9/70 East Creek $7/270$ Lick 7/9/70 Lick $7/2770$ Lick 7/9 5 - F $6/19/70$ Lick $7/22/70$ 7/2 7/0 Lick $7/22/70$ Lick 80 8 - F $6/13/70$ $6/25/70$ Lick 8/26/70	74	8 or 9 - F	6/14/70	7/6/70	Lick				
75 6 - F $6/19/70$ $7/23/70$ Lick 76 7 - F $6/16/70$ $7/24/70$ Lick 76 7 - F $6/16/70$ $7/21/70$ Lick 77 $11-13 - F$ $6/19/70$ $6/19/70$ Lick 77 $11-13 - F$ $6/19/70$ $6/19/70$ Lick $7/9/70$ Bird Nest Creek $7/9/70$ East Creek $7/9/70$ East Creek $7/9/70$ Lick 78 $4-5 - F$ $6/17/70$ Lick 78 $4-5 - F$ $6/17/70$ Lick 7/10/70 Lick $7/21/70$ Lick 7/21/70 Lick $7/21/70$ Lick 7/22/70 Lick $7/21/70$ Lick $7/21/70$ Lick $7/21/70$ Lick $7/22/70$ Lick $7/21/70$ Lick $7/22/70$ Lick $7/25/70$ Lick 80 8 - F $6/13/70$ $6/13/70$ Lick $7/25/70$ Lick $7/25/70$ Lick 81 2 - M <td></td> <td></td> <td></td> <td>7/9/70</td> <td>Lick</td>				7/9/70	Lick				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	75	6 - F	6/19/70	7/23/70	Lick				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				7/24/70	Lick				
76 7 - F $6/16/70$ $7/2/70$ Lick 77 $11-13 - F$ $6/19/70$ $6/19/70$ Lick $7/2/70$ Lick $7/2/70$ Lick $7/2/70$ Bird Nest Creek $7/9/70$ East Creek $7/9$ $5 - F$ $6/17/70$ Lick $7/9$ $5 - F$ $6/19/70$ $7/5/70$ Lick $7/20/70$ Lick $7/20/70$ Lick $7/22/70$ Lick $7/21/70$ Lick $7/22/70$ Lick $7/22/70$ Lick $7/22/70$ Lick $7/22/70$ Lick $7/29/70$ Two Ram Creek $8/27/70$ Creek 80 $8 - F$ $6/16/70$ $7/25/70$ Lick $8/27/70$ G/25/70 Lick $9/24/70$ Upper West Fork of $8/2$ $6 - F$ $6/17/70$ $6/18/70$ Lick $7/2/70$ $8/2$ $6 - F$ $6/17/70$ $6/25/70$ Southeast Creek $8/2$ $6 - F$ $6/17/70$ $6/25/70$ Right Limit Forgotten <t< td=""><td></td><td></td><td></td><td>9/24/70</td><td>Lick</td></t<>				9/24/70	Lick				
77 $11-13 - F$ $6/19/70$ $6/19/70$ $Lick$ 77 $11-13 - F$ $6/19/70$ $Lick$ $7/2/70$ $Lick$ 78 $4-5 - F$ $6/17/70$ $Lick$ $7/9/70$ $East Creek$ 78 $4-5 - F$ $6/19/70$ $7/5/70$ $Lick$ 78 $4-5 - F$ $6/19/70$ $7/5/70$ $Lick$ 78 $4-5 - F$ $6/19/70$ $7/5/70$ $Lick$ $7/20/70$ $Lick$ $7/20/70$ $Lick$ $7/22/70$ $Lick$ $7/22/70$ $Lick$ $7/22/70$ $Lick$ $7/22/70$ $Lick$ $7/22/70$ $Lick$ $7/22/70$ $Lick$ 80 $8 - F$ $6/16/70$ $7/16/70$ Seclusion Creek 81 $2 - M$ $6/13/70$ $6/25/70$ $Lick$ $Lick$ 81 $2 - M$ $6/17/70$ $6/18/70$ $Lick$ $Lick$ 83 $4 - M$ $6/19/70$ $8/26/70$ Right Limit Forgotten 83 $4 - M$ $6/19/70$ $8/27/70$ Ro	76	7 - F	6/16/70	7/2/70	Lick				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	77	11–13 – F	6/19/70	6/19/70	Lick				
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$				6/29/70	Lick				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				7/2/70	Lick				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				7/9/70	Bird Nest Creek				
$\begin{array}{cccccccccccccccccccccccccccccccccccc$				7/9/ 7 0	East Creek				
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7/29/70 Lick 89 3 - M 6/19/70 8/27/70 Rogers Creek				7/22/70	Lick				
89 3 - M 6/19/70 8/27/70 Rogers Creek		¥		7/29/70	Lick				
	89	3 M	6/19/70	8/27/70	Rogers Creek				

		· · · ·	Resigh	tings
Collar No.	Age & Sex	Date Collared	Date	Location
90	9 – F	6/17/70	7/1/70	Lick
			7/2/70	Lick
			7/21/70	Lick
			7/22/70	Lick
91	8 – M	6/19/70	6/29/70	Lick
			7/1/70	Lick
			8/14/70	Slate Creek -
				Hunter Kill
92	3 – F	6/19/70	6/19/70	Lick
4			7/2/70	Lick
			7/9/70	Lick
			7/10/70	Lick
			8/27/70	Upper Dry Creek
93	7 – M	6/19/70		
94	9-10 - F	6/14/70	×-	
95	7 – M	6/20/70	8/2 7 /70	Rugged Creek
			9/24/70	Rugged Creek (Same
				vicinity)
96	3 – F	6/15/70	7/1/70	Lick
			7/2/70	Lick
			7/3/70	Lick
97	3 – F	6/19/70	6/30/70	Lick
			7/1/70	Lick
			7/5/70	Lick
			7/21/70	Lick
			7/22/70	Lick
			7/24/70	Lick
			7/25/70	Lick
			7/29/70	Two Ram Creek
			8/27/70	Bird Nest Creek
98	3 – F	6/17/70	6/29/70	Lick
			7/1/70	Lick
			8/27/70	Big Foot Creek
99	7 – M	6/19/70	8/27/70	Rogers Creek
			9/24/70	Rugged Creek
			10/21/70	Rogers Creek
G-1	7 – F	6/12/70	6/30/70	Lick
			7/1/70	Lick
			7/2/70	Lick
			7/3/70	Lick
			7/21/70	Lick
			7/22/70	Lick
			8/27/70	West Fork Dry Creek
G-2	3 – F	6/12/70	6/29/70	Lick
			7/1/70	Lick
			7/21/70	Lick

0.11			Resig	htings
No.	Age & Sex	Date Collared	Date	Location
		₩ <u>₩</u> ₩ <u>₩</u> ₩	7/22/70	Lick
		19 - A.	7/27/70	Forgotten Creek
			8/26/70	Right Limit Slate Creek
G-3	3 – M	6/12/70	7/9/70	Lick
G-4	4 – F	6/12/70	6/25/70	Lick
			7/5/70	Lick
G - 5	2 – M	6/19/70	7/6/70	Lick
			7/10/70	Lick
G-6	6 – F	6/12/70	6/29/70	Lick
r			6/30/70	Lick
			7/1/70	Lick
			7/2/70	Lick
		χ.	7/2/70	East Creek
			8/27/70	Right Limit Southeast
.*				Creek
G-7	7 – M	6/12/70		
G8	7 – F	6/12/70	7/1/70	Lick
			7/21/70	Lick
			7/22/70	Lick

			Resightings				
Ear Tags	Age & Sex	Date Tagged	Date	Location			
501	1 - F	6/12/70	······································	<u>, , , , , , , , , , , , , , , , , , , </u>	-		
510	1 - M	6/12/70					
512	1 – M	6/12/70					
515	1 – M	6/13/70					
516	1 – M	6/13/70	7/9/70	Lick			
518	1 - F	6/13/70	.,,,,,,				
521	1 – M	6/14/70	6/30/70	Lick			
527	1 – M	6/16/70	7/1/70	Lick			
530	1 – M	6/17/70	17 =770				
536	2 – F	6/17/70	6/30/70	Lick			
220	~ 1	0, 1, , , 0	7/21/70	Lick			
544	2 - F	6/18/70	6/29/70	Lick			
553	2 - F	6/19/70	7/9/70	Lick			
562	2 - 1 1 - M	6/19/70	7/24/70	Lick			
563	2 – H	6/20/70	// 24//0				
564	2 - F 6 - F	6/20/70					
565	1 – M	6/20/70					
566	1 - M	6/20/70					
567	1 - H 2 F	6/20/70					
568	2 - F 9 - F	6/20/70					
560	7 - F 7 - F	6/20/70					
509	2 - F 1 M	6/20/70					
570		6/20/70	7/24/70	Lick			
5/1	7 - F	6/20/70	//24//0	LICK			
27Z	9 - F	6/20/70					
5/3	1 - 1	6/20/70	7/21/70	Lick			
5/4		6/20/70	6/21/70	Lick			
577	10 - F	6/20/70	0/21//0	LICK			
578		6/20/70					
5/9	2 - M	6/20/70					
580	2 - M	6/20/70					
581	2 – M	6/20/70					
583	2 - M	6/20//0					
585	Unk - M	0nk 6/70	7 (05 /70	T f 1_			
586	6 - F	6/21/70	1/25/70	LICK			
587	3 – M	6/20//0					
588	3 - M	6/21//0					
589	1 - F	6/21/70					
590	2 – M	6/21/70					
591	13 - F	6/23/70					
600	9 – M	6/21/70					

Appendix III. Resightings of ear-tagged sheep near Dry Creek, Alaska Range.

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JOB PROGRESS REPORT (RESEARCH)

State:	<u>Alaska</u>		
Cooperators:	Arthur C. Si	mith and Various	Temporaries
Project No.:	<u>W-17-2</u>	Project Title:	Big Game Investigations
	<u>W-17-3</u>	Job Title:	Dall Sheep Horn Growth
Job No.:	6.2R		

Period Covered: January 1, 1970 to December 31, 1970

SUMMARY

One hundred ninety-three sets of Dall sheep ram horns were measured at local taxidermy shops in Anchorage and Fairbanks.

Computer analysis of data from 1968, 1969, and 1970 was begun.

BACKGROUND

Data have been collected on horn growth characteristics and trophy production of sheep by various investigators (Erickson 1968, 1969 and 1970; Hemming 1967; Scott 1951; Taylor 1962; Wishart 1969).

Comparisons of growth patterns of Dall sheep horns within Alaska from the seven different mountain ranges have not been accomplished.

OBJECTIVES

To compare and contrast the age related measurements of Dall sheep ram horns between and among sheep from seven mountain areas in Alaska.

PROCEDURES

Procedures for horn measurement were as described by Erickson (1970).

All sheep horns made available to us through local taxidermy shops in Fairbanks and Anchorage were measured.

FINDINGS

One hundred ninety-three sets of ram horns were measured by Department of Fish and Game personnel in Anchorage and Fairbanks following the 1970 harvest.

A total of 604 sets of horns has been measured during 1967, 1968, 1969 and 1970.

Data have been key punched and computer analysis has begun. James Dunlap, a biometrician working as a temporary for the Department, is assisting in analysis of the data.

RECOMMENDATIONS

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

PUBLICATION PLANS

- 1972 "Horn growth rates for Dall sheep rams from seven mountain ranges in Alaska."
- 1973 "Hunter measurement reliability for Dall sheep horns in Alaska." Note.

"Age structure of Dall sheep ram harvest in Alaska from 1967 to 1970."

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ACKNOWLEDGMENTS

I would like to extend thanks to Walter Cunningham, a temporary Game Technician of the Anchorage Game staff, who completed the rather dull task of measuring ram horns as they became available to Anchorage taxidermy shops following the 1970 hunting season.

Many other Fish and Game temporaries and U. S. Army personnel, including Charles Jensen and Michael McBrayer, deserve a hearty thanks for their assistance.

PREPARED BY:

Arthur C. Smith Game Biologist APPROVED BY:

MC.

Management-Research Coordinator Division of Game

Acting Director, Division of Game

2.

JOB PROGRESS REPORT (RESEARCH)

State:	<u>Alaska</u>	
Cooperators:	Lyman Nichols	
Project No.:	<u>W-17-3</u>	Project Title: Big Game Investigations
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Job No.:	6.4	Job Title: <u>Productivity in Unhunted</u> and <u>Heavily Exploited Dall</u> <u>Sheep Populations</u>
Job No.:	<u>6.5</u>	Job Title: <u>Dall Sheep Population Trends</u> and <u>Composition on the Kenai</u> <u>Peninsula</u>

SUMMARY

July 1, 1970 to December 31, 1970

Period Covered:

During a special either-sex hunt which was held on Crescent Mountain on the Kenai Peninsula from August 10-23, 1970, 60 permittees took 15 sheep. Specimens, including blood samples, femurs, rumen samples, horns and teeth were obtained from a number of these.

Nine sheep were collected for study on November 13, 1970 from Crescent Mountain. Weights, measurements, femurs, horns, reproductive tracts, teeth and samples of blood, rumen contents and fecal pellets were taken. Results of analyses completed from this collection, the August hunt, and an earlier collection on Surprise Mountain are listed. Internal organs were shipped to the Fairbanks laboratory for parasitological examination.

Limited field observations showed the sheep were able to move and feed with relative ease through the soft powder snow until at least December 17, 1970 on Copper Landing Closed Area and Surprise Mountain winter ranges.

The main rutting season in the Cooper Landing herd apparently began during the period of November 21-25, 1970 and ended during the December 11-15 period. Data from the Surprise Mountain herd are too scanty for conclusions to be drawn. More extensive observations are needed to determine the peaks of breeding in both herds.

Interactions between sheep observed during the rutting season are described. The two most promising methods for determining the presence of ewes in estrous, and hence the timing of active breeding, are the "chase" and "guard" activities by rams. In the Cooper Landing herd, most breeding-related interactions were initiated by full-curl or larger rams. In the Surprise Mountain herd, half-curl rams--the largest class present--initiated all breeding-related interactions.

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Aerial surveys of the three herds under study were conducted after lambing and before hunting in 1970. Totals counted were: Surprise Mountain -185; Cooper Landing Closed Area - 311; Crescent Mountain - 287. A post-hunting season count showed 273 remaining on Crescent Mountain.

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BACKGROUND

The Dall sheep (Ovis dalli) in Alaska has been managed traditionally for the harvest of mature rams only. Such harvest has not controlled herd growth and sheep numbers have increased or declined due to natural causes alone. Populations have apparently been increasing during the past decade and, in some areas, may be approaching their maximum safe level.

One herd on Surprise Mountain on the Kenai Peninsula is known to have declined by about 20 percent because of a harsh winter in 1969-70. Similar or more serious declines may face this and other populations which have been allowed to reach overabundance through lack of control.

The overall objective of this study in addition to obtaining basic life history data is to determine whether such natural declines can be reduced by maintaining sheep populations at a level below the carrying capacity of their winter range through either-sex hunting. Three herds on the Kenai Peninsula were chosen for study: the Crescent Mountain herd, the Surprise Mountain herd and the Cooper Landing Closed Area herd (Fig. 1). These herds are near each



other but appear to be isolated because of topographical features; no significant movement is known to occur between them. The habitats seem to be similar and the herds had been increasing at approximately the same rate prior to the winter of 1969-70 when that on Surprise Mountain declined as stated previously.

Both the Surprise and Crescent Mountains herds are readily accessible to hunters from nearby highways. Both have been hunted heavily during past years with almost every ram being harvested as soon as its horns reached the legal status of three-quarter curl. The Cooper Landing Closed Area is, as its name implies, closed to sheep hunting. The herd within its boundaries has been, for practical purposes, unhunted.

The study calls for the reduction of the Crescent Mountain herd by some 30 percent during the first year with maintenance at this lowered level for at least four more years. The Surprise Mountain herd will be hunted for rams only as it has been, and the Cooper Landing herd will remain protected. Production and survival of young, herd size and herd response to winter stress will be monitored on the three areas. A comparative study of winter range trend and climate on the three areas is also planned. Thus, the effects of either-sex hunting and consequent herd control will be compared with those of ram-only hunting and complete protection.

OBJECTIVES

To determine the forage plants eaten by Dall sheep, their feeding habits and changes in their body condition throughout the winter.

To compare the various factors relating to reproduction in Dall sheep, including: body condition, chronology of breeding and parturition, minimum breeding age, pregnancy rate, prenatal sex ratio, fetal growth rate, rutting behavior and differences in rutting behavior between a population which is relatively unhunted and one which is heavily exploited.

To determine the population compositions and trends on Crescent Mountain, Surprise Mountain and Cooper Landing Closed Area, Kenai Peninsula.

PROCEDURES

A public hunting season was held on Crescent Mountain from August 10-23, 1970. The purpose of the hunt was to undertake the first phase of reducing the Dall sheep herd on this area from a pre-hunt figure of 287 animals to an eventual level of 200. Prior to the hunt, a public drawing was held in which 60 names were drawn from approximately 1100 applications. Each successful applicant was issued a permit to take one sheep of either sex with horns of one-half curl or less. Permittees were instructed on the rules of the hunt, its purpose, the locations of groups of sheep and how to differentiate between ewes and young rams. They were required to check in and out through a hunter checking station before and after hunting and to present the jaw and horns of any sheep killed. In addition, hunters were requested to bring out rumen and blood samples and one femur. A checking station was maintained throughout the hunting period at a convenient road junction adjacent to the hunting area. Frequent flights were made in a float-equipped Piper PA-18 to monitor the hunt and to locate sheep bands. Hunters were contacted both at the checking station and in the field and the location of sheep were pointed out to them in an effort to increase hunting success.

Checking station personnel retrieved specimens. Horns were aged by their annuli and jaws were dried for future extraction of incisiform teeth for age-determination. Rumen samples were preserved in 10 percent formalin for future analysis. Smears were made from whole blood samples; three or four cc were preserved with EDTA; the remaining blood was refrigerated and the serum removed later by centrifugation. Femurs were refrigerated until marrow could be extracted in the laboratory.

The first of a series of winter sheep collections was made on November 13, 1970 when nine sheep were taken from Crescent Mountain. The specimens were killed with a shotgun and buckshot from a Bell 206 A Jet Ranger helicopter and were lifted by the helicopter directly to the laboratory at Soldotna. This method of collecting is hazardous and depends on near-perfect weather for success--a rarity here--but is the only practical means of taking sheep in winter and getting them rapidly to the laboratory for necropsy. Smears, whole blood and serum samples from both collections were sent to Alaska Medical Laboratories in Anchorage for hematological and serological analyses.

At the Soldotna laboratory, each sheep was weighed, measured and examined externally. Horns and incisor teeth were removed for age-determination. A femur was removed for fat extraction. Reproductive tracts of females were preserved for later examination. A rumen sample was preserved in formalin. Internal organs were grossly examined for indications of pathology, then lungs, abomasa and intestines were preserved for detailed parasitological examination. Carcasses were given to approved charitable organizations.

Bone marrow was extracted from femurs taken in the August hunt and November collection and analyzed by the method described by Neiland (1970). Horns were aged by their annuli using the method discussed by Hemming (1967).

Winter feeding behavior observations were made in conjunction with the breeding behavior study. A spotting scope and binoculars were used to observe feeding sheep.

Observations to determine and compare the chronology of the breeding season and behavior of sheep during the rut on Surprise Mountain and Cooper Landing Closed Area were conducted from November 16 to 25 and from December 8 to 17, 1970. No specific advance information was available concerning the timing of the rut but it was assumed its beginning and ending would be covered during these two periods.

Two self-contained, insulated tent camps were prepared and with one observer each, were flown by helicopter to Surprise Mountain and to the head of Slaughter Creek in Cooper Landing Closed Area. Each camp was set up in a grove of alpine hemlock at timberline for wind protection. The camps were heated by propane and made as comfortable as possible to enable the men to work



Figure 2. Unisort Sheep Breeding Observation Card.

efficiently without wasting effort in merely surviving under alpine winter conditions.

Observations were conducted each day the weather permitted. The observer on Surprise Mountain conducted his observations along the edge of the steep slopes above Lower Russian Lake and Skilak River but was sometimes able to do so right from camp when sheep were moving on the flats nearby. From the Cooper Landing camp it was necessary to walk approximately a mile to a point overlooking the ridges and cliffs used by the sheep. In this area it was possible to make observations from a fixed base each day.

Observations were made with the aid of binoculars and spotting scope. Interactions between sheep were recorded directly on printed Unisort cards (Fig. 2), or in some instances, into a tape recorder for later transcription. The cards were designed so that behavioral sequences could be listed as they occurred. Space was also provided for noting time, weather, habitat and other pertinent data.

Information categories were coded to enable a minimum of writing on the cards. A key was provided each observer (Fig. 3). Behavioral actions and reactions were listed according to Geist (1968) with some additions to cover expected behaviorisms. Descriptions of these activities can be found in Appendix I.

Organization of data was accomplished by designing an appropriate key (Appendix II), punching the cards accordingly, then sorting them and listing data by categories of interest. Data were then compared and examined as necessary for preliminary analysis. No attempt has been made to compare data statistically at this time, nor to analyze the relationships of weather, temperature, time of day, snow conditions or habitat to breeding behavior or season.

Aerial classification counts were conducted of the Crescent and Surprise Mountain herds in July, 1970 and of the Cooper Landing Closed Area herd in early August, 1970. These counts were done after the conclusion of lambing (about mid-June) and were designed to obtain an estimate of total population and lamb production. A Piper PA-18 airplane was used for the counts, with pilot and observer assisting each other in locating and classifying sheep. Observations were recorded on appropriate forms by the observer, and each sheep or group of sheep was marked on a topographical map of the area. The technique has been described by Nichols and Erickson (1969).

An additional count was conducted of the Crescent Mountain herd in September after the special either-sex hunt. During both the mid-summer and September counts, efforts were directed toward obtaining as complete a total census as possible.

Considerable effort was also directed toward classifying rams and lambs during these surveys so as to separate them from the ewes and yearlings. No opportunity was available for ground-checking the accuracy of aerial classification during this segment.

Figure 3. Sheep Breeding Observation Card Key.



Access. No.	Sex	Age by Horn, Months	Whole Weight	Lactat- ing	Preg- nant	% Fat in Marrow
ate, Locatio	<u></u>		· · · · · · · · · · · · · · · · · · ·			
pril 28, 197	0	Surprise Mountair	n Collection	E Contraction of the second se		
62051	FF	131	85	No	No	5.76
62052	\mathbf{FF}	23	48	No	No	31.73
62053	\mathbf{FF}	23	45	No	No	25.96
62054	FF	93	88	No	No	32.78
62055	FF	23	42	No	No	35.60
ugust 10-23,	1970	Crescent Mountair	1 Hunt			
62056	FF	86		Yes	No	_
62057	MM	26	_	-	-	92.17
62058	\mathbf{FF}	110	⊷	No	No	
62059	FF	62		Yes	No	
62060	MM	38	_		_	94.84
62061	MM	38	-	•••• –	-	
62062	FF	50		Yes	No	92.26
62063	MM	26	_	-		_
62064	FF	98		Yes	No	_
62065	\mathbf{FF}	62	_	Yes	No	_
62066	MM	38	_	_	-	93.36
62067	FF	· 51		No	No	_
62068	FF	27	-	No	No	82,60
62069	MM	27	<u></u>			94.64
62070	FF	51	-	Yes	No	94.19
ovember 13,	1970	Crescent Mountair	n Collection	L		
62075	FF	89	144	Yes	No	94.87
62076	FF	77	119	Yes	No	93.02
62077	MM	5	65	<u> </u>		88.43
62078	\mathbf{FF}	46	129	Yes	No	95.25
62079	FF	101	139	No	No	95,65
62080	MM	5	74	-	. 🗕	89,92
62081	FF	29	122	No	No	93.38
62082	FF	29	91	No	No	95,90
62083	MM	5	60		_	91.96

Table 1. Summary of significant Dall sheep specimen material obtained in 1970.

FINDINGS

Winter Food Habits and Body Condition

Despite the accessibility of the area, abundance of sheep, and briefings and assistance by Department personnel, the 60 permittees were able to take only 15 sheep during the special Crescent Mountain either-sex hunt. Poor weather and inexperienced hunters were the main influencing factors in the low success. The post-season aerial count showed a minimum of 273 sheep remaining on the mountain. The winter collecting program and natural winter mortality would have to remove the additional 73 sheep to obtain the planned herd reduction.

Hunters cooperated well during the hunt and brought in 13 rumen samples. These, with the nine others taken during the November collection have been preserved for analysis after the collection program has been completed.

Table 1 lists some of the significant information obtained from specimens taken during the hunt and first collection. Prior to the beginning of this study, five sheep had been collected from Surprise Mountain. These were taken on April 28, 1970 to obtain specimen material during or just after the die-off of part of that herd. Information obtained from these animals is also listed in Table 1.

Results of the hematological and serological analyses of blood samples taken during the Surprise Mountain collection, the Crescent Mountain hunt, and the first Crescent Mountain collection are listed in Table 2. Abbreviations used in the table for blood values are as follows:

HGB	Hemoglobin
нст	Hematocrit
WBC	Leukocytes
EOS	Eosinophils
SEGS	Segmenters
Lymphs	Lymphocytes
CA	Calcium
Inor. Phos.	Inorganic Phosphorous
GLU	Glucose
BUN	Blood Urea Nitrogen
Chol	Cholesterol
TP	Total Protein
ALB	Albumin
T. Bili	Bilirubin
Alk. Phos.	Alkaline Phosphatase
LDH	Lactic Dehydrogenase
SGOT	Glutamic Oxalacetic Transaminase

No further analyses of these data will be attempted until completion of the collecting program in the next segment.

Feeding behavior observations were limited to the periods of breeding season field work in November and December. At this time, accumulations of

Access. No.	HGB gm%	HCT vol %	WBC	Eos	Segs	Lymphs	Ca mg%	Inor Phos mg%	Glu mg%
62051	11.7	32	2700	3	38	57	8.5	5.6	105
62052	-	-	-	17	10	72	8.6	9.1	80
62053	13.6	37	4000	8	14	70	10.3	10.4	295
62054	14.4	40	3600	8	14	78	7.9	8.0	100
62055	14.8	39	4800	10	36	54	9.7	6.9	100
62056	12.0	32	4900	11	60	29	6.9	8.6	100
62057	14.0	39	3800	2	46	51	11.2	*10+	90
62062	14.6	40	10300	2	20	78	9.5	9.5	40
62065	16.4	45	7100	-	14	86	*15+	*10+	80
62075	19.6	51	3900	2	22	74	13.8	*10+	350
62076	-	-	-	-		-	7.9	4.9	145
62077	-	_		_		<u> </u>	11.1	8.6	115
62078	-	(Speci -	mens Fro -	ze) –	-	-	12.0	*10+	285
62079	-	-	-	8	54	38	11.6	*10+	370 e
62080	-	-	-	-	-	-	10.8	9.2	120
62081	20.8	52	3400	-	-	-	10.8	8.6	145
62082	-	-	-	-	20	80	-	-	-
62083	-	-		-	-	_	10.5	8.6	90

Table 2. Blood values obtained from Dall sheep in 1970.

* Trace went off the scale; above maximum value shown on recording graph.

Access. No.	BUN mg%	Uric Acid mg%	Chol. mg%	TP gm%	Alb. gm%	T. Bili mg%	Alk Phos mU/ml	LDH mU/m1	SGOT mU/ml
62051	8	0.6	65	5.6	0.7	0.3	65	365	200
62052	9	0.6	90	5.8	0.7	0.4	75	*600+	* 250+
62053	7	0.7	65	5.1	0.9	0.3	185	450	210
62054	11	0.7	100	5.6	0.7	0.4	145	*600+	*250+
62055	8	0.6	55	5.2	0.9	0.2	235	475	195
62056	24	5.9	90	6.7	1.4	0.3	*350+	*600+	*250+
62057	38	1.0	100	6.9	1.4	0.3	*350+	*600+	*250+
62062	23	0.7	90	6.4	*0-	0.6	*350+	* 600+	*250+
62065	31	1.0	120	8.4	2.1	0.4	270	625	*250+
62075	7	1.2	110	6 .9	1.1	0.3	305	*600+	*250+
62076	6	0.5	90	5.7	0.2	0.2	120	615	*250+
62077	2	0.5	95	6.3	0.5	0.2	330	485	*250+
62078	5	0.7	90	5.6	0.8	0.2	210	425	*250+
62079	9	1.5	85	6.0	1.1	0.2	205	280	230
62080	9	0.5	100	5.9	1.0	0.3	265	*600+	* 250+
62081	9	0.5	100	6.1	0.7	0.2	290	*600+	*250+
62082	-		-	-	-	-	-	-	<u> </u>
62083	9	0.7	80	6.1	0.4	0.2	195	*600+	*2 50+

Table 2 (cont.). Blood values obtained from Dall sheep in 1970.

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* Trace went off the scale; above maximum or below minimum value shown on recording graph.

snow varied from 2-3 inches to about 18 inches. The snow was light and powdery on the feeding areas used by sheep and appeared to offer no serious impediment to their feeding or traveling. Lambs and adults were able to paw feeding craters in belly-deep powder snow, apparently with little effort. Most of the area utilized for feeding had much lighter snow cover offering even easier foraging.

During this period sheep usually fed throughout the morning and afternoon with a general resting period of about two hours at mid-day. Their casual search for feed, the long resting periods and the abundance of grass sticking above the snow indicated adequate feed availability.

Productivity

The sex, age in months as estimated by horn annuli, and reproductive state of ewes taken during this segment, and of those from Surprise Mountain in April, 1970 are listed in Table 1. No ewes were obviously pregnant in August or November, nor would they be expected to be during these months. Neither of the two adult ewes taken on Surprise Mountain was pregnant, nor were the three 2-year-old ewes. Reproductive tracts have not yet been examined, so little can be inferred at this time about possible loss of fetuses due to the animals' debilitated state.

Six of the eight ewes (75 percent) over two years old taken during the August hunt were reported as lactating. This sample is too small for any conclusions regarding lambing rate.

'Three of four ewes, three years old and older, were lactating lightly when killed on November 13. The relationship of this lactation to weaning of lambs is not known. During all of the days spent observing sheep on Cooper Landing Closed Area commencing on November 17, only two instances of lambs attempting to nurse were seen. In both cases, the ewes kicked them away before they could begin.

None of the three ewes taken which would have been 18 months old during the preceding breeding season were lactating. Further discussion regarding productivity must await completion of the collecting program and examination of reproductive tracts.

Interactions between animals recorded during the breeding season field observation periods appeared to fall into four general categories: a) nonaggressive, probably nonbreeding-related; b) aggressive, formal "fighting"; c) checking of ewes by rams to locate those coming into estrous; d) actual breeding behavior.

The first category, including rubbing (Rb) and horning (H) may be initiated by a ewe but is usually done by a smaller ram to a larger one. This form of behavior appeared fairly constant throughout the observation period and is probably not directly related to breeding. It will not be discussed further at this time. Aggressive, formal "fighting" may be indirectly related to breeding in that it appears to allow rams to establish dominance over each other; possibly saving energy and time for when actual breeding is at hand. These contests were not over "possession" of ewes as is sometimes believed. The few such fights observed appeared to have no other relation to breeding activities. All those seen were contests between rams of equal horn size. Apparently, rams can recognize by sight their dominance status in relation to other rams with larger or smaller horns (Geist, 1968).

A description of the longest fight observed will illustrate the behavior. Two almost identical class V rams participated. The action began rather quietly with some rubbing and gentle horning but mostly with the two standing head to shoulder in the present (P) position, then front-kicking (Fk) up at each other's belly. Much head-bobbing, or nudging (N) was done along along with the kicking, and some shoulder shoving. After a period of this activity, the rams would walk away from each other, turn and possibly threat-jump (Tj) and or rush (Ru) at each other with horns lowered and heads twisted so as to catch the blows on the keel of one or both horns. After the clash (Cl), both would stand still for 'a few moments, then move forward and commence the nudging and front-kicking again. Some brief periods of grazing were also noted.

As the contest progressed, it became much more forceful and aggressive. Front-kicking became harder. Before clashing, the rams would walk five or six feet apart, whirl simultaneously, stand on their hind legs, then dive with all their strength at each other. So much force was put into these lunges that their hind hoofs were kicking out frozen clods of ground and tundra. The clashes, which could be distinctly heard one-half mile away and which sounded like two hickory baseball bats striking each other, would appear to stun the animals momentarily and they would stand with heads up in a dazed attitude before resuming the head to shoulder position again.

The battle continued in this stylized manner for one and one-half hours, after which both rams walked away together to feed. No anger was apparent at any time, nor was any deliberate attempt noted to catch the opponent off guard. Neither did the contest appear to establish a winner.

The other fights observed were similar in behavior to the above but lesser in degree. The only actual clashing seen was between pairs of class IV and V rams. One pair of class VII rams merely stood head to shoulder and front-kicked and nudged or presented for five minutes before walking away. A pair of class VI rams locked horns--probably accidentally--and tugged and shoved for two minutes before separating.

Four of the six contests seen on the Cooper Landing Closed Area occurred from November 19-22; one each occurred on December 10 and 16. Probably most of this activity is conducted prior to or early in the rut. No such fights were observed on Surprise Mountain.

The major interaction noted between sheep was the checking of ewes by rams to determine their state of estrus and receptivity. This behavior typically commenced with a ram approaching a ewe in the low stretch (Lo) attitude, sometimes at a rapid pace. Usually, just as the ram reached the ewe, he would turn his

lowered head into the twist (T) attitude, often with tongue extended. Almost invariably this approach would be to the ewe's rear end. Sniffing of the ewe's vulval region (Sv) would then be done, often followed by one or more front-kicks toward her belly or flank from the rear and head nudges. The sniffing, kicking and nudging might be repeated several times until the ram was satisfied.

Often, and especially later in the rut, rams would dispense with the low stretch and twist, merely approaching directly to smell the vulva. A ram approaching a group of ewes might rush up to the first one in a deep low stretch, then check succeeding ewes without this initial behavior.

Response by the ewe might include completely ignoring (Ig) the ram, especially if it was a class IV or V ram, standing and submitting to the checking (Ss,S), squatting (Sq) and urinating (U), moving away (Ma) or running away (Ra). Whenever a ewe urinated the checking ram would smell and possibly lick the urine and immediately raise his head in the lip-curl (Lc) attitude. Any urinating ewe, whether being checked or not, would attract nearby rams who would smell the urine on the ground and lip-curl.

Rams would check bedded ewes as readily as those standing. In doing so, they would approach in the usual manner, then nudge and front-kick at the ewe until she stood, whereupon checking would be completed. Ewes did not always stand up for class IV and V rams; however, they always rose promptly for class VI and VII rams.

The approach and checking of ewes by class VI and VII rams gave much more of an impression of purpose and power than did that by smaller rams. Ewes appeared to respond more promptly to the approach of a large ram, often watching him alertly and occasionally seeming to cower. Large rams unhesitatingly shoved between smaller rams and ewes to check the ewe, and when several rams approached a ewe together, they would check her in order of their horn size. Large rams seemed to use less time per ewe in checking than did younger males. It is possible that they are able to recognize nonestrous ewes more readily than one of the more inexperienced young rams.

The observed rate of ewe-checking interactions by ram class is shown for both areas in Table 3. The observed rate of checking by full-curl and larger rams (class VI and VII) on the Cooper Landing Area was higher than that of all smaller rams. On Surprise Mountain, class IV rams checked far more ewes than did smaller rams. No class V or larger rams were observed on Surprise Mountain.

In checking ewes, rams on the Cooper Landing Area did considerable inter-group traveling during the initial observational period. There was constant movement by lone rams and small groups of rams between groups of feeding ewes. Rams were seen moving over all visible sheep-inhabited parts of the mountain, and several rams were observed moving to or from nearby mountains. With this continuing interlaced movement and checking, it is unlikely that any ewes coming into estrus would have been missed.

Movement between widely separated ewe groups appeared to decline after about November 23 or 24 when more ewes were coming into estrus. Rams would still move between nearby groups but the restless, far-ranging searching was no longer

Table 3. Ewe-checking interactions by class of ram initiating action, 1970.

COOPER LANDING CLOSED AREA

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Ram Class	No. of Observed Interactions	% of Observed Interactions
III	0	0
I V	23	12%
V	61	31%
VI	89	45%
VII	24	12%
	197	100%

SURPRISE MOUNTAIN

III	1.1	11%
IV	92	89%
	103	100%

observed. Ewe-checking interactions also seemed to decline somewhat at this time on the Cooper Landing Closed Area (Fig. 4), though this was not evident on Surprise Mountain (Fig. 5).

The intensity of checking interactions was noted to be less during the December observational period on both areas, but especially on the Cooper Landing study area. Early-season ewe-checking was described in field notes as "forceful" and "excited". Later checking was not as stylized and was described often as "lethargic" or "half-hearted". After December 11, lone rams and groups of rams were observed feeding away from ewes or ignoring them if nearby. Much more time was spent in feeding and resting by rams than during the earlier observational period in November. Rams never did cease feeding during the portion of the rut under observation, however. Even during the more active early stages, they could be seen stopping to graze or rest between sessions of ewe-checking.

Actual breeding interactions included mount (M), copulation (Mc), chase (C) and guard (G). Observed breeding interactions as percentages of all interactions are shown by observation periods for Cooper Landing Closed Area and Surprise Mountain in Figs. 3 and 4. These interactions, except for mount, which may not always be related to rutting activities, appeared to be directed at estrous ewes, although these were not always identified in observations. Estrous females could only be identified by the behavior of males toward them and their response. Sometimes their status was confusing to the observer; therefore, only those exhibiting definite receptive behavior or being actively chased by groups of rams were classed as in estrus.

In Cooper Landing Closed Area, the first ewe showing indication of being in estrus was seen November 19. She was being chased, fought over and copulated with by a group of rams. No other estrous ewes were seen until November 23, when at least four different ewes were either being chased actively or guarded and copulated with. Three others were seen on the following day, the last day of the first observational period. Only one each was observed on December 10, 12 and 15 respectively.

It seems likely that the chase and guard interactions are the best indicators of the presence of ewes in estrus. The occurrence and frequency of these behaviorisms should thus be a good means of determining the chronology of the rutting season. Of the eight chases observed, one took place during the November 16-20 period and seven occurred during the November 21-25 period. None were seen in December.

All the observed chases but one involved wild scrambles by up to six rams, each attempting to outmaneuver the others to get at the ewe. Rams, recognizing the onset of estrus, gather around the ewe. A sudden run by the ewe apparently triggers the breeding response; immediately, all rams are after her in a pell mell chase through the cliffs. A class VI or VII ram was usually present and attempting to defend the ewe from other rams. Defense was in the form of rough shouldering-aside, presenting, butting or powerful rushes and clashes aimed at any available part of the opponent's anatomy. This was defensive and offensive fighting in the true sense, not stylized clashing.

Smaller rams, usually class V, unhesitatingly challenged large ones, though





A= CHECKING OF 99 (LO, T, SV etc.) B= BREEDING INTERACTIONS (M, Mc, C, G) C= GUARD ONLY (G)


N= No. of All Interactions Recorded

Interactions Recorded and Period of Observation.

Figure 5. Surprise Mountain - Significant Interactions by Percentage of all

FOR THE PERIOD

A= CHECKING OF && (Lo, T, Sv, etc.) B= BREEDING INTERACTIONS (M, Mc)

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not usually in a direct clash but rather side butting as they attempted to get around the defender. The younger rams were frequently able to outmaneuver and outrun the full-curl rams, catching up with and mounting the faster ewe, often on the run.

On one occasion when a ewe was caught and mounted by a class V ram, she stopped during the mounting. The large class VII ram involved in the chase caught up and rushed the younger ram from above, catching him in the flank with lowered horns and full power. The young ram was knocked off the ewe and rolled completely over. He stood up, looked around, and immediately scrambled around the defending ram, again after the ewe.

It seemed that most of the copulating during chases was by younger, more nimble males even though large rams were actively participating. It is not known whether the ewes are in full estrus and fertile at this stage nor whether they are impregnated during these chases. If this occurred regularly, selection would favor quicker, lighter males, rather than those with large, heavy horns which appear somewhat slower and more prone to tire during a chase. It is possible that actual impregnation does not occur until later while the ewes are being guarded and bred by large rams more exclusively.

Another possiblility is that the running response by ewes coming into estrus may depend on the age or experience of the ewe. Young ewes might tend to run and so be bred by younger rams, or possibly overbred by too many rams, lowering their reproductive success. More experienced ewes might not run and thus be more selective toward guarding and impregnation by large rams. Capturing, aging and marking a number of animals would aid in such behavioral interpretations.

Guarding activity was noted only during the November 21-25, December 6-10, and December 11-15, 1970 observation periods (Fig. 3). The number of interaction observations recorded during the December 16 period was so small and of such short duration that further guarding could have occurred and been missed.

Except for one instance involving a class V ram, all guarding observed was by class VI and VII rams. It was usually done away from other sheep, although other rams might remain nearby, occasionally attempting to get to the guarded ewe. The guarding ram would follow the ewe closely, often with his nose at her rump, occasionally nudging or front-kicking her lightly or sniffing her vulva. Mounting and copulation were observed on several occasions by guarding rams, but they usually appeared somewhat tired as if they had done most of their breeding before being observed. These rams frequently grazed next to their ewe and would lie down near her when she did.

Guarding rams were usually seen to stay with their ewes throughout the day of observation. One class VII ram which had been guarding a ewe all morning on December 12 finally moved away and began feeding alone, not returning to the ewe. This probably marked the end of his guarding period.

On Surprise Mountain only two possible copulations were recorded, both by class IV rams. One was on November 18 and the other on November 21. The estrous stage of the ewe could not be determined in either case. Following the

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mountings and apparent copulations, the rams left the ewes. No chases nor guarding interactions were recorded here.

Observed breeding interactions by class of ram initiating each are shown for both Cooper Landing Closed Area and Surprise Mountain in Table 4. It is apparent that in the Cooper Landing herd, where all classes of rams are present, most of the breeding interactions were carried out by full-curl or larger rams. In the Surprise Mountain herd, where larger rams were not present, the breeding activities observed were carried out exclusively by class IV males, the largest class present. No breeding interactions were seen to be conducted by class III rams on either area.

According to the chronological data obtained in 1970, it appears that the rut in the Cooper Landing herd commenced in earnest during the November 21-25 period, continuing at least through the December 11-15 period. Some breeding probably occurred both before and after these dates. The peak of the rut must have occurred during the last week of November or the first week in December, but was missed by the gap in observations this year.

No conclusions can be drawn regarding rutting chronology on Surprise Mountain. Rutting behavior may have been missed or possibly the onset of the main rut did not take place during the period of observations.

Problems in observation were encountered in both areas due to days of inclement weather and poor visibility. The observer on Surprise Mountain reported difficulty in obtaining adequate observations because the sheep would see him and leave the area. A blind might help solve this problem. The topography of Surprise Mountain makes observation difficult when the sheep are in the cliffs which slope away from the central plateau. The sheep in the Copper Landing area showed little fear of the observer and observation was relatively easy. The topography was more suitable in this area as well.

Population Trends and Composition

Results of the aerial classification counts conducted of the three herds under study are presented in Table 5. Also included for comparative purposes are the results of similar counts performed in the spring of 1970. These spring counts were designed to determine the proportion of lambs surviving the previous winter, and were conducted under a Survey and Inventory project. Total population estimates were not attempted during the spring surveys.

No attempt will be made to analyze or interpret these data until further counts are completed. Although overall accuracy, as indicated by the totals obtained in the two summer counts on Crescent Mountain, appears good, problems still exist in the identification of sex and age classes.

LITERATURE CITED

Giest, V. 1968. On the Interrelation of External Appearance, Social Behavior and Social Structure of Mountain Sheep. Z. Tierpsychol. 25. pp 199-215. Table 4. Breeding interactions by class of ram initiating action, 1970.

		Class of Ram									
Interaction	III	IV	V	VI	VII	Group					
Mount (M)	0	2	3	2	2	0					
Copulate (Mc)	0	0	2	3	1	0					
Chase (C)	0	0	0	1	0	7					
Guard (G)	0	0		5	8	0					
Total	0	2	6	11	11	7					

COOPER LANDING CLOSED AREA

SURDRICE	ΜΟΠΝΤΑΤΝ

Mount (M)	• 0	4	-	-	-	0
Copulate (Mc)	0	1?	-	-	-	0
Chase (C)	0	0	-		-	0
Guard (G)	0	0	-	-	-	0
Total	0	5				

Table 5. Results of aerial sheep classification surveys in 1970.

				1	./			
Area	Young <u>Rams</u>	Legal <u>Rams</u>	A11 <u>Rams</u>	Ewes plus Yearlings	Ewes	<u>2/</u> Yearlings	<u>3/</u> <u>Lambs</u>	Total
Date								
Surprise M	t.							
3/2/70	16	-	16	137	132	5	_	153
7/15/70	-	-	19	146	-	-	20	185
Crescent M	t.							
3/2,9/70	37	6	43	212	162	50	-	255
7/7/70	-	-	84	159	-	. – .	44	287
.*		(15	removed	by hunting	beteen t	this and follow	ving count)	
9/22/70	-	-	64	165	-	-	44	27 3
Cooper Lan	ding Cl	osed Are	a					
3/3,9/70	11	17	28	89	75	14	-	117
5/8/70	14	19	33	167	143	24	-	200
8/4/70	_	·	84	193	-	_	34 (311

1/ This category includes young rams mis-identified as "ewes", and is the main source of error in aerial classification.

2/ "Yearlings" is used to distinguish lambs of the previous summer from new lambs.

3/ "Lambs" as used here includes those born in the summer of 1970.

Hemming, J. E. 1969. Cemental Deposition, Tooth Succession, and Horn Development as Criteria of Age in Dall Sheep. J. Wildl. Mgt. 33(3). pp 552-558.

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ACKNOWLEDGMENTS

R. A. Rausch and R. J. Somerville were instrumental in implementing this study.

D. Cornelius, D. Jones, E. Klinkhart, R. LeResche, P. LeRoux, L. Miller and R. Perkins assisted in the operation of the checking station during the Crescent Mountain either-sex hunt.

K. Pitcher did the bone marrow analyses and, with C. Lucier and N. Steen, prepared collecting materials and handled the many items required in processing specimens in the laboratory.

N. Steen, E. Klinkhart, R. LeResche, P. LeRoux, J. Davis and K. Pitcher helped with the collection and post mortem examination of sheep in November. The collection could not have been done without the expert flying of D. Ward, pilot for Trans Alaska Helicopters, Inc.

A. Johnson conducted the Surprise Mountain portion of the breeding season field work. D. Schimberg, who lives in Cooper Landing, donated considerable time in coordinating radio communications between the two field camps during this operation.

D. Cornelius, R. Kramer, L. Johnson, A. Johnson, L. Miller and K. Pitcher acted as observers during the several aerial surveys flown during the segment.

This study could not have been conducted without the help of all the above. To each of them, I offer my sincere thanks.

RECOMMENDATIONS

In order to maintain the Crescent Mountain herd at the desired level, another either-sex public hunting season is recommended for August, 1971. The number of sheep to be taken will depend on the size of the post-lambing population, expected winter loss and planned scientific collecting.

It is recommended that scientific collection of sheep during the winter of 1971-72 be limited to only those necessary to fill in specific information gaps and to visibly sick or weak individuals.

A comparative study of winter range conditions and trends on the three study areas is needed. I recommend that a range expert be hired under special contract to determine the proper methods to be used and to initially set up the field study.

A comparison of winter climates on the three areas is needed so that climatic effects can be considered when comparing the effects of the different management treatments. Wind, temperature, snow depth and snow-pack hardness should be compared.

PREPARED BY:

Lyman Nichols Game Biologist APPROVED BY:

Management-Research Coordinator Division of Game

tor, Division of Game Dire Acting

Appendix 1. Description of coded actions and reactions.

 Low-stretch (Lo): Ram approaches another sheep with head lowered and neck stretched out in a somewhat crouching approach; similar to the position exhibited by a bird dog on "point".

2. Twist (T): Ram extends head and neck and rotates head along median axis. Usually points muzzle towards flank of animal approached and rotates head away from the other sheep rather than towards it. Ram may extend tongue during twist. Often is combined with low-stretch.

- 3. Front-kick (Fk): Ram kicks forward and up with front foot at opponents body. Often accompanied by the nudge, and occasionally by a shoulder-shove.
- 4. Nudge (N): (Not used in 1970 field observations.) Ram nods head towards opponent in a quick, bobbing motion, sometimes with a twisting motion. May extend tongue when nudging a ewe. May actually shove opponent lightly with muzzle during bobbing. Often accompanied by front-kick.
- 5. Mount (M): Mounting other animal from rear. May be performed on subdominant animals of the same sex. Not necessarily a sexual expression but during the rut, probably represents an attempt to copulate.
- 6. Copulate (Mc): A successful copulatory mount of a ewe by a ram, including intromission.
- 7. Sniff-vulva (Sv): Smelling a ewe's vulval region by a ram. May include licking or nuzzling the vulva and here used to include smelling urine.
- 8. Lip-curl (Lc): Head and muzzle stiffly upraised, upper lip curled back. Head may be moved from side to side and mouth somewhat opened. Performed by rams after smelling urine, either directly from ewe or on the ground.
- 9. Chase (C): Self-explanatory. As a breeding interaction, used to denote any chase of a ewe by one or more rams for the purpose of breeding.
- 10. Guard (G): (Not used on 1970 field observation forms.) Ram stays with estrous ewe defending her possessively from other rams. Ram remains near ewe, often with his nose at her rump, occasionally nudging or front-kicking her. Copulates at leisure if alone. May feed and rest with ewe. Guarding may be interrupted by the determined approach of other rams, at which time a chase may result. The guarding ram, if dominant, regains possession of ewe after chase unless losing her to a larger ram which may begin guarding in turn. Guarding and/or chasing are probably the best visible indicators of the presence of estrous ewes.

- 11. Rubbing (Rb): Performed by subordinate males and estrous females on dominant males. Subordinate rubs rostrum and cheeks in face of dominant. May also lick or nibble face and horns of dominant. Not restricted to rutting season.
- 12. Horning (H): Subordinate males rub horns on face, horns or body of dominant male. Not restricted to rutting season.
- 13. Butt (B): Typical butting action with horns; a deliberate butt rather than a horn clash or incidental butt while nudging.
- 14. Horn-threat (Ht): An intention movement to butt which serves as a threat.
- 15. Threat-jump (Tj): An intention movement to clash. Sheep rises on hind legs and inclines head preparatory to clashing.
- 16. Clash (C1): Sheep usually rises on hind legs and lunges down at opponent, delivering heavy blow with horns. Head usually twisted to side. Opponent catches blow with its own horns in a similar manner. The typical "fight" between rams.
- 17. Rush (Ru): With head lowered, sheep rushes at opponent with the intent of smashing into its body a true fighting movement.
- 18. Present (P): Ram presents side view of horn towards opponent with head held erect at close range. A horn display apparently to allow recognition of dominance by degree of horn curl.
- 19. Head-shake (Hs): Performed mainly by subordinate female to pestering by dominant sheep.
- 20. Spontaneous ejaculation (Se): Self-explanatory.
- 21. Shove (Sh): (Not used on 1970 field observation forms.) Dominant sheep shoves bodily against another, forcing it aside. May be used by rams attempting to intervene between another ram and a ewe, or an animal pushing another aside for a favored feeding spot.

Appendix 2. Sheep breeding observation punch card key.

Breeding Observation F	orm (all)	(corner)	29.5
Area: Surprise Mt Cooper Landing Other	Closed Area	• • • • • • • • • • • •	1 2 3
<u>Year</u> : 1970 1971 1972 1973 1974	• •	• • • • • • • • • • • • • • • • • •	4 5 6 7 8
Month and Date: Nov. Nov. Nov. Dec. Dec. Dec. Dec. Dec. Dec. Dec.	$\begin{array}{cccccccccccccccccccccccccccccccccccc$	• • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • • •	9 10 11 12 13 14 15 16 17
Period of Day: Early Morni Mid d After Late	morning (0800-0900) ng (0900-1100) ay (1100-1300) noon (1300-1400) afternoon (1400+)	· · · · · ·	18 19 20 21 22
<u>Temperature</u> : -11° 0° to 1° to 11° t 21° t 31° +	to -20°	· · · · · ·	23 24 25 26 27 28
Wind:NorthNortheast.East.Southeast.South.Southwest.West.Northwest. <	29 30 31 32 33 34 35 36
Wind Speed: 0-5 m 6-10 11-15 16-20 20 +	ph	· · · · · ·	37 38 39 40 41

Appendix 2 (cont.). Sheep breeding observation punch card key.

<u>Sky</u> :	Clear to	scattere	d -	0	•	•••	•	•	•	•	٠	٠	•	•	•	•	•	•	•	42
	Broken cl	ouas — y	•	• •	•	• •	•	٠	٠	٠	٠	٠	٠	٠	٠	٠	٠	٠	•	43
	Overcast		•	••	•	••	•	•	•	•	•	•	•	•	•	•	•	•	•	44
Precipi	itation:	Fog F.	٠	• •	•	• •	•	•	•	•	•	•	•	•	•	•	•	•	•	45
		Snow S	•	• •	•	• •	•	•	•	٠	٠	•	•	٠	•	٠	٠	٠	•	46
		Blowing	sn	ow H	Bs				•		•	•	•		•	•	٠	•		47
		Rain R	•				•	•	•	•	•	•	•	•	•	•			•	48
		Freezin	g r	ain	Fr	•	٠	٠	٠	•	•	•	٠	•	٠	٠	٠	٠	٠	49
Sheep (Class Init	iating A	cti	on:		I		•		•			•	•				•		50
					-	II														51
					I	II		•			•		•	•		•	•	•	•	52
						EV	•		٠	٠	•	٠	•	•	•	•	•	٠	٠	53
						v	•	•	•	•	٠	•					•	•	•	54
					١	lΙ	٠	•	•	•	•	•	•	•	•		•	•	•	55
,					V	LΙ	٠	٠	٠	•	•	•	•	•	•	•	٠	•	•	56
				0	Grou	D					-									71

Initiated Action Includes:

1

.

Lo stretch (Lo) Twis	st (T) Front kick (Fk) Nudge, short	
twist or Butt, Sniff	E vulva (Sv), and/or Lip curl (Lc) . 5	7
Mount (M)	5	8
Copulation (Mc)	5	9
Chase (C)		C
Guard (G)	63	1
Horn threat (Ht) Thr	ceat jump (Tj) Clash (Cl) Rush (Ru)	
or related fighting	or threat behavior 62	2
Rubbing (Rb) Horning	g (H) and associated behavior 6	3
Estrous Ewe Obviously Prese	$ent: \dots \dots$	4
Interaction Time Interval:	Less than 1 min 6	5
an a	1 to 5 min 60	5
	6 to 15 min 6	7
	16 to 60 min 68	8
	60 min. + 69	9
		_
Notes of Importance:	••••••••••••••)
Feeding behavior and	foods	2
Maternal behavior n	ursing etc. 7	3
Movements agility	7/	4
INVENCIAL SA CELLUY		۴.

JOB PROGRESS REPORT (RESEARCH)

State: Alaska

Project No.: W-17-3

Cooperators: Kenneth A. Neiland Pro

Project Title: Big Game Investigations

Parasites

Dall Sheep Diseases and

Job No.: 6.6R

Period Covered: July 1, 1970 to December 31, 1970

SUMMARY

No gross evidence of disease was noted in nine Dall sheep collected on the Kenai study area.

Job Title:

Eight sera from these nine sheep were negative in the agglutination and complement fixation tests for brucellosis.

Several severe cases of "lump jaw" were submitted from rams killed by hunters in the Wrangell Mountains.

BACKGROUND

Relatively little published information is available on the diseases and parasites of Dall sheep in Alaska, or elsewhere. Goble and Murie (1942) reported the occurence of a genus of lungworms, <u>Protostrongylus</u>, which is commonly associated with verminous pneumonia in bighorn sheep elsewhere. Murie (1944) recorded lump jaw as a common afflication of Dall sheep in McKinley Park. Phillips (1938) noted the occurrence of the larvae of <u>Taenia hydatigena</u> (Pallas, 1776) in Alaskan Dall sheep. Rausch (1951) failed to find any helminths in Dall sheep taken near Anaktuvak Pass in the Brooks Range.

Studies on selected Dall sheep populations involving manipulation of numbers which have been recently initiated must take into account the possible effects of pathogens as well as weather, nutrition, etc. Because disease is known to be an important factor in the walfare of wild sheep populations elsewhere (Forrester, 1971), it seemed especially important that it be critically evaluated in our Alaskan Dall sheep population studies.

OBJECTIVES

To qualitatively and quantitatively evaluate diseases and parasites as potential limitations to Dall sheep populations on the Kenai Peninsula.

PROCEDURES

All sheep collected under Job 6.4 were subjected to a careful necropsy. Samples of presumed pathological conditions and parasites were preserved and analyzed in the laboratory. Serum samples from collected sheep were tested for presence of antibodies for a variety of bacterial and viral diseases.

In conjunction with Job 6.1 one or more sheep were to be trapped and held at the Dry Creek Study Area. Samples of fecal pellets were to be collected from each deposit during a 24-48 hour long period. These pellets were to be quantitatively analyzed using centrifugation to ascertain qualitative and quantitative parasite differences between deposits. Fresh fecal pellets were collected at each study area and qualitatively analyzed for parasite burdens. Mandibles from hunter-shot and collected sheep were analyzed to determine the incidence of mandibular disease.

FINDINGS

Autopsies:

Only one collection of nine sheep was made during the reporting period. These were autopsied by the leader of the Dall Sheep Study and his assistants. No pathology or parasites were noted during the field autopsies. The lungs and the abomasum and intestional tract of each animal were collected and shipped to the Fairbanks laboratory for later analysis. These analyses are not yet completed.

Serology:

Eight serum samples were tested for brucellosis antibodies by both the agglutination and complement fixation procedures by Dr. David Berman of the Department Vet. Sci., Univ. Wisconsin. No reactors were detected.

Arbovirus and other serology is not yet completed by colleagues of Dr. Berman.

Pellet Analysis:

Two days were spent at the Dry Creek study area when space was made available on an inspection tour via helicopter. During that short time it was not possible to obtain adequate samples of fecal pellets during various times of the day to investigate variation in parasite release from one time of day to the next. No attempt will be made to use pellet analysis as a quantitative indicator of parasite burden until it is possible to study the release of parasite larvae and ova in fixed parasite burdens under varying conditions.

Lump Jaw:

None of the nine sheep collected during the reporting period were noted by the field autopsy personnel to be afflicted by the "lump jaw" condition.

Five of seven mandibles from sheep taken by hunters in the Wrangell Mountains showed some degree of the "lump jaw" condition. In two of these, loss of molariform teeth and/or serious erosion and/or swelling of both or individual rami was noted. There evidently were no complaints by any of the hunters concerning the apparent condition of the affected rams.

1

Loss of personnel from the Fairbanks sheep project and laboratory precluded an active jaw collecting campaign at local taxidermy shops. No jaws were collected at taxidermy shops in Anchorage.

An attempt to observe possible cases of "lump jaw" in animals being tagged at the Dry Creek study area will be made during the 1971 summer field season.

ACKNOWLEDGMENTS

I would like to acknowledge the efforts made by the study leader, Mr. Lyman Nichols, to ensure the success of this job. Mr. David Harkness of the Region III laboratory staff performed the limited field work undertaken at the Dry Creek study area.

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