

MOUNT CRONIN DALL SHEEP REPORT

MARCH, 1979

TR-79-4

SHARON RUSSELL  
MANFRED HOEFS  
YUKON WILDLIFE BRANCH

# TABLE OF CONTENTS

	<u>PAGE</u>
Figures .....	I
Tables .....	IV
Appendices .....	V
Introduction .....	1
Dempster Highway Construction .....	2
Management Status of Mt. Cronin Population .....	2
Study Area .....	3
Methods .....	5
Results & Discussion .....	9
Population size and structure .....	9
Composition of nursery bands .....	11
Distribution of sheep .....	13
Snow conditions .....	26
Lambing period and progression of lambing .....	28
Critical areas .....	31
Lambing grounds .....	31
Mineral licks .....	38
Winter range .....	57
Movement routes .....	60
Habitat .....	65
Behaviour .....	76
Feeding .....	76
Suckling .....	76
Response to predators, aircraft and machinery and human presence .....	77
Molt .....	82
Other species observed in study area .....	83
Summary .....	86
Recommendations .....	88
Research Needs .....	92
Literature Cited .....	94
Acknowledgements .....	95

## FIGURES

1. The Mt. Cronin study area.
2. Area covered on foot in Mt. Cronin study area.
3. Frequency distribution of nursery band sizes, May - Aug. 1978.
4. Average nursery band size, May - Aug. 1978.
5. Ram and nursery band distribution in relation to Dempster Highway (based on aerial surveys).
6. Monthly ram distribution based upon ground and aerial surveys.
7. Proposed summer and winter ranges of Mt. Cronin population.
8. Ram and ewe summer ranges, north and south of the Rock River.
9. Ewe summer range in the eastern Richardson Mountains.
10. Tetlit Creek mineral lick and ewe summer range to the west.
11. Base camp on Rock River, mineral lick and Dempster Highway in background.
12. "Grandmother in tennis shoes" ridge on south side of Rock River.
13. Extensive snow patches, Ridge C, May 31.
14. Snow patches on Ridge D, June 5.
15. Remaining snow in drainage channels.
16. Map of cliff areas on western half of Mt. Cronin study area.
17. Locations of ewes with lambs sighted during May 19 and June 17 aerial surveys.
18. Sheep on bluff above cliffs.
19. Steep east-facing scree slopes above cliffs.
20. Cliff area on south side of Rock River.
21. Schematic drawing of geology of Rock River and Tetlit Creek mineral lick areas.
22. Rock River mineral lick with Dempster Highway in background.

## II

23. Seven sheep on cliff face of Rock River mineral lick 9/6/78.
24. Three rams resting at Rock River mineral lick in June.
25. Seven sheep on Rock River mineral lick in June.
26. Sheep observed at Rock River lick site May - September.
27. An iron-rich site along Tetlit Creek.
28. Tetlit Creek mineral lick site. Sheep bedded on face,  
and sheep licking at base.
29. Sheep observed at Tetlit Creek lick July 12-27.
30. Sheep approaching Tetlit lick from upstream along creek bed.
31. Sheep departing from Tetlit lick on trail crossing blue-gray  
shale slopes west of lick.
32. Sheep on trail from Tetlit Creek leading onto eastern flanks  
of Richardson Mtns.
33. Frequency of known arrival and departure times at Tetlit  
Creek mineral lick, July 12 - 27.
34. Three salt lick holes at Lick #1, Tetlit Creek.
35. Sheep at Lick #2, Tetlit Creek.
36. Nineteen sheep at Lick #3, Tetlit Creek.
37. Chewing site at Lick #3, Tetlit Creek.
38. Lick #4 on Tetlit Creek.
39. Possible winter range with Dempster Highway, 1 km west,  
visible in background.
40. Another view of area in Figure 39.
41. Sheep movement routes.
- 42.(a) and (b): Trail A from south ridges crosses tussocks  
to Rock River mineral lick.
43. Trail H from eastern flanks of Richardson Mtns. to Tetlit  
Creek mineral lick.
44. Sheep on Trail H heading up onto alpine slopes of eastern  
Richardson Mtns.

### III

45. Grizzly sightings in Mt. Cronin area.
46. Sheep on Salix-Picea-forb vegetation typical of creek and river bed areas.
47. Sheep feeding site in Eriophorum-Carex tussocks zone.
48. Dryas-Moss-Salix feeding site on rocky north-facing alpine slope above Rock River in July.
49. Dryas-Lichen-Moss-Carex-Cassiope feeding site on northwest facing alpine slope in July.
50. Moss-Carex-Salix feeding site on lower north-facing alpine slope in July.
51. Lichen-Dryas-Carex feeding site on west-facing alpine slope, June.
52. Two ewes and 2 lambs feeding in sunlight on northwest-facing alpine slope at 9:00 p.m., June 10.
53. Vegetation plot locations.

## IV

### TABLES

1. Species significance and distribution values used in vegetation plots.
2. Results of aerial surveys, 1977 and 1978.
3. Aerial surveys of Mt. Cronin sheep populations, 1978, and distribution of sheep in relation to Dempster Highway.
4. Ground and aerial survey sightings of rams in Mt. Cronin study area. May - September, 1978.
5. Daily sheep counts obtained by ground survey from Rock River camp.
6. Progression of lambing, 1978.
7. A comparison of Yukon and Alaska lambing periods.
8. Comparison of flowering dates for Sheep Mountain (1969-73) and Mt. Cronin area (1978).
9. Numbers of lambs observed on ridges June 3 - 9.
10. Chi-square tests of ram, ewe, yearling and lamb use of Rock River and Tetlit Creek mineral licks.
11. Activity of rams, ewes and lambs at Tetlit Creek lick, July 12 - 26.
12. Percent time spent licking and total time spent at Tetlit lick by 13 individual sheep.
13. Differential use of 4 lick sites at Tetlit Creek, July, 1978.
14. Plant species recorded in vegetation plots (June and July).
15. Plant species observed to be eaten by sheep.

## APPENDICES

- A. Bird species observed on Mt. Cronin study area May - July, 1978, and Birds in Richardson Mountains observed May 20 - July 30, 1978, by R. Frisch.
- B. Counts of sheep utilizing Rock River and Tetlit Creek mineral licks.
- C. Plant species collected on Mt. Cronin study area.
- D. Winter surveys of Mt. Cronin area
- E. Cost of project.

# THE MOUNT CRONIN SHEEP STUDY

## INTRODUCTION

The Mt. Cronin Dall sheep population was first investigated in 1977 when the Yukon Game Branch conducted aerial surveys to determine distribution and abundance of Dall sheep in the Richardson Mountains. Of the four sheep populations located during the surveys, only the Mt. Cronin population was within an area of potential impact from the construction and subsequent use of the Dempster Highway. A preliminary discussion of this population is contained in Hoefs (1978).

The western boundary of this population's range is adjacent to the Dempster from the Rock River crossing at km 432 (mile 270) for approximately 16 km north. The emphasis of this study was, therefore, carried out in proximity (within 16 km) of the highway in consideration of the potential adverse effects of construction and subsequent use on this sheep population.

The major objectives of the study were:

- a) determination of critical areas (lambing grounds, mineral licks, winter range, migration routes) and their relation to the Dempster Highway;
- b) recommendation for mitigative measures if a critical area was located in close proximity to the Dempster route;
- c) monitoring of sheep response to construction activity;
- d) slow conditioning of sheep to the presence of men.

## DEMPSTER HIGHWAY CONSTRUCTION

Highway construction from km 406 (mile 254) to km 432 (mile 270) was initiated in June, 1977. As of October 1, 1977, several km of highway had been constructed between km 428 and km 464. By October 17, 1977, equipment was being moved on site between km 406 and km 428 with construction scheduled to begin in the spring of 1978. Construction from km 406 to 432 was completed in July of 1978.

Construction was well underway and some was completed on that section of the Dempster contiguous with the sheep range when this sheep study began in May 1978.

The Dempster is now passable to traffic but the official road opening has been delayed until late in 1979 as the road must be resurfaced from the Rock River crossing north to the Peel River (km 464). The road will be kept open to public traffic this winter to km 29. Beyond km 29, use of the road is by permit only.

## MANAGEMENT STATUS OF MT. CRONIN POPULATION

Game Management Zone 1, within which the study area lies, was closed to sheep hunting as of August 1, 1978. It is the intention of the Yukon Wildlife Branch to manage the Mt. Cronin sheep population for non-consumptive use. Being the northernmost resident sheep population in the Yukon Territory and in

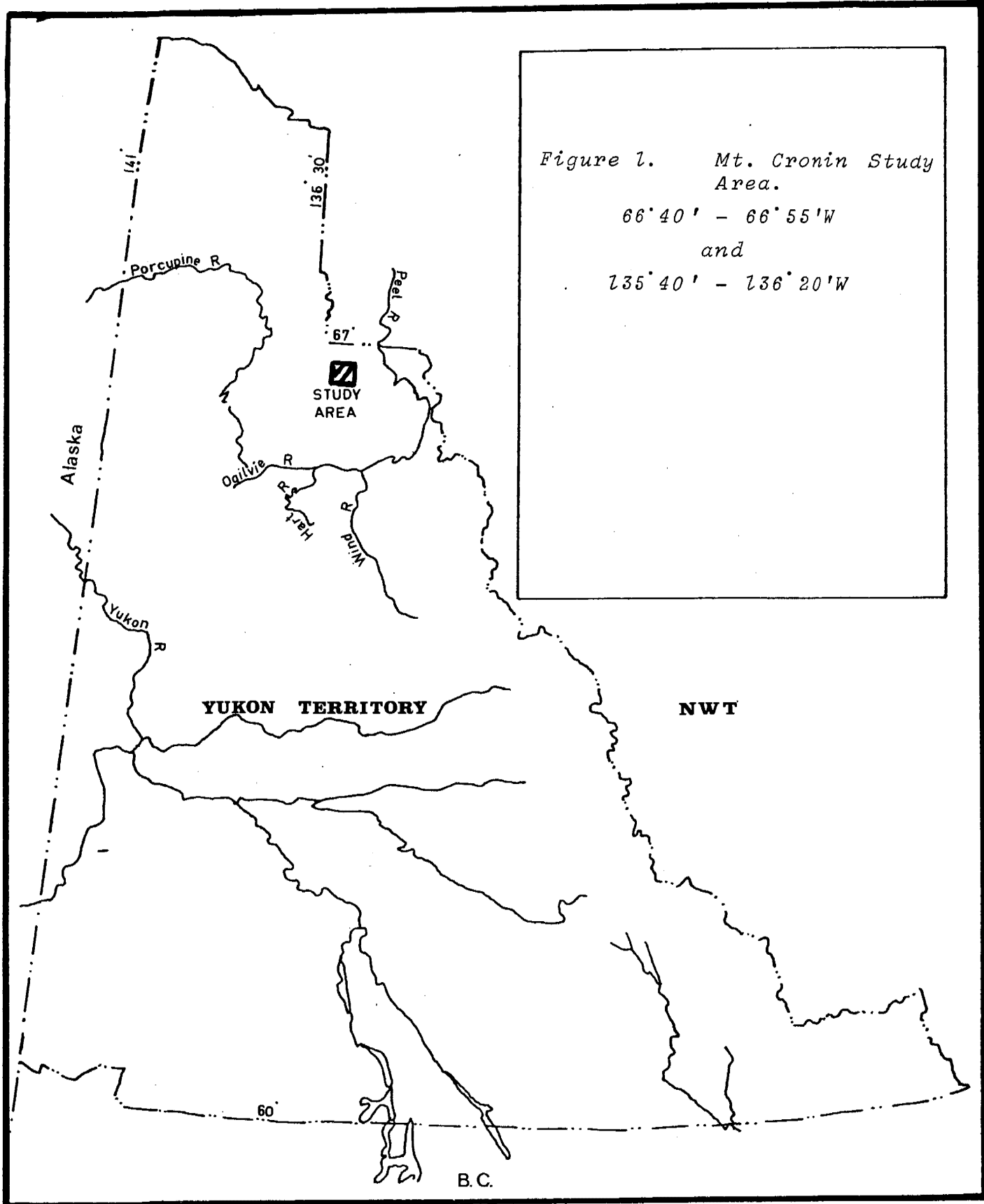
view of its vulnerability in relation to the Dempster Highway, this population merits special status.

One need only consider the historical status of other sheep populations in North America and Europe to justify the concern for the Mt. Cronin population.

STUDY AREA: 66° 40' to 66° 55'N and 135° 40' to 136° 20'W.

The study area (Figure 1) lies approximately 35 km north of the Arctic Circle and is within the Northern Mountains and Coastal Plain Ecoregion of Oswald and Senyk (1977). It encompasses approximately 518 km<sup>2</sup> and extends across the breadth of the Southern Richardson Mountains. The area is drained to the west by the Rock River, to the northeast by the Vittrekwa River and to the east by Tetlit Creek, a tributary to the Road River. This region lies within the continuous permafrost zone and is underlain by sedimentary rocks, examples of which can be seen exposed along the Rock River and Tetlit Creek.

Trees (*Larix laricina*, *Picea glauca*, *Picea mariana*, *Populus balsamifera*, *Salix* spp.) are limited to river, creek and snow melt drainage channels, south-facing bases of ridges and some poorly-drained tussock areas. *Carex* and *Eriophorum* tussock communities form the predominant vegetative cover in the lowland areas. The steeper slopes of the mountain ridges are scree covered at upper elevations with shallow colluvium at the lower elevations. *Dryas*, *Carex*, *Arctostaphylos* and graminoids form



the predominant vegetative cover over extensive areas on the ridges.

The boundaries of the study area were determined from sheep surveys flown in 1977 and are described in Hoefs (1978). Sheep distribution as determined by aerial surveys in the present study supports the assumption that these physiographically distinct boundaries are the limits of this population's range.

## METHODS

Much information concerning this population was derived from ground observations within 16 km of the Dempster Highway. A camp was established on the Rock River and a temporary camp was set up on Tetlit Creek, each camp being in close proximity to a mineral lick. Dates and duration of field observations at these camps were as follows:

Rock River : May 17 - 26

: May 29 - June 17

: June 28 - July 9

: August 4 - 10

: August 14 - 19

\*Away from base camp  
June 12, 13, 14.

Tetlit Creek: July 12 - 27

The study was terminated August 19.

Observations of sheep in the Rock River area were made by systematic hiking and investigation of ridges to the north and south of the Rock River. Observations in Tetlit Creek were primarily of mineral lick utilization and were made from the

campsite. Sheep were observed with the aid of binoculars and a 45x spotting scope. That portion of the study area covered on foot is indicated in Figure 2.

Plants were collected and the date of first flowering was recorded for many species.

Vegetation plots 10 m x 10 m in size were established on sites where sheep had been observed feeding. All species were recorded and assigned a species significance value and a distribution value (Table 1). These plots were for descriptive purposes only and were not intended for a vegetation classification of any area. On some occasions it was possible to observe the plant species an individual animal was feeding upon. Otherwise, feeding sites were subjected to a "hands and knees" inspection to determine which species had been grazed upon.

A record was kept of bird species in the area and notes were made of any nesting observed. A much more complete record of species on the area was received from Mr. Bob Frisch, an independent naturalist who was observing birds in the Richardson Mountains from May 20 to July 30, 1978. These records of bird species are contained in Appendix A.

Other mammals observed on the study area were noted also.

Aerial surveys were flown in a Bell 206A Jet Ranger helicopter to establish an accurate population count and to document the distribution of ram groups and nursery bands. Four surveys were made of the entire study area and three were made of a portion of the study area.

Rock and soil samples and sheep pellets were collected at mineral licks.

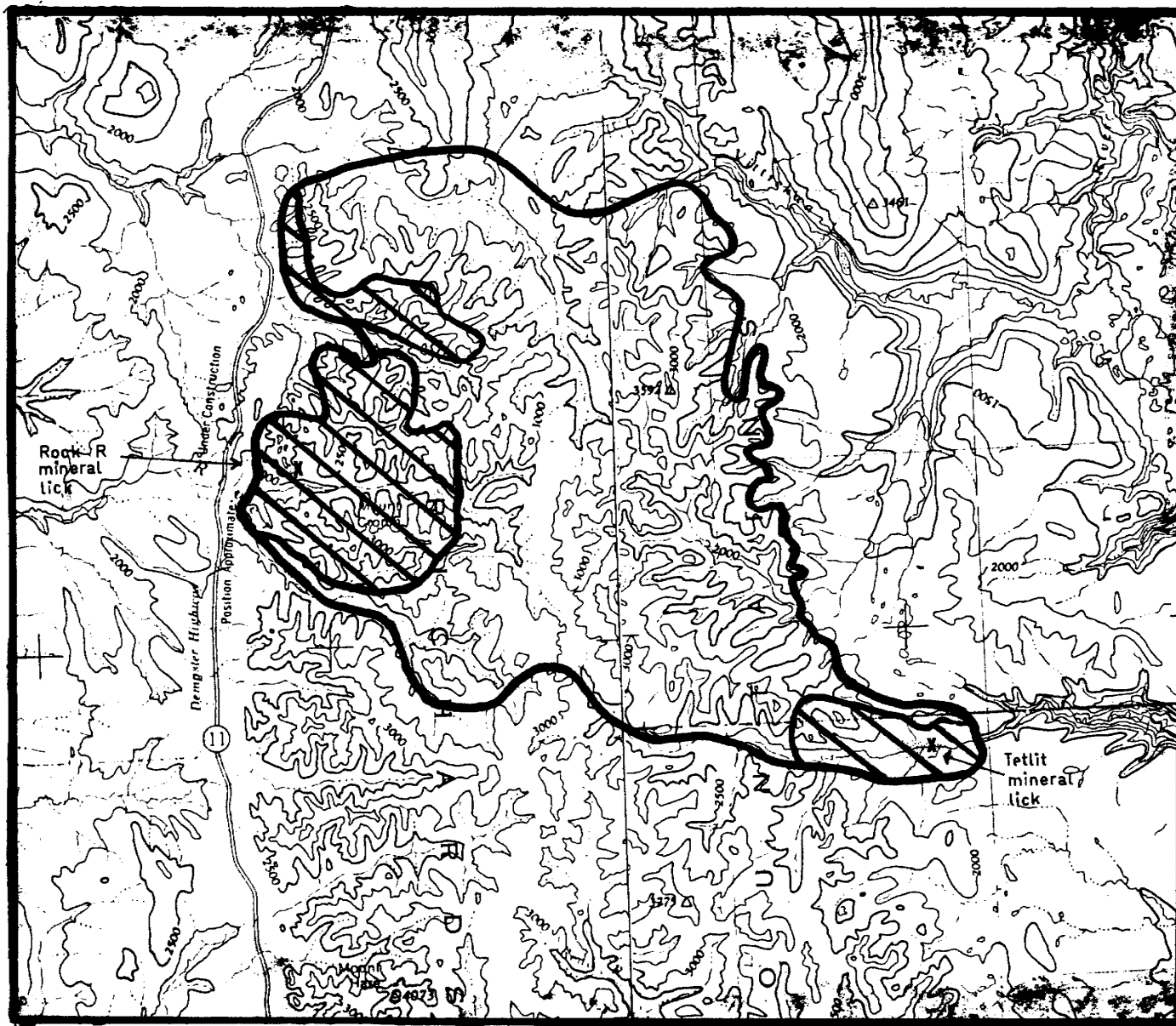


Figure 2. Area covered on foot in Mt. Cronin study area.

TABLE 1: SPECIES SIGNIFICANCE AND DISTRIBUTION  
VALUES USED IN VEGETATION PLOTS.

---

<u>Species Significance:</u>	<u>Species Distribution:</u>
+ solitary	1 rare individual
1 seldom	2 few scattered
2 less than 10% cover	3 few clumped
3 1 - 5% cover	4 many scattered
4 5 - 10% cover	5 many clumped
5 10 - 20% cover	6 continuous cover, few openings
6 20 - 30% cover	7 continuous cover, no openings
7 30 - 50% cover	
8 50 - 75% cover	
9 75 - 95% cover	
10 95 - 100% cover	

---

## RESULTS AND DISCUSSION

### 1. POPULATION SIZE, STRUCTURE AND DISTRIBUTION

#### a) Population size and structure.

Table 2 summarizes the results of aerial surveys conducted over the range of the Mt. Cronin sheep population. If maximum values are taken from each cohort group, the minimum population size is 103 animals consisting of at least 20 rams, 46 ewes, 11 yearlings and 26 lambs.

TABLE 2. AERIAL SURVEY COUNTS

<u>Date</u>	<u>Rams</u>	<u>Ewes</u>	<u>Yearlings</u>	<u>Lambs</u>	<u>Total</u>
July 25, 1977	8	.....37.....		13	58
May 19, 1978	5	25	11	5	46
June 17, 1978	14	46	11	26	97
July 11, 1978	20	.....43.....		18	81
Aug. 14, 1978	2	.....55.....		17	74
Aug. 19, 1978	17	.....55.....		26	98

---

A ratio of 56 lambs per 100 ewes is recorded for this population. This is considered average for northern sheep populations. Hoefs (1975) summarized productivity ratios from the available literature. The Sheep Mountain population under study by Hoefs (1975) was observed to have lamb:ewe ratios varying from 41% to 64% over a 5-year period.

A yearling:ewe ratio of 24% is calculated for the Mt. Cronin population. According to the literature reviewed by Hoefs (1975) this is an average ratio, sufficient to keep a population stable.

Hoefs (1975) reviewed the literature concerning the adult sex ratio of hunted and unhunted sheep populations. A ram:ewe ratio of 43% is recorded for the Mt. Cronin population and is considered indicative of a heavily hunted population.

Assuming a normal natural sex ratio and age structure, as described for Kluane Park, Hoefs (1975), there should be 30 - 35 rams over 2 years of age in this population. The expected number of old rams is present in this population thereby precluding the possibility that trophy poaching has taken place.

Of the 20 rams counted during this study, 18 were classified as follows:

<u>No. Rams</u>	<u>Age Class</u>
8	360° curl and >360°
5	270° curl (6 - 7 yrs)
5	2 - 5 years old

Only 5 rams in the 2 - 5 years' age class were located in the study area. It is this age class that has not been successfully located within this population's range. It is possible that rams of this age class may range over a territory larger than the area surveyed, and were, therefore, not accounted for. It is also feasible that young rams in nursery bands were not detected. A portion of this segment of the population may also

have been illegally shot. Three rams and one other sheep were illegally shot in late February of 1978 on a ridge north of the north branch of the Cornwall River, within the Mt. Cronin population's range. Considering the 3 rams shot in February, there were possibly 23 rams in this population.

#### COMPOSITION OF NURSERY BANDS

Observations of sheep on mineral licks were not included in calculations of nursery band composition. Our observations indicate that a segregation of nursery groups into ewes with lambs and ewes with yearlings may have occurred. Of 123 nursery band observations, 40 (33%) were ewe-yearling bands, 37 (30%) were ewe-lamb bands and 46 (37%) were mixed bands of ewes, yearlings and lambs. Band size ranged from 1 to 38 animals, and the overall average band size was 7.7 animals, the mode was 4, the median 6 (Figure 3).

It is hypothesized that such a segregation of nursery groups may indicate that ewes have lambs every second year only (pers. comm. Dr. M. Hoefs).

Average band size increased during the study from 3.4 (May 17 - 20), 7.5 (May 29 - June 17), 9.8 (June 28 - July 11) to 11.6 (August 4 - 19). Hoefs (1975) found the same trend on Sheep Mountain. The comparison is as follows:

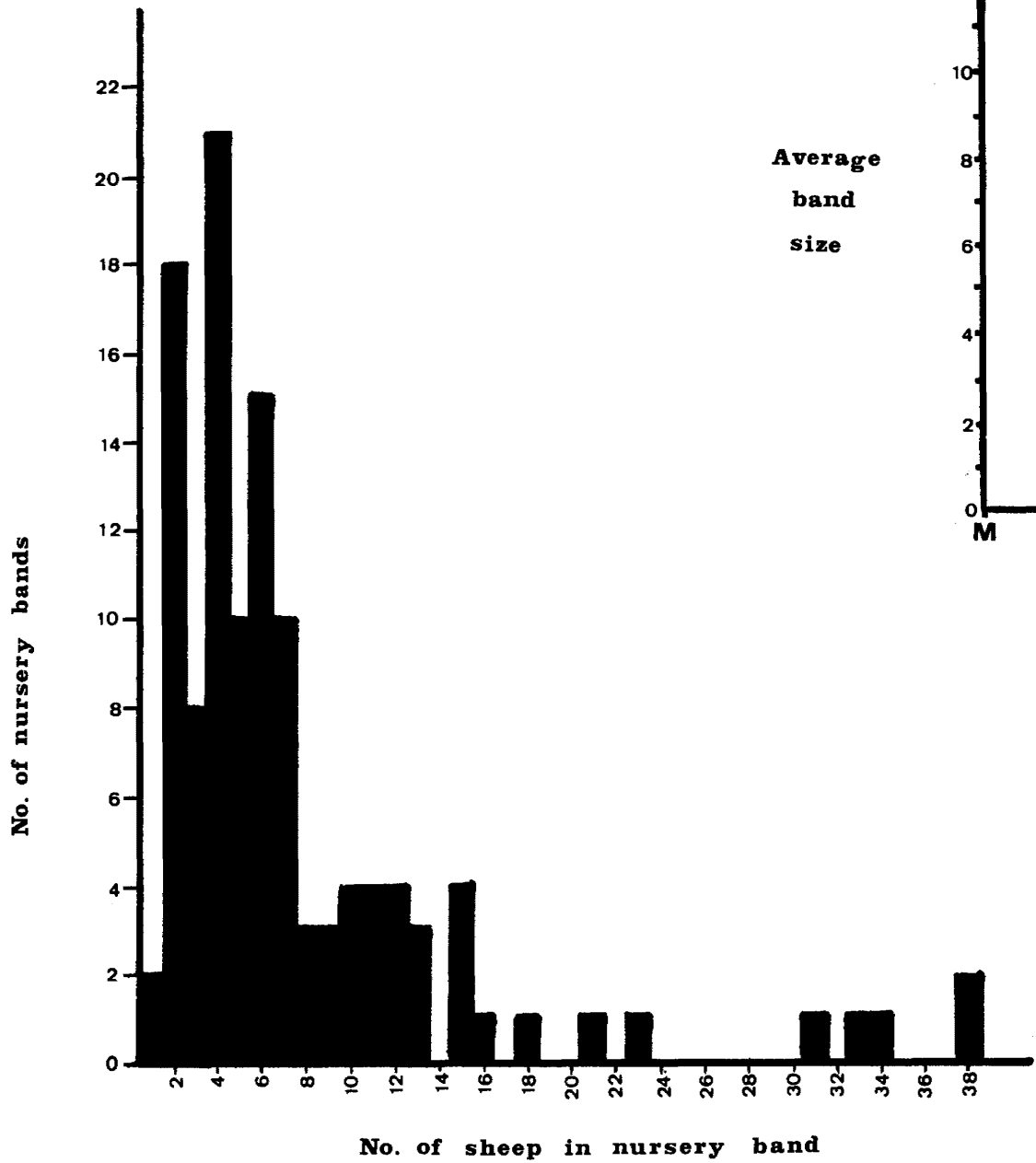


Figure 3. Frequency distribution of nursery band sizes  
May - Aug., 1978

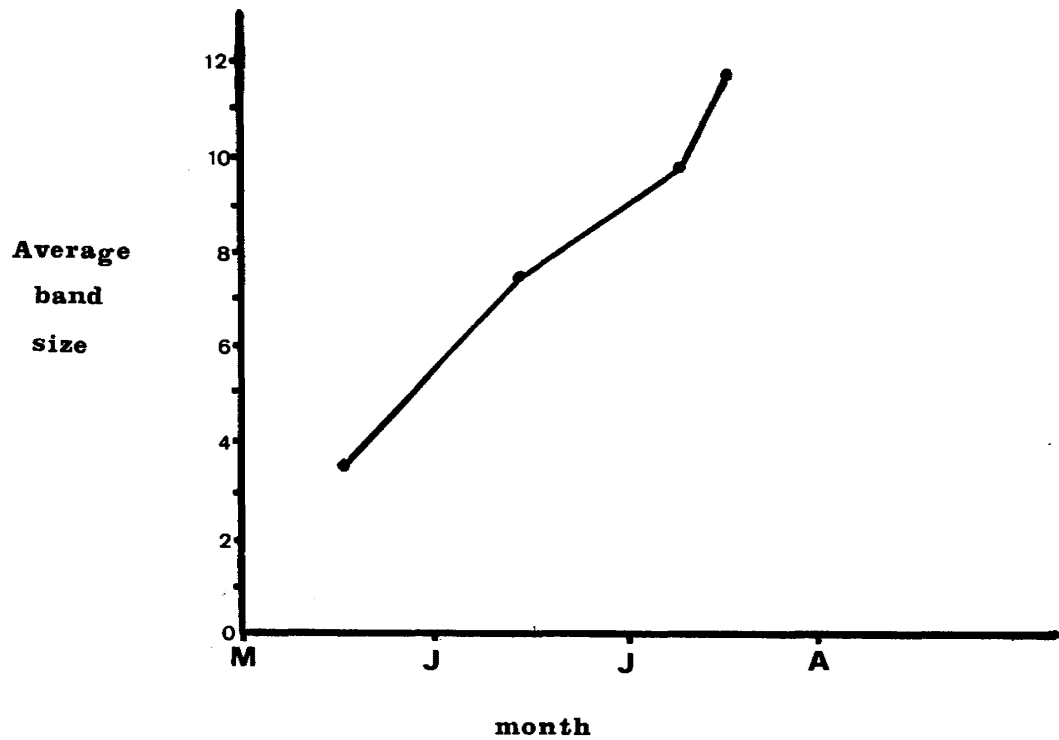


Figure 4. Average nursery band size.

TABLE 2A. AVERAGE NURSERY BAND SIZE

	<u>Sheep Mountain</u>	<u>Mt. Cronin Area</u>
May	4.5 (r= 3.1 - 6.0)	3.4 (r= 2 - 6)
June	5.7	7.5 (r= 2 - 33)
July	20.0 (r= 4 - 96)	9.8 (r= 2 - 38)
August	18.2 (r= 2 - 63)	11.6 (r= 2 - 34)
Overall Average Band Size	12.1	8.0

The composition of nursery bands was based on 123 nursery band observations. Of 920 sheep observed, 204 were classified simply as nursery sheep, ie. ewes, yearlings or young rams. The composition was as follows: 47% ewes, 30% lambs, 20% yearlings and 3% young rams (2 - 3 years old). Hoefs (1975) found that the proportion of young rams in nursery bands on Sheep Mountain varied from 0 - 4%.

#### DISTRIBUTION OF SHEEP

Sheep were never seen west of the Rock River mineral lick and were seen only once south of the south branch of the Rock River. On the June 17 survey, a ewe and a lamb were in that area. Sheep were not observed south of Tetlit Creek. It is of interest to note here that a decayed ram horn sheath was found by D. Mossop on Mt. Sittichinli. Mt. Sittichinli lies midway between the range of the Mt. Cronin population and the Mount Millen population,

51 km to the north.

Table 3 and Figure 5 depict the distribution of rams and nursery bands from May to August 1978, in relation to the Dempster Highway. These figures are derived from the results of aerial surveys. Data is presented in terms of the percentage of sheep occurring in a corridor within 8 km and 16 km of the Dempster.

From Figure 5 it is apparent that more than 50% of all rams observed May - August were within 16 km of the highway. Within 8 km of the highway the percentage of sheep declined from 60% on May to 0% in July and early August. Note that these figures are based only on the results of aerial surveys. Each aerial survey is a record of sheep distribution on one day.

Ground surveys were limited to the western portion of the range (except July 12 - 27 at Tetlit Creek). During those surveys, rams were observed to be within 8 km of the Dempster in May, June, July, August and September. Table 4 and Figure 6 depict monthly ram distribution based upon the results of both survey methods and it is apparent that 11 of 38 rams observed (29%) in July and 7 of 19 (37%) observed in August were within 8 km of the highway.

Aerial survey results indicate that numbers of nursery sheep (ewes, lambs, yearlings and young rams) tended to decline within the 8 km and 16 km corridors over the study period. Our ground surveys also reveal this trend. The results of these surveys are contained in Tables 3 and 5.

It thus appears that rams summer on the western range,

TABLE 3. AERIAL SURVEYS OF MT. CRONIN SHEEP POPULATION, 1978, AND DISTRIBUTION OF SHEEP IN RELATION TO DEMPSTER HIGHWAY.

Date Flown	RAMS			EWES and YEARLINGS			LAMBS			TOTAL SHEEP		
	Total Obsvd	Within* 8 km	Within+ 16 km	Total Obsvd	Within 8 km	Within 16 km	Total Obsvd	Within 8 km	Within 16 km	Total Obsvd	Within 8 km	Within 16 km
++ May 17	5	2	3	17	6	17	-	-	-	22	8	20
May 19	5	3	5	36	15	34	5	3	5	46	21	44
June 17	14	5	8	57	24	30	26	14	16	97	41	54
July 11	20	-	13	43	3	13	18	2	6	81	5	32
Aug. 4**	2	-	2	55	3	28	17	-	9	74	3	39
Aug. 19	17	5	8	55	-	7	26	-	1	98	5	16

\* total sheep count within 8 km of Dempster Highway

+ total sheep count within 16 km of Dempster Highway

\*\* this aerial survey was not complete but is included due to the fact that 74% of the known population was located

++ this aerial survey was incomplete

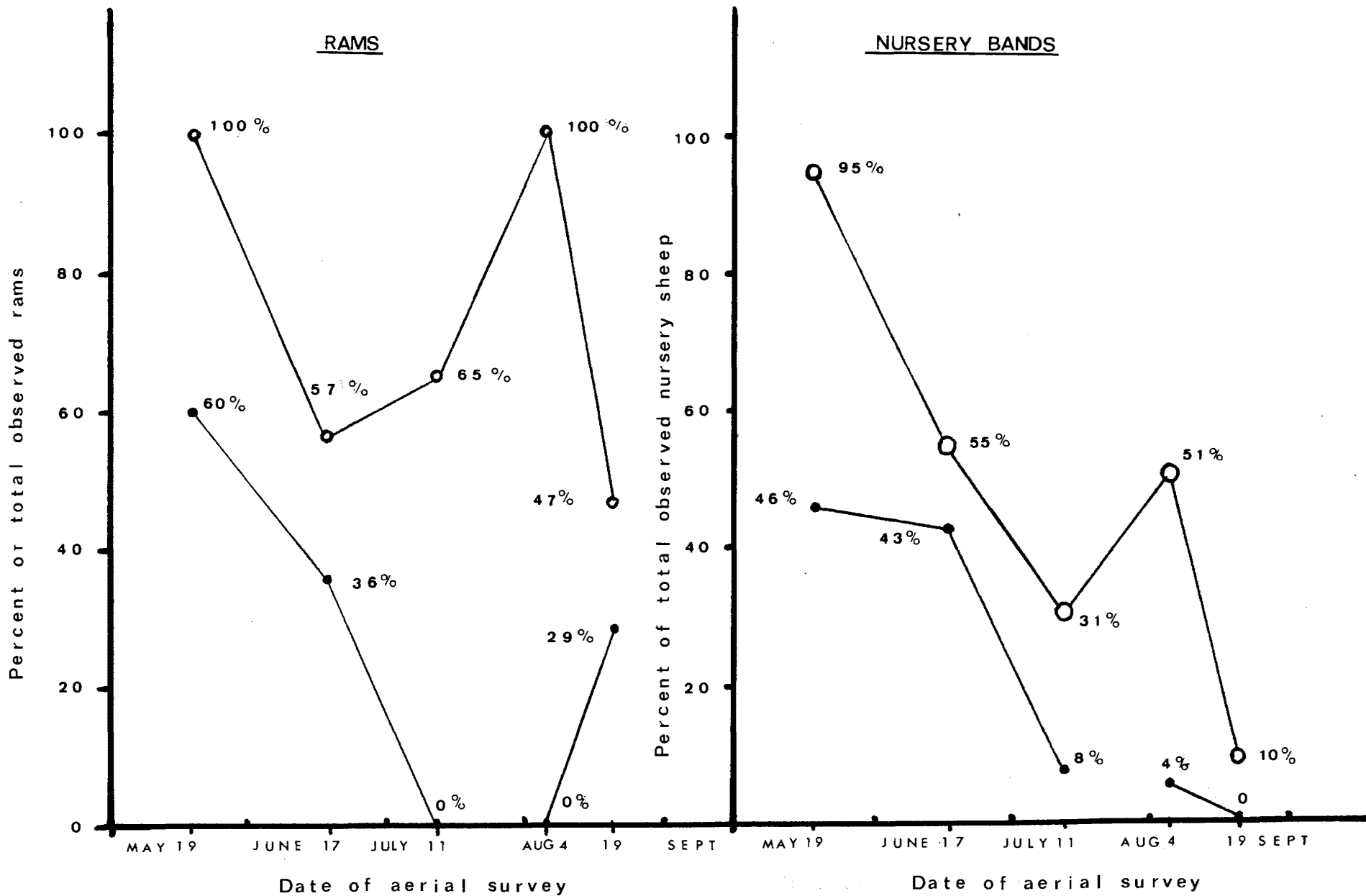


Figure 5. Ram and nursery band distribution in relation to Dempster Highway.

● within 8 km of Dempster

○ within 10 km of Dempster

TABLE 4. \* GROUND AND AERIAL SURVEY SIGHTINGS OF RAMS  
IN MT. CRONIN STUDY AREA MAY TO SEPTEMBER, 1978.

<u>Date</u>	<u>No. Rams Observed</u>	<u>Map Location</u>
* May 17	1, 1, 1, 2	1, 2, 3, 4
* May 19	2, 2, 1	5, 6, 7
May 20	2	8
June 2	4	1
June 4	1, 1	2, 3
June 8	3	4
June 9	3	5
June 10	3, 3, 1	6, 7, 7a
June 12	1, 4	8, 9
June 14	3	10
June 15	4	11
June 16	3, 4, 3	12, 13, 14
* June 17	3, 2, 1, 3, 1, 2, 3, 2	15, 16, 17, 18, 19, 20, 21
June 28	2	23
June 29	1, 1	24, 25
July 1	1	1
July 3	5	2
July 6	1	3
* July 11	11, 2, 7	4, 5, 6
July 12	2	7
July 13	1	8
July 15	3	9
July 21	1	10
July 22	1	11
July 23	1	12
July 24	1	13
July 25	1	14
* August 4	4, 1	1, 2
August 8	2, 1	3, 4
* August 19	2, 3, 8, 1	5, 6, 7, 8
September 1 (pers.comm. Barney Smith)	2	9

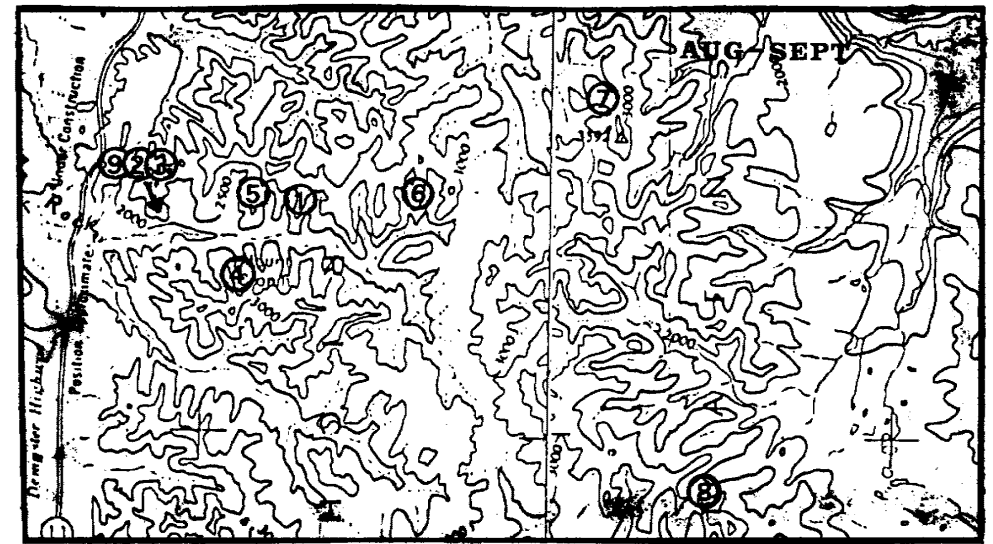
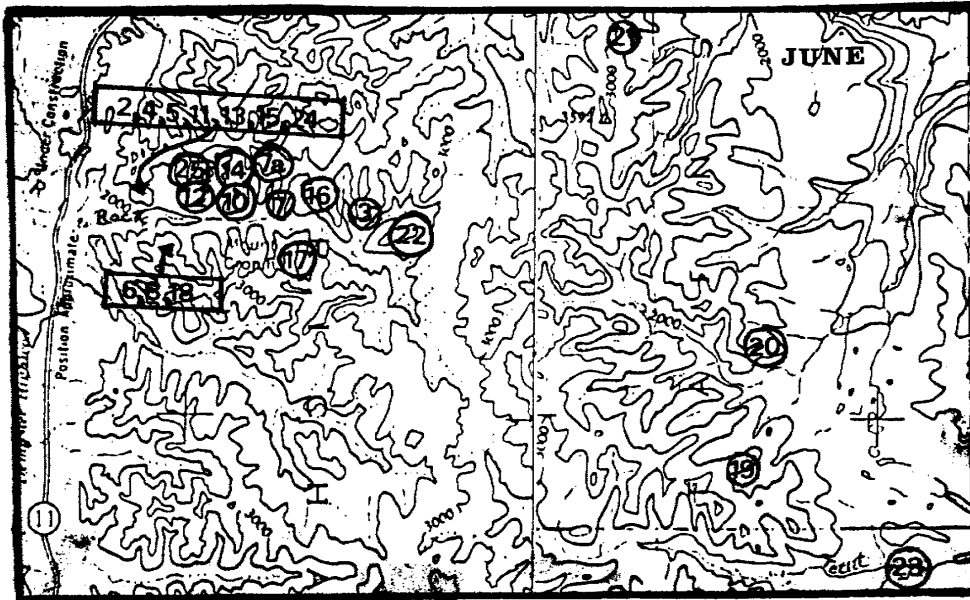
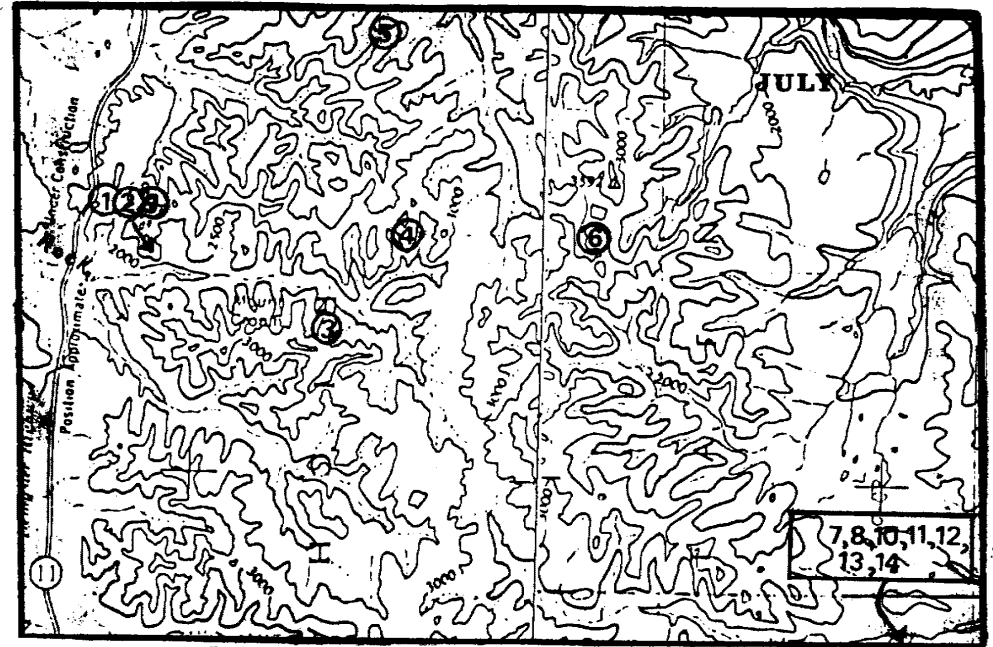
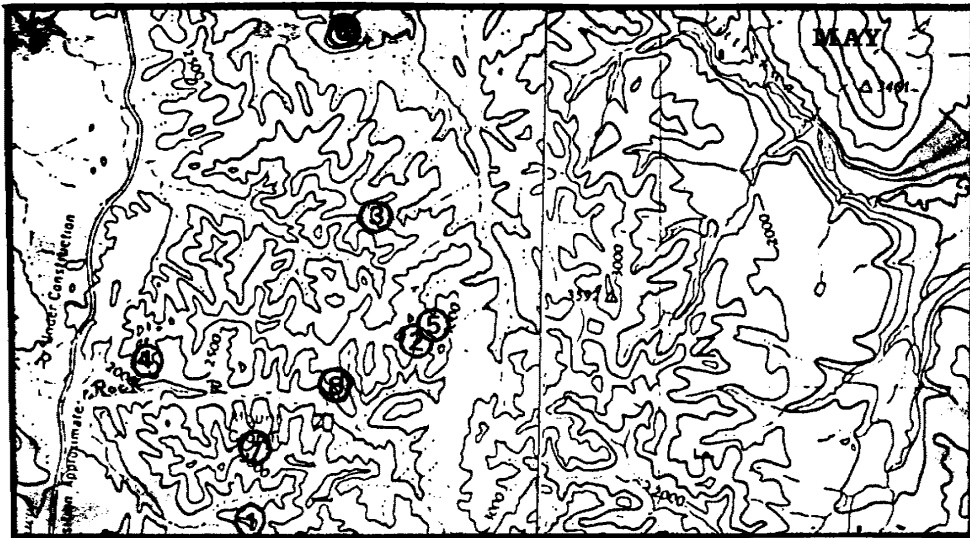


Figure 6. Monthly ram distribution based on ground and aerial surveys. Refer to Table 4.

TABLE 5. \* DAILY SHEEP COUNTS OBTAINED BY GROUND SURVEY FROM ROCK RIVER CAMP

Date	Total Number Sheep	Ewes	Rams	Yearlings	Lambs	Nursery
May 18	9	4	-	1	-	4
May 20	28	11	2	7	2	6
May 23	-	-	-	-	-	-
May 24	-	-	-	-	-	-
May 25	-	-	-	-	-	-
May 29	6	4	-	2	-	-
May 30	9	-	-	2	-	7
May 31	29	11	-	6	4	8
June 1	1	1	-	-	-	-
June 2	20	5	4	5	-	6
June 3	29	13	-	6	10	-
June 4	46	17	2	9	13	5
June 5	21	9	-	6	6	-
June 6	37	11	-	6	15	5
June 7	59	22	-	9	22	6
June 8	54	25	3	11	14	1
June 9	41	16	3	11	10	1
June 10	55	21	7	7	14	6
June 11	20	8	-	4	7	1
June 12	17	-	5	-	-	12
June 13	-	-	-	-	-	-
June 14	10	-	3	1	-	6
June 15	31	11	4	3	9	4
June 16	13	1	10	-	-	-
June 28	7	4	-	2	1	-
June 29	7	3	2	1	1	-
June 30	13	8	-	1	4	-
July 1	6	3	1	-	2	-
July 2	5	3	-	-	2	-
July 3	10	3	5	-	2	-
July 4	-	-	-	-	-	-
July 5	-	-	-	-	-	-
July 6	16	9	1	2	4	-
July 7	-	-	-	-	-	-
July 8	-	-	-	-	-	-
July 9	12	1	-	-	-	11
July 15	15	1	3	-	1	10
Aug. 5	-	-	-	-	-	-
Aug. 6	-	-	-	-	-	-
Aug. 7	-	-	-	-	-	-
Aug. 8	12	5	3	1	2	-
Aug. 9	3	2	-	-	1	-
Aug. 14	-	-	-	-	-	-
Aug. 15	8	2	-	-	2	-
Aug. 16	-	-	-	-	-	-
Aug. 17	1	-	-	-	-	-
Sept. 1 **	2	-	2	-	-	-

\*\* (Pers. comm. B. Smith)

\* These counts do not include sheep observed at Tetlit Creek mineral lick.

mostly north of the Rock River, and ewes summer on the eastern range and the southwestern range south of the Rock River (Figures 8, 9, and 10). This portioning of rams and nursery bands was noted by Hoefs during the summer of 1977. Although our findings are in general agreement with Hoefs' findings, the segregation is not complete. Both rams and nursery sheep could be found on the western and on the eastern parts of the range from May to August.

Figure 7 is a map of the study area delineating the proposed summer ranges of the population based on aerial and ground surveys. (It is important to note that about 50 per cent of the expected ram population was not located and it is conceivable that they summer beyond the bounds of the study area.) There may be a number of summer ranges rather than one and only further study and familiarization of researchers with the movements of these sheep (especially in relation to mineral licks) will elucidate this. Possible winter range areas are discussed in the section on critical areas.

That the mountains in the southeast corner are possibly a major ewe summer range is indicated by counts of nursery sheep on those mountains as follows:

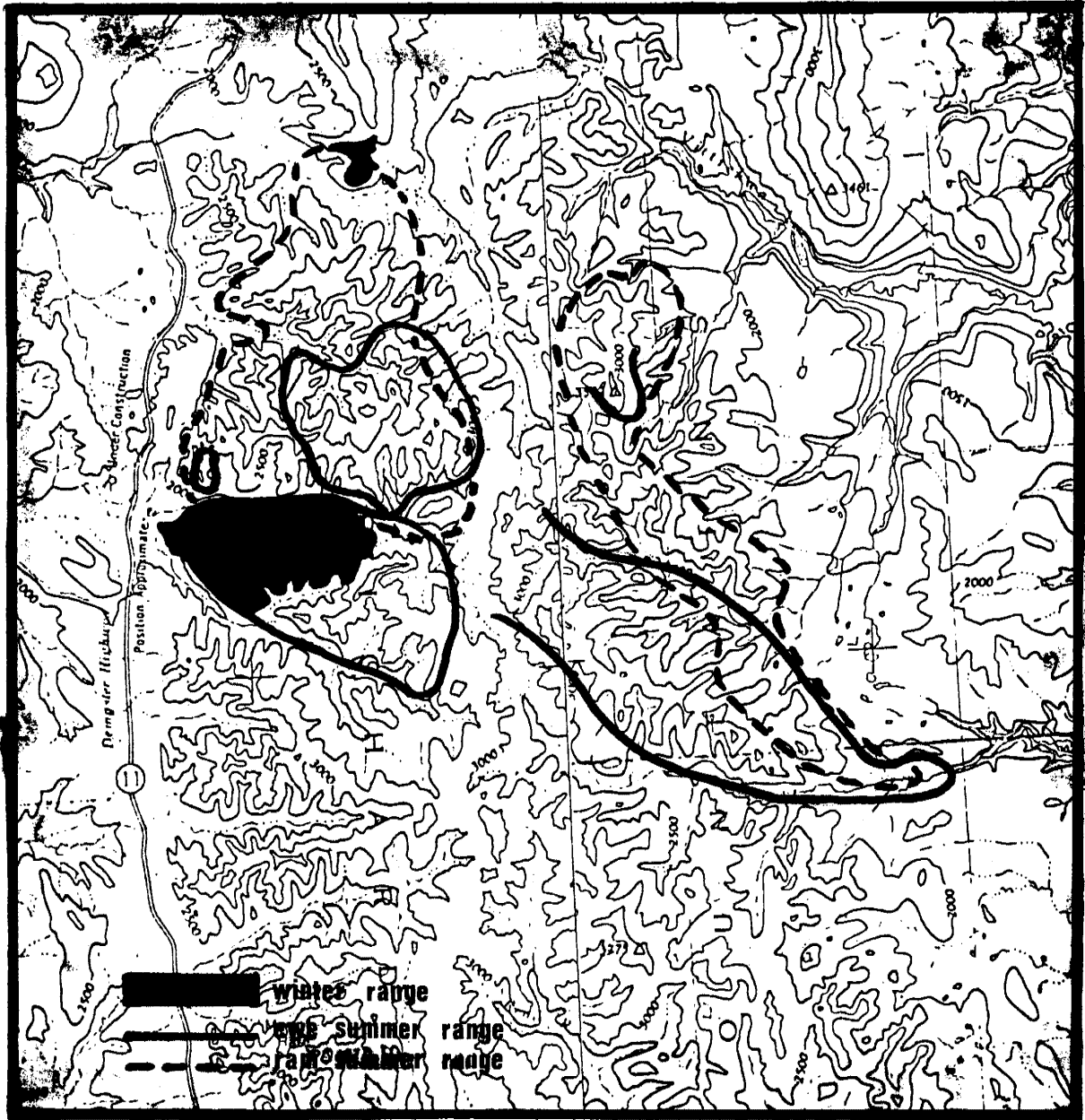
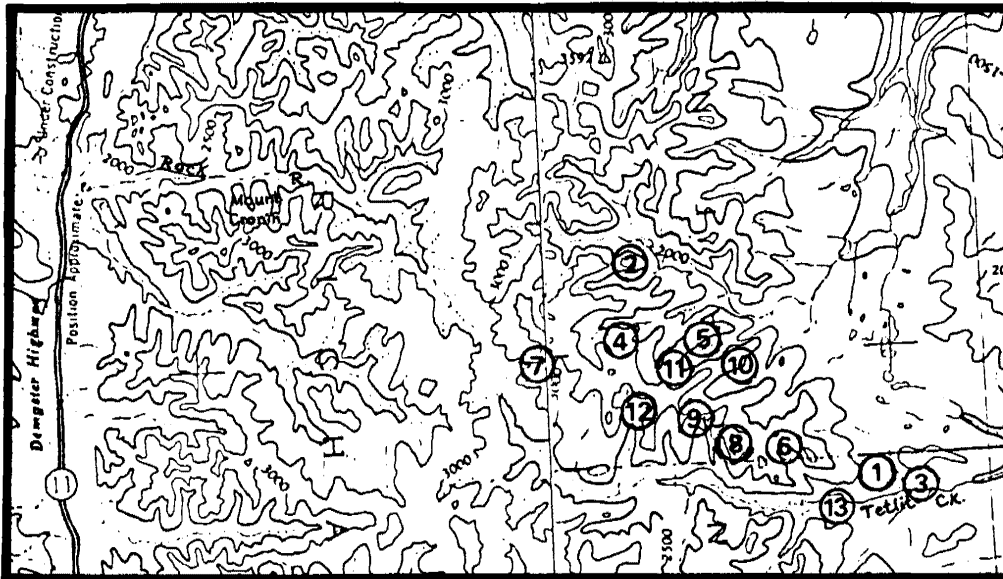


Figure 7. Proposed summer and winter ranges of Mt. Cronin population.

<u>Date</u>	<u>Map Location</u>	<u>Total Nursery Sheep</u>	<u>Size of Nursery Bands</u>
June 17	1, 2	32	23 - 9
*June 28	3	34	34
July 11	4, 5	42	38 - 4
July 14	6	20	20
*July 16	3	21	21
*July 25	3	22	22
Aug. 4	7	34	34
Aug. 19	8, 13	75	38 - 16 - 7 - 6 - 4 - 3

\* nursery bands on Tetlit Creek mineral lick



Survey band locations in south-east portion of study area.

The fact that the majority of rams frequent the western half lends support to Hoefs' concern about the vulnerability of rams to hunting. On the August 19 flight, 8 rams were located within easy hiking distance of the Dempster. In February of this year, after Hoefs' concerns were published, 4 sheep, of which

3 were rams, were illegally shot approximately 6.4 km east of the Dempster in the northern end of the Mt. Cronin study area.

Ground surveys gave insight into the projected vulnerability of this population. Our base camp on the Rock River was an easy 2-hour hike from the Dempster Highway crossing (Figure 11). Our ground surveys, with two exceptions, were day hikes along the ridge systems north, south and east of our camp. The gain in elevation from the highway at 2000' to the ridge tops (3000') is an easy 1000'. Once on the ridge-tops, a 'grandmother in tennis shoes' could walk with ease for many miles. See Figure 12, which is a photograph taken along a typical ridge top. Table 5 gives a good indication of numbers of sheep one could encounter May to September simply by hiking in from the Dempster.

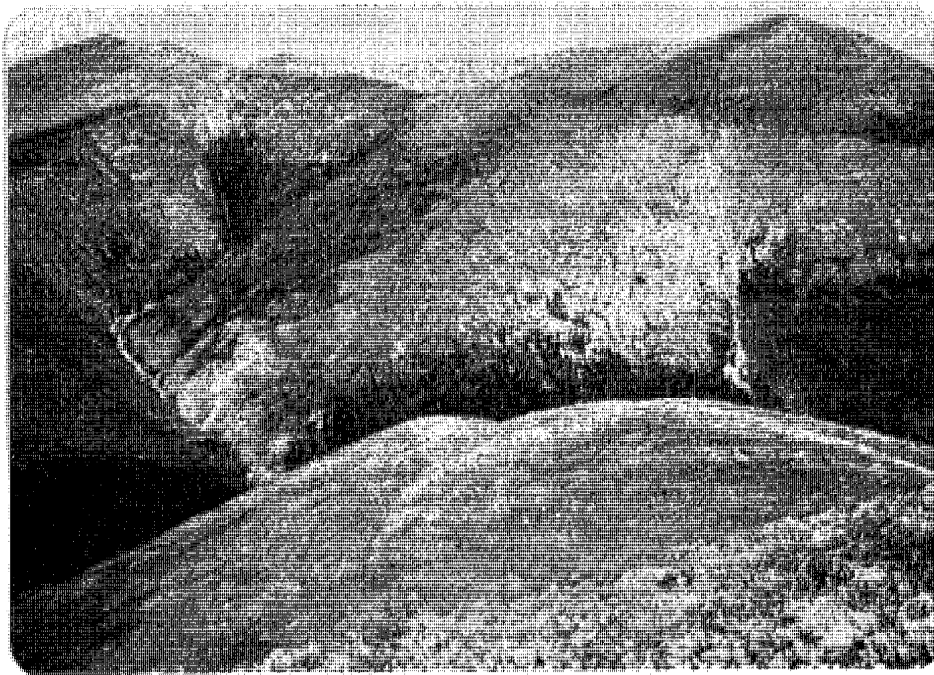


Figure 8.  
Ram and ewe summer  
range north and  
south of Rock River,  
respectively.  
Note nursery band  
of 9 sheep on  
Ridge F, July 6/78.

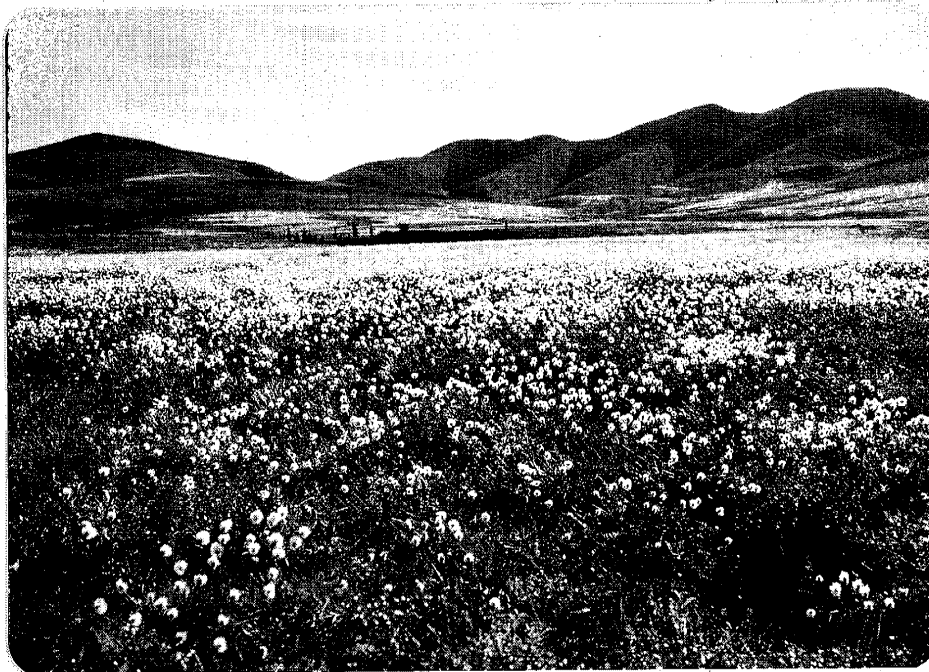
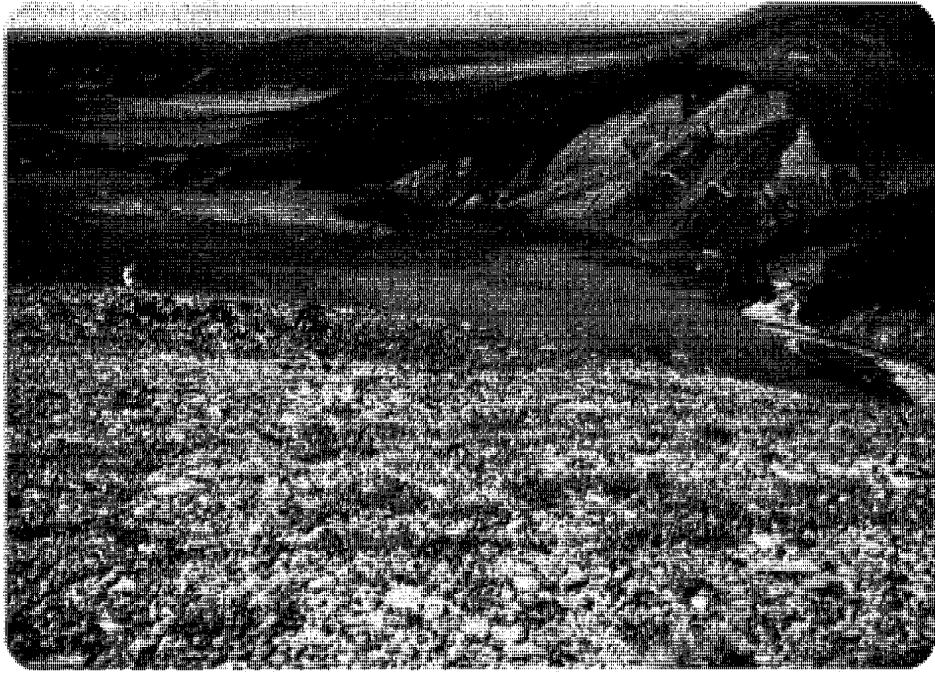


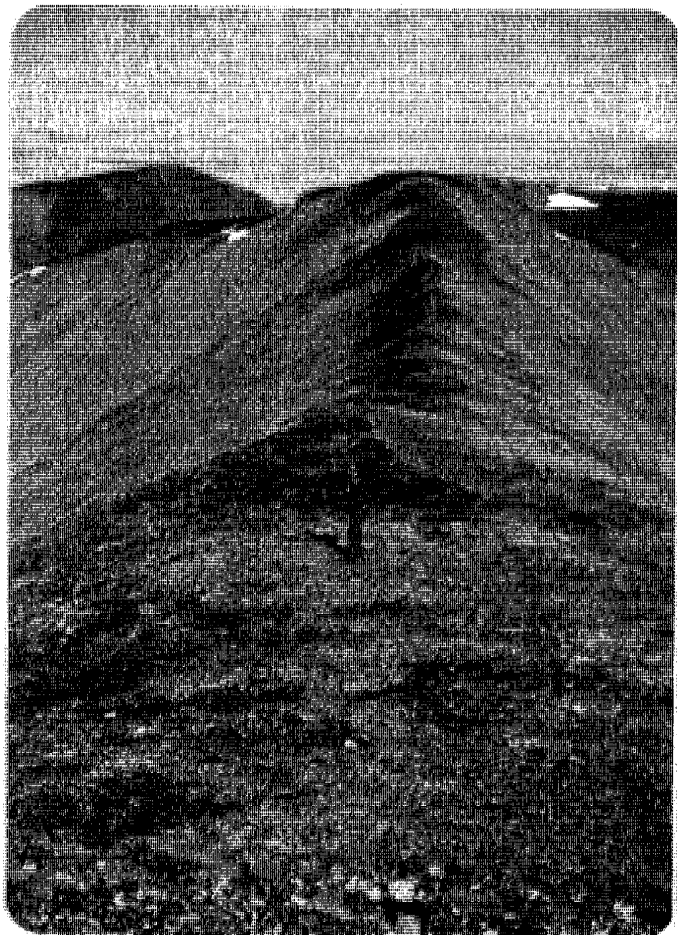
Figure 9.  
Richardson Mtns. -  
ewe summer range.



Figure 10.  
Mineral lick and  
ewe summer range  
to the west.



*Figure 11. Base camp on Rock River, mineral lick and Dempster Highway in background.*



*Figure 12.  
"Grandmother in tennis shoes" ridge and trail on south side of Rock River.*

## SNOW CONDITIONS

Snow conditions are a factor in the distribution and movement of most mammals. Upon arrival in the study area May 17, the researchers found that many south and southwest-facing aspects of slopes and lowland areas were snow-free but other aspects including most ridge tops were still snow-bound. All rivers in the area were frozen. It was snowing in the area May 21 to 26, June 14 and August 15.

Numerous extensive snow patches still remained as of June 5, whereas by July 8 only very small patches of snow remained at the heads of snow melt drainage channels (Figures 13, 14, 15). The lowland divide which is oriented in a north-south direction and which separates the western and eastern halves of this population's range remained snow-bound much later into the summer than did the western region. The western half appeared from aerial surveys to have much less snow than the eastern half. The Richardson Mountains are higher and more rugged east of the divide. The validity of these observations could be examined and documented by using available LANDSAT imagery which provides coverage of this area every 9 days.

These differential snow conditions and the associated phenological progression of vegetation may be a significant factor in the distribution of sheep in some or all years.

Assuming that snowmelt was most advanced and snow conditions more favourable on the western range, the observed concentration of the Mt. Cronin population on the west until mid-June could be directly or indirectly related to this phenomenon.

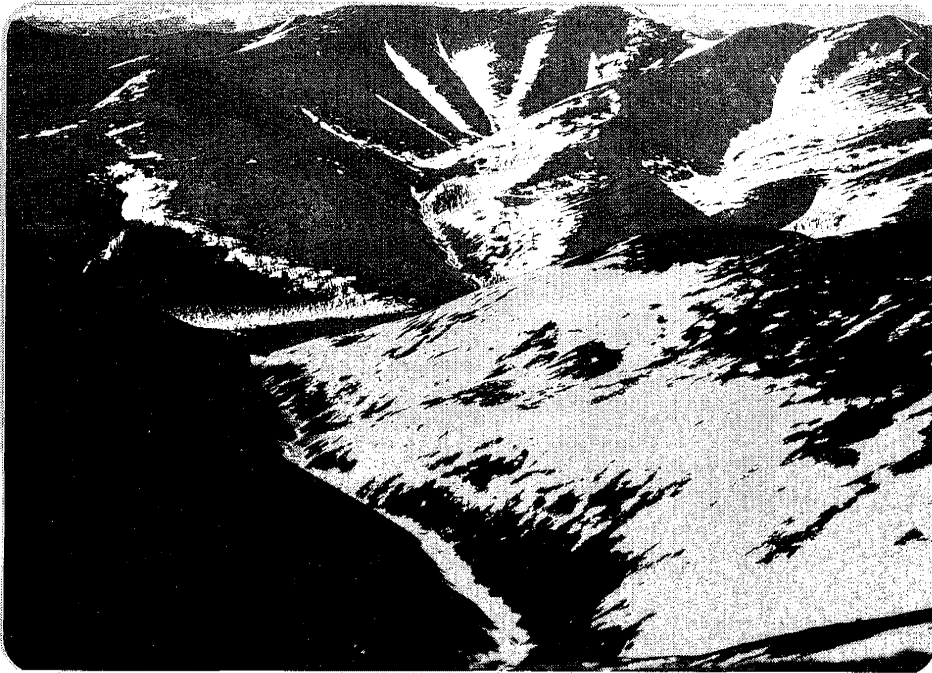


Figure 13.  
Extensive snow patches, Ridge C, May 31, 1978.



Figure 14.  
Snow patches on Ridge D, June 5, 1978. Five ewes and 5 lambs on saddles of ridge.



Figure 15.  
Little snow remains by July 8, 1978. Ridges A and B.

### LAMBING PERIOD AND PROGRESSION OF LAMBING

Lambs were first observed during the May 19 survey when 5 were seen, all very young and isolated with their ewes. A brief flight May 17 did not locate any lambs although 32 sheep were observed. Table 6 presents the results of some ground surveys and all complete aerial surveys and indicates the progression of lambing.

TABLE 6. PROGRESSION OF LAMBING, 1978

---

<u>Date Observed</u>	<u>Number of Lambs Observed</u>	<u>Census Method</u>
May 19	5	aerial survey
June 3	10	ground survey
June 4	13	ground survey
June 6	15	ground survey
June 7	22	ground survey
June 17	26	aerial survey
July 11	18	aerial survey
August 19	26	aerial survey

---

The peak of lambing (when half of year's lambs have been born) may have occurred around June 3 or 4 but this was difficult to ascertain. Weather conditions from May 20 - 28 did not permit surveillance of the cliff areas. From June 3 - 7, the ground survey count increased from 10 lambs to 22 lambs. As it was difficult to get an accurate and reliable count in this terrain,

we cannot conclude that most lambs were born during this period. We can conclude that lambing began at the latest by May 19 and was likely completed by June 7. During mid and late summer aerial surveys no more than 26 lambs were counted. No lamb births were observed.

This lambing period is later than that reported by Hoefs (1975) for the Sheep Mountain population, May 1 - June 2, in Kluane Park, Yukon. The lambing period in this study does coincide with some lambing periods reported in studies of Alaskan Dall sheep (from Hoefs, 1975). See Table 7.

TABLE 7. A COMPARISON OF YUKON AND ALASKA LAMBING PERIODS

---

<u>Year</u>	<u>Start of Lambing</u>	<u>End of Lambing</u>	<u>Location</u>
1971-72	April 30	June 2	Sheep Mtn., Kluane Park, Y.T.
1973	May 9	*	Western Ogilvie Mtns., Y.T. (480 km north of Sheep Mtn)
1973	May 15	June 15	Mt. Goodenough, Y.T. (832 km north of Sheep Mtn.)
1978	May 19	June 7	Mt. Cronin, Y.T. (672 km north of Sheep Mtn.)
*	June 1	*	Alaska
1938	early May	late June	Alaska
1963	May 18	*	Alaska
1968	May 17-20	June 4	Peters Creek, Alaska
*	June 19	*	Surprise Mtn., Kenai Peninsula, Alaska

---

\* data not available. Please see Hoefs (1975) below:

*"It is likely that the later beginnings of the lambing periods in certain areas of Alaska are an adaptation to a delayed plant development of such more northern latitudes. Lambs will be born at a time of year which is most advantageous for them."*

When the researchers entered the study area May 17, many south and southwest-facing slopes were snow-free but most of the area was dominated by large, extensive snow patches as discussed in another section. Table 8 compares the phenology of some plants recorded by Hoefs (1975) on Sheep Mountain (1969-1973) with those data noted in the Mt. Cronin area (1978).

TABLE 8. COMPARISON OF FLOWERING DATES FOR SHEEP MOUNTAIN (1969-1973) AND MT. CRONIN AREA (1978)

Plant Species	Date of First Flowering Mt. Cronin area	Sheep Mountain, Kluane Park
<i>Anemone parviflora</i>	May 23	May 12- 20
<i>Arctostaphylos rubra</i>	May 23	May 12 - 20
<i>Anemone drummondii</i>	May 25	June 3 - 18
<i>Saxifraga oppositifolia</i>	June 2	May 14 - 28
<i>Cassiope tetragona</i>	June 10	June 8 - 18
<i>Anemone multifida</i>	June 14	June 6 - 13
<i>Ledum palustre</i>	June 29	July 5 - 11
<i>Lupinus arcticus</i> *	June 29	May 19 - 29
<sup>a</sup> <i>Vaccinium vitis-idaea</i>	July 10	July 3 - 9

\* discrepancy may be due to the fact that *Lupinus arcticus* in the Mt. Cronin area was restricted to late snowbed areas.

From Table 8 there appears to be an approximate one-week delay in the phenological development of plants in the Mt. Cronin area compared with Sheep Mountain. (The number of species compared is small and there is data for only one year in the Mt. Cronin area,

but the trend is apparent.)

The later lambing period in the Mt. Cronin area could be related to the area's comparatively later plant phenology. The similarity of the Mt. Cronin lambing period to that of Mt. Goodenough and the relative lateness of the Alaskan periods supports the correlation between latitude, plant development and lambing period.

## CRITICAL AREAS

Included in this section:

- A) Lambing grounds
- B) Mineral licks
- C) Wintering range
- D) Movement routes

### A. LAMBING GROUNDS

Many researchers have found that ewes select primarily broken, rugged cliffs to lamb in (Geist, 1971) but it is acknowledged that there are exceptions to this. Ewes have given birth in open terrain and on small, forested knolls and Geist postulates that in some areas patches of timber and scattered bushes substitute for cliffs as lambing habitat. It is also generally acknowledged that most lambing areas are associated with winter ranges and that sheep, at least nursery sheep, return to them every winter.

In the western half of the Mt. Cronin area, a number of

cliff areas were located and mapped (Figure 16). Only those cliff areas which provided at least ledges and/or recesses subjectively considered usable by sheep were noted. Further investigation of the study area will give a more comprehensive picture of available cliff habitat and utilization of that habitat.

With one exception, ewes with lambs seen during the May 19 aerial survey were in close proximity to cliff areas which are dispersed throughout an area within 8 km of the Dempster Highway (Figure 17). Of the known lamb crop of 26 lambs, 22 (85%) were observed within this area June 7. Also, 54% of ewes with lambs seen during the June 17 aerial survey were observed within this area, within 8 km of the highway (Figure 17). The western extremity of this area is 2.4 km east of the Dempster and extends eastward for approximately 6.4 km.

Nursery bands of ewes, lambs, yearlings and young rams were most frequently observed on or in close proximity to the cliffs of ridges B, C, D, E and F on the south side of the Rock River (see Figure 2). The cliffs of ridges D, E, and F were most rugged, being 33 - 49 m high and were characterized by numerous recesses, ledges and columns at varying heights above the snow melt drainage channel below them. Extensive and steep (30 - 35°) scree slopes extended from the cliffs to the ridge tops above and also extended below the cliffs. Figures 18, 19 and 20 depict some of these cliff areas.

Geist and other authors (Geist, 1971) found nursery bands remained near their lambing grounds for 3 - 4 weeks after the

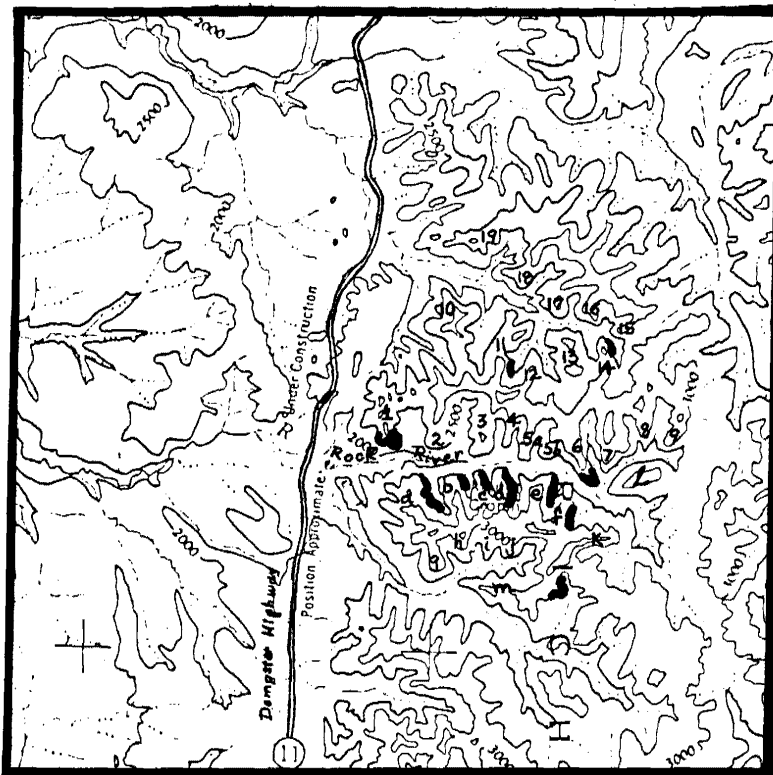
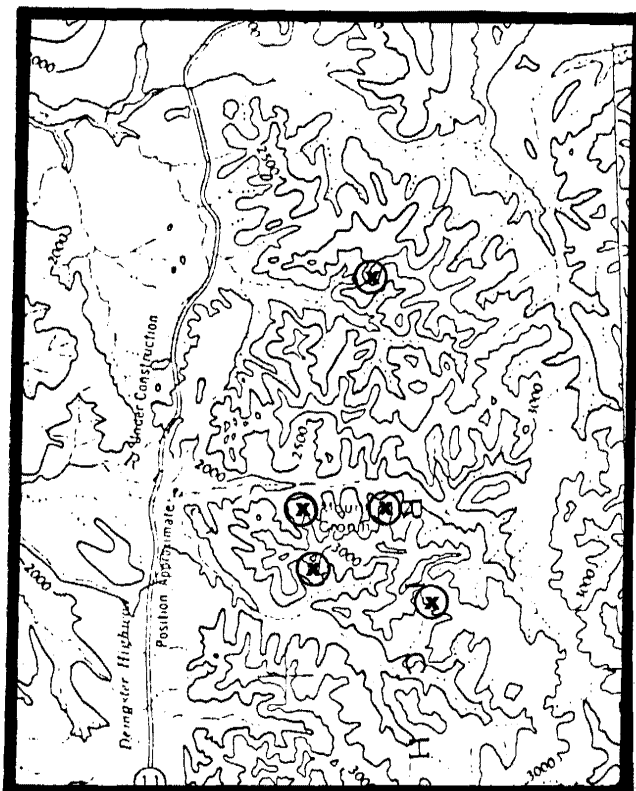
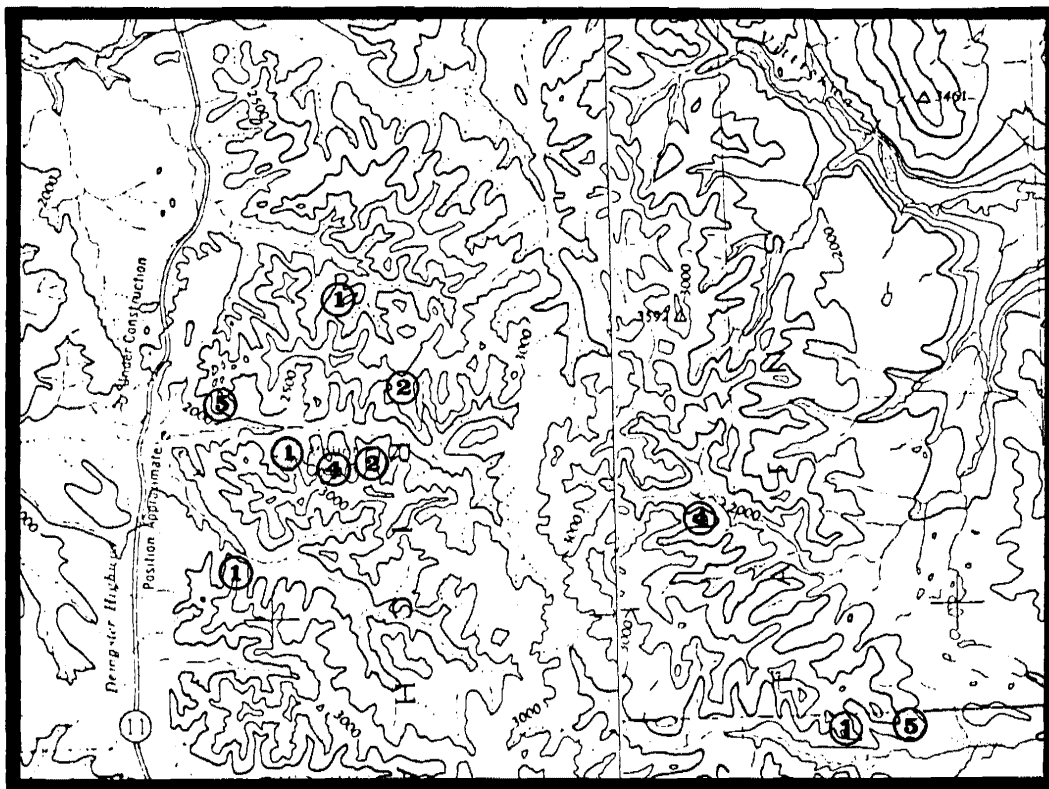


Figure 16. Map of some cliff areas on western half of Mt. Cronin study area. Cliff areas are outlined. Letters and numerals designate ridges.



May 19, 1978

⊗ = 1 ewe and 1 lamb



June 17 Nos refer to lambs seen

Figure 17. Locations of ewes with lambs sighted during May 19 and June 17 aerial surveys.

lambing period. This appears to hold true for the Mt. Cronin population. Nursery bands remained within the aforementioned ridge system until mid-June when they dispersed eastward and perhaps northward. Table 9 gives the ground survey lamb counts obtained in this ridge system for the period June 3 - 9. It is interesting also to note that yearling counts for May 20, June 4, 7, 8, 9 within these ridges were 7, 9, 9, 11, 11 respectively.

TABLE 9. NUMBERS OF LAMBS OBSERVED ON RIDGES, JUNE 3-9, 1978.

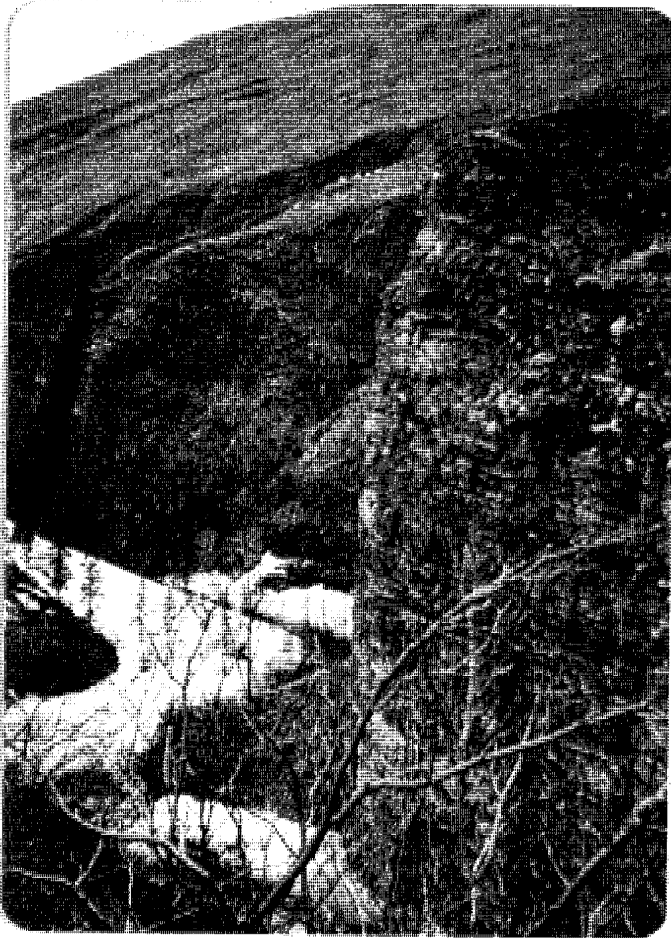
Date	B	C	R I D G E		F	8	Total Lambs
			D	E			
June 3		5	5				10
June 4	4		4	5			13
June 6	3	2	1	5	2	2	15
June 7	4		7	5	6		22
June 8	1			13			14
June 9	2	2	3	3			10

This ridge system is proposed to be a major lambing area. The numbers of lambs observed in this area within the 3-week period following the commencement of lambing, the habitat they utilized and the fact that 4 of 5 lambs seen during the May 19 aerial survey were located here, support this proposal.

One ewe and lamb were seen on ridge 18, north of the south branch of the Cornwall River and 8 km north of the Rock River. No cliffs were observed in this area, but a

small area may have been overlooked. The ewe may have lambed in the steep, open scree slopes or in the timber at the base of the ridges along the Cornwall River.

Of obvious and immediate concern is the necessity of minimizing disturbance to lambing grounds prior to, during, and for 3 - 4 weeks after lambing.

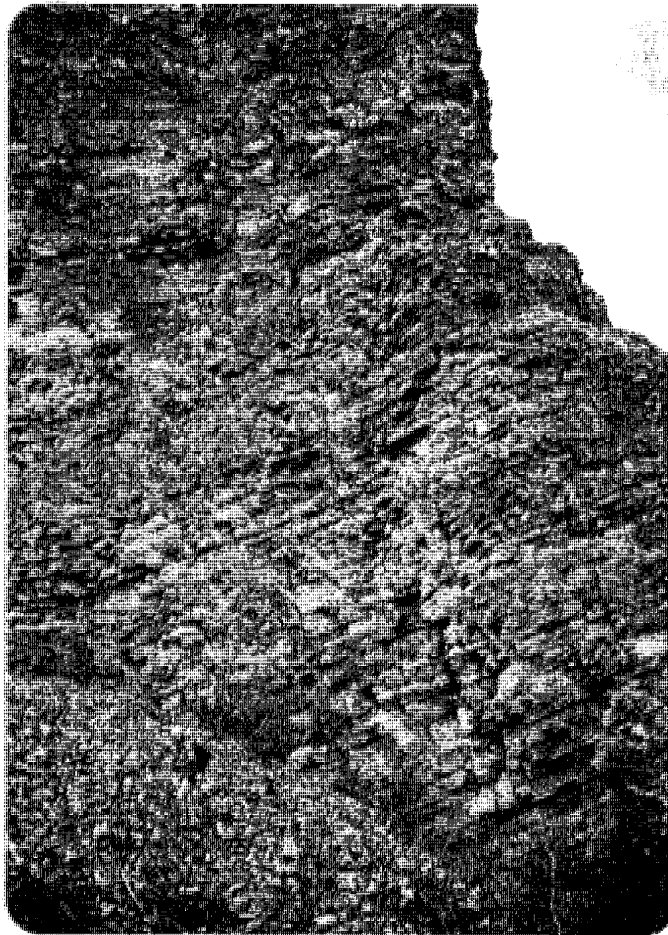


*Figure 18. Sheep in bluffs above cliff areas on south side Rock River.*



*Figure 19. Steep scree slopes above cliff areas.*

*Figure 20. Cliff area on south side of Rock River.*



## B. MINERAL LICKS

Geist (1971) states:

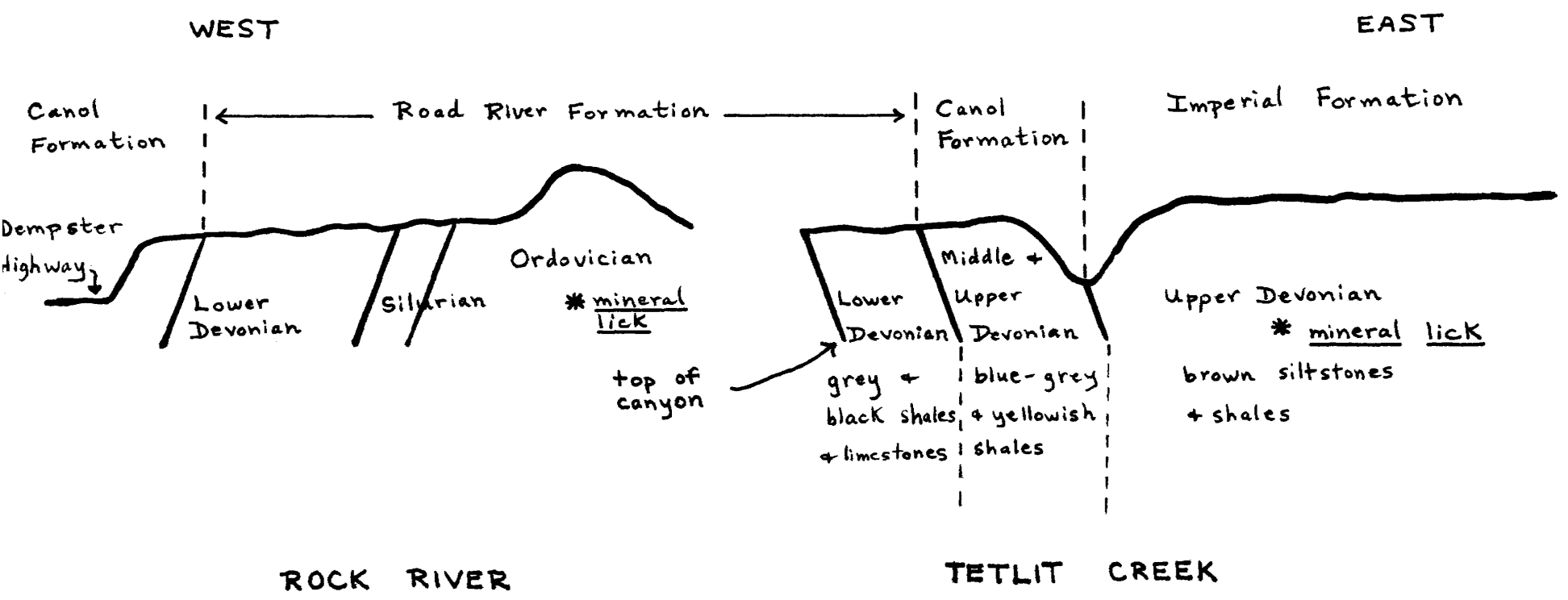
*"The skeleton appears to function as a reserve of mineral salts for dissolution in winter when forage with an adequate mineral supply is not available. Growing, molting and lactating ungulates attempt to restore the lost deposits and satisfy the increased demands of the body in spring and summer by utilizing mineral licks. Licks often afford escape terrain as well."*

Two mineral licks used by sheep were located within the range of the Mt. Cronin sheep population, on the Rock River and on Tetlit Creek (Figure 2). Sheep were observed on these licks throughout the study period. Samples of substrate and sheep pellets were collected from both licks and await mineral analysis. Geologists working in the area indicated that they expected the sedimentary rocks within which the licks are situated to be sulphur rich and that sodium chloride and potassium chloride salts were present in the Tetlit Creek lick sites. The geologists also provided a schematic drawing of the geology of the rock formations (Figure 21).

A table of sheep use of the two mineral licks is contained in Appendix B.

### Rock River Lick:

The Rock River lick site on the western flank of the Richardson Mountains, 2.4 km east of the Dempster, is vulnerable and easily accessible to man year-round. When the researchers arrived May 17, snowmobile tracks led from the Dempster upriver past the cliff face which forms this lick. After the ice had left the river, spent



Geology by A.C. Lenz + R.W. Macqueen.

Figure 21. Schematic drawing of geology of Rock River and Tetlit Creek mineral lick areas.

rifle cartridges were found on a gravel bar below the cliff. (It is not inferred that these two facts are directly related to each other). The cliff face also affords sheep excellent escape terrain and is possibly a lambing area.

Figures 11, 22, 23, 24, 25 depict the cliff face and sheep using it. Sheep licked at many different sites on the face and primarily on the lower half of it. The cliff face was observed daily, but it was not possible to conduct time-use studies on individuals due to the physiography of the face. Individuals or groups were often seen on the face in early morning or they would arrive later in the day. Individuals and groups usually remained for the duration of the day on the lick until evening and sometimes were still there the next morning. Figure 26 depicts the number of sheep observed on the lick from May to September. Use appears to be pulse-like, perhaps indicating that groups of sheep were within the general area for a number of days and individuals used the lick for varying lengths of time. There was no evident decline in the numbers of sheep using the lick from May to September.

An indication of the preference of the different population cohorts for use of the lick is summarized in Table 10.

From Table 10, there is an overall significant variation among samples, but sheep use of each lick is not significantly different from expected. There was no overall significant difference in ewe and yearling numbers among the two licks and the population. There were significantly fewer rams at Tetlit Creek than at Rock River and in the population. The number of rams using the Rock River lick was not significantly different from expected (i.e. their proportion in the population). This may reflect the fact that the majority of rams

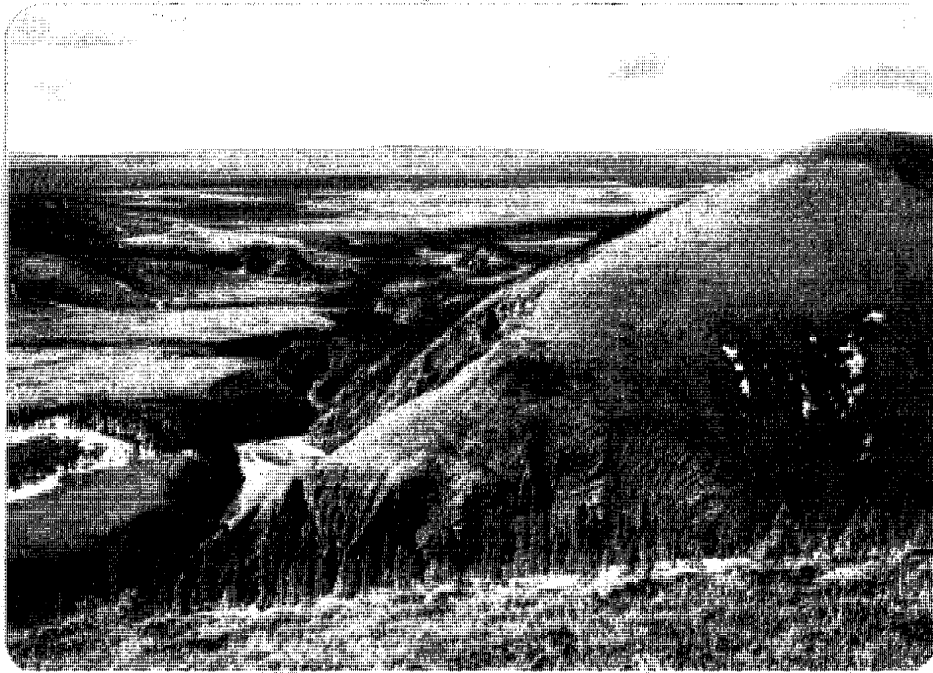
TABLE 10. CHI-SQUARE TEST OF RAM, EWE, YEARLING AND LAMB USE OF ROCK RIVER AND TETLIT CREEK MINERAL LICKS.

Segment	Comparisons tested			x <sup>2</sup>	df	level of sign
	Rock River	Tetlit Creek	Population			
All	X	X	X	16.23	6	0.05
All	X	X		15.62	3	0.01
All	X		X	4.66	3	NS
All		X	X	5.44	3	NS
Rams	X	X	X	11.51	2	0.01
Rams	X	X		11.59	1	0.01
Rams	X		X	1.33	1	NS
Rams		X	X	5.45	1	0.05
Lambs	X	X	X	7.92	2	0.05
Lambs	X	X		7.46	1	0.01
Lambs	X		X	3.99	1	0.05
Lambs		X	X	0.55	1	NS

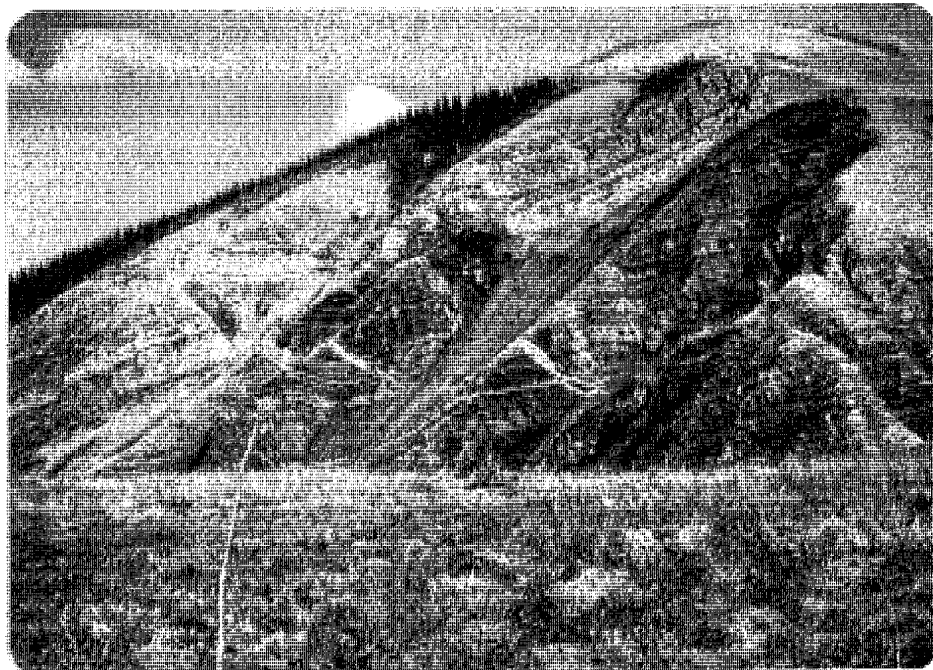
appear to summer on the western half of the study area. These results should be interpreted with caution, for as previously mentioned, all rams in this population may not have been accounted for. Similarly, lambs were not observed on the Rock River lick until June 9, probably because they remained secluded close to the lambing cliffs.

The number of lambs at Tetlit Creek was significantly greater than at Rock River. The number of lambs at the Rock River lick was significantly less than expected in the population. This may reflect the eastward shift of nursery groups onto summer range.

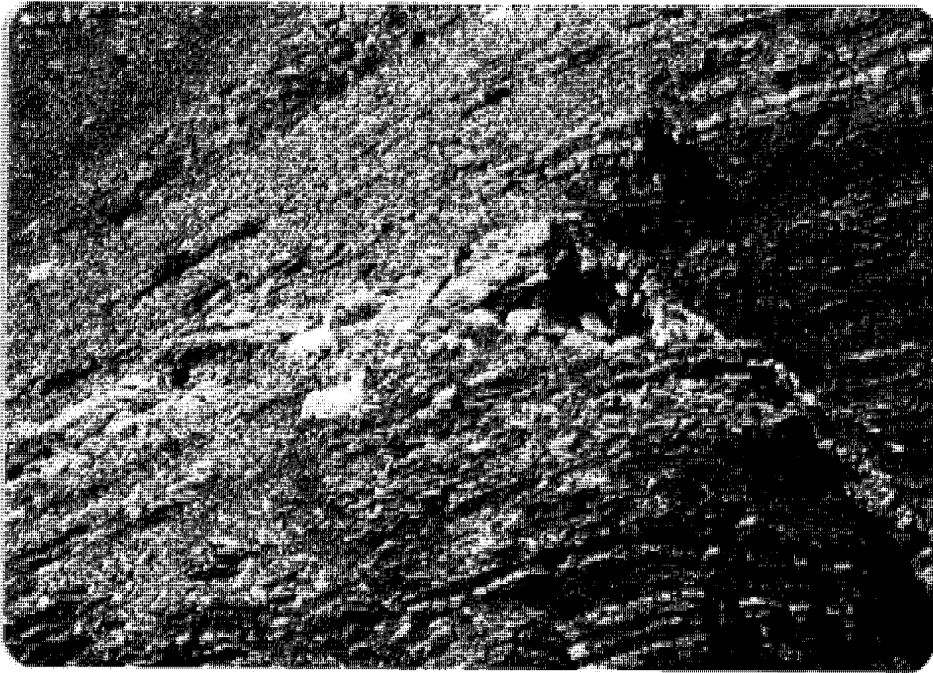
Conclusions are somewhat speculative at best. Data on lick use would be greatly augmented by a marking program, whereby frequency of use by individuals and by groups could be determined. For example, two groups of 21 and 23 sheep appeared at the lick 9 days apart (July 16 and 25). The group of 23 had one more ewe, ram and lamb and one less yearling than the group of 21. Were they the same sheep?



*Figure 22. Rock River mineral lick with Dempster Highway in background.*



*Figure 23. Seven sheep on cliff face of Rock River mineral lick, June 9, 1978.*



*Figure 24.*  
*Three rams resting at*  
*Rock River mineral lick*  
*in June.*



*Figure 25.*  
*Seven sheep on Rock*  
*River mineral lick, June.*

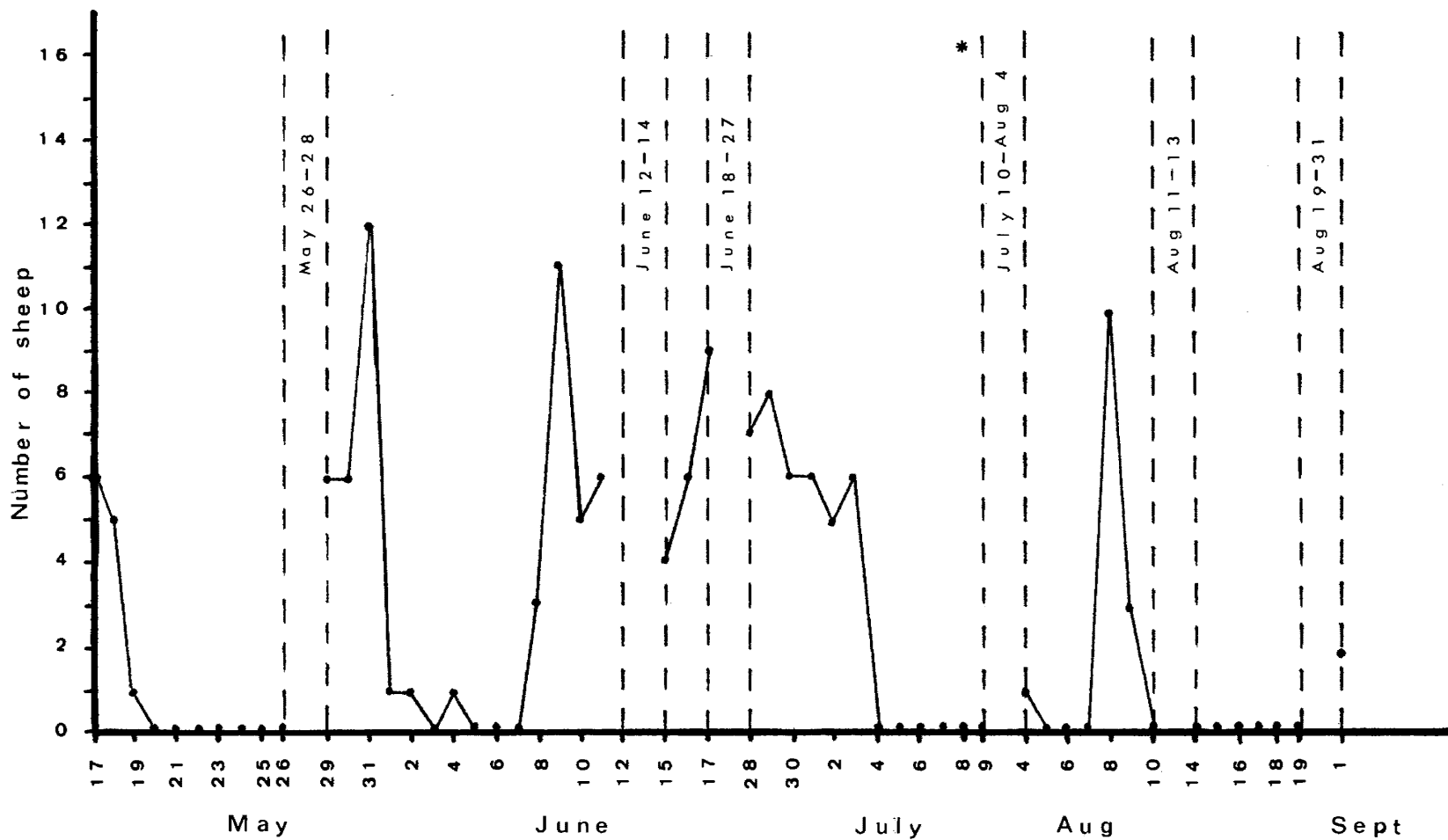


Figure 26. Sheep observed at Rock River mineral lick site, May - September, 1978.

\* during helicopter flights over the lick area July 11 and 15, 4 and 15 sheep respectively were observed at the mineral lick.

--- dates during which observers absent from lick site.

Tetlit Creek Lick:

The Tetlit Creek lick is situated in the southeastern corner of the study area, 1.6 km east of the eastern flanks of the Richardson Mountains and 26 km east of the Dempster Highway. The lick is situated at the base of a highly-eroded, south-facing bluff along Tetlit Creek. The bluff consists of brown siltstones and shales formed during the Upper Devonian. Numerous iron-rich seepage sites occur along the creek bed in the lick area. See Figures 10, 27, 28. As this site is outside the 16 km Dempster corridor, only 16 days (July 12 - 27) were spent observing sheep use of the lick. Figure 29 summarizes observations of sheep for this period.

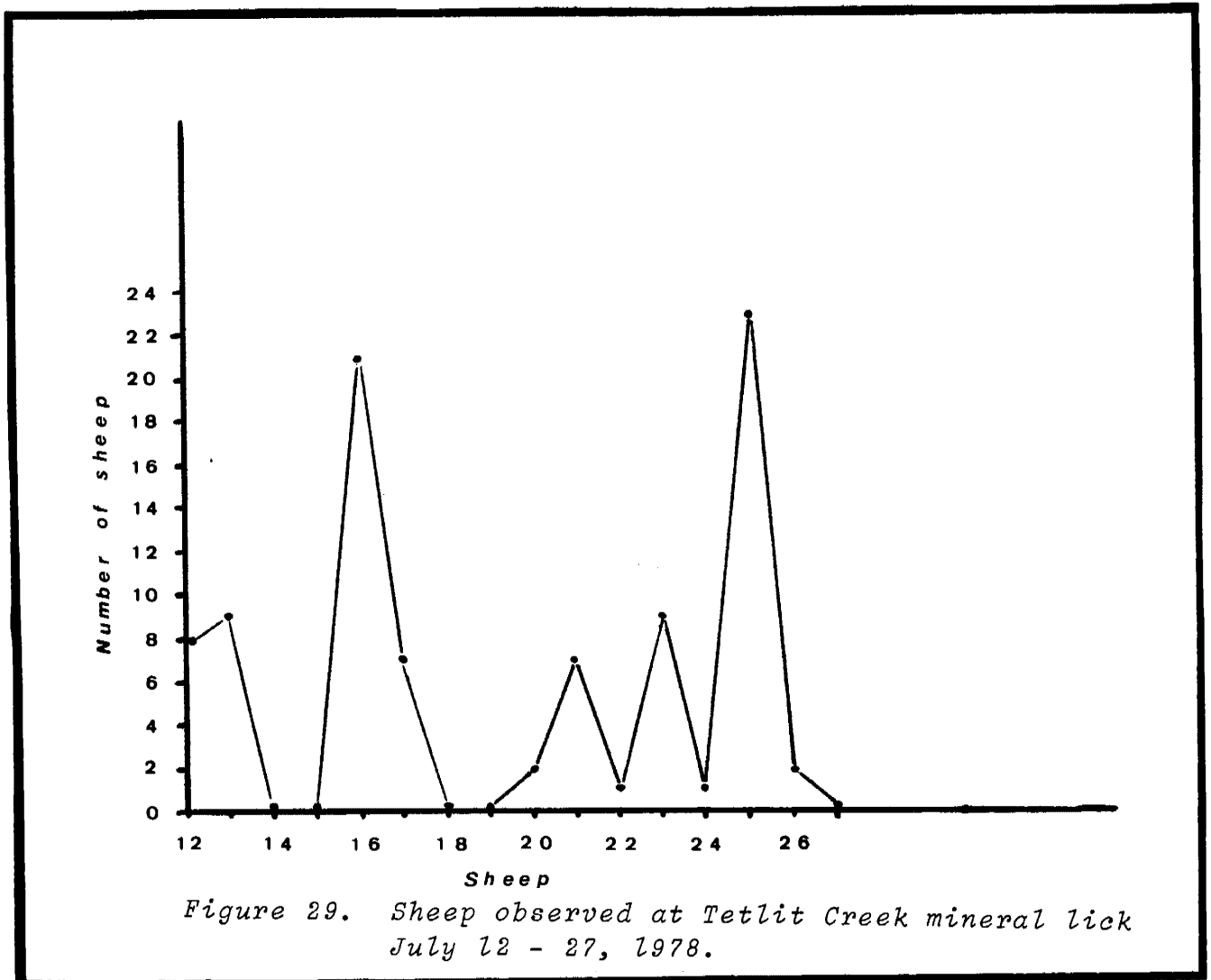
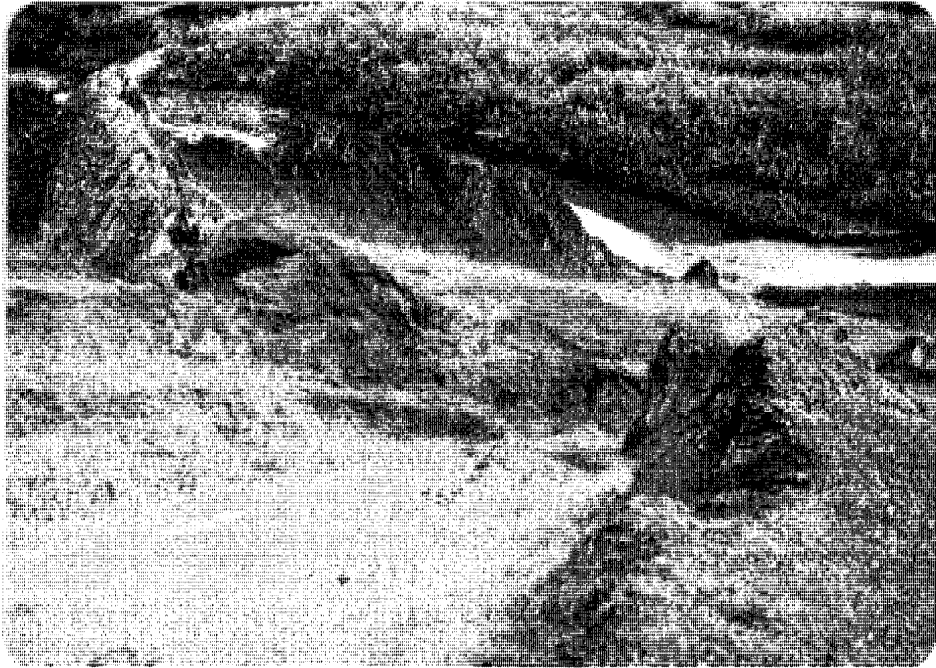
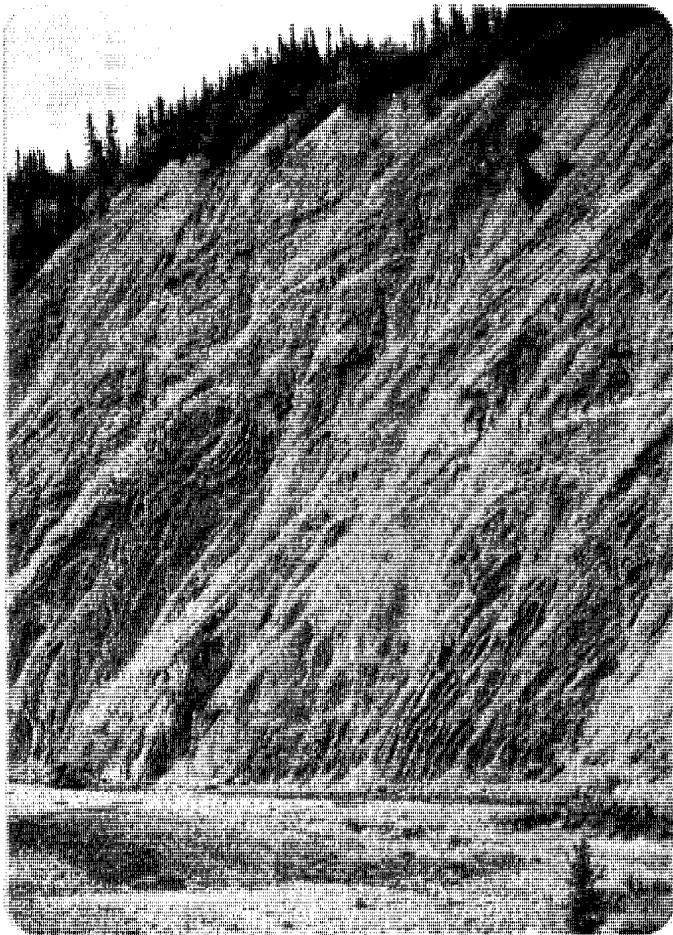


Figure 29. Sheep observed at Tetlit Creek mineral lick July 12 - 27, 1978.



*Figure 27. An iron-rich site along Tetlit Creek.*



*Figure 28.*

*Tetlit Creek mineral lick.  
Note sheep bedded on face  
and sheep licking at base.*

During observation of the Tetlit lick, we had the opportunity to record activity patterns of sheep using the lick. Individuals were observed for an average of 5 hours, the range being 2 to 7 hours. Rams, lambs and ewes were observed, but time spent licking was recorded for lambs and rams only. Lactating ewes licked virtually continuously while up. Ewes' per cent time spent licking is therefore an estimate. Table 11 summarizes the results of these observations.

TABLE 11. ACTIVITY OF RAMS, EWES AND LAMBS AT TETLIT CREEK  
- JULY 12 - 26.

Group	No. Obsvd.	Total Time Observed (mins.)	Total % Time Down	Total % Time Up	Total % Time Licking
Rams	2	541	47	53	37
Ewes	5	1539	21	79	78
Lambs	6	1781	37	63	8
Yearlings	1	201	17	83	17

Ewes utilized the lick very intensively, spending 78% of their time at the lick in licking. The ewes observed all had lambs and the 2 rams observed were 2 - 3 years old. Yearling activity reported in Table 11 may be atypical. There was considerable aggression directed toward the observed yearling. In one half-hour period he was bunted 19 times and chased off lick sites by other sheep.

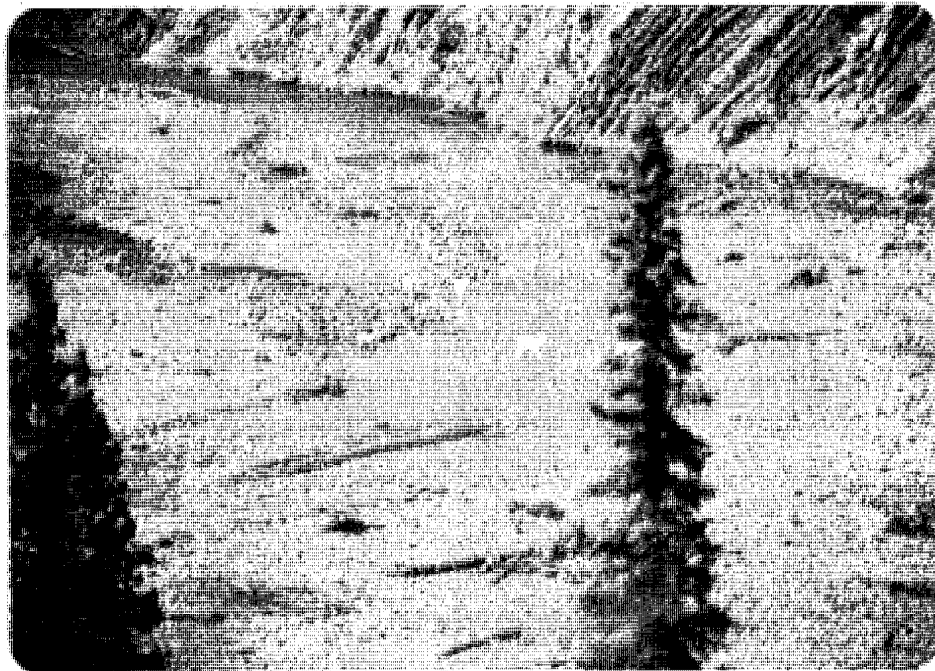
TABLE 12. PER CENT TIME SPENT LICKING AND TOTAL TIME SPENT AT THE TETLIT CREEK LICK BY 13 INDIVIDUAL SHEEP

Date	EWES n= 5		LAMBS n= 6		RAMS n= 2	
	% Time Licking	Time at Lick (min)	% Time Licking	Time at Lick (min)	% Time Licking	Time at Lick (min)
<u>July</u>						
12					33	356
13	85	420	1.9	420		
13	90.2	420	26.2	420		
24					44	185
25	80	114	3.8	114		
25	82	345	7.1	345		
25			3.8	246		
26	25	240	0.6	240		

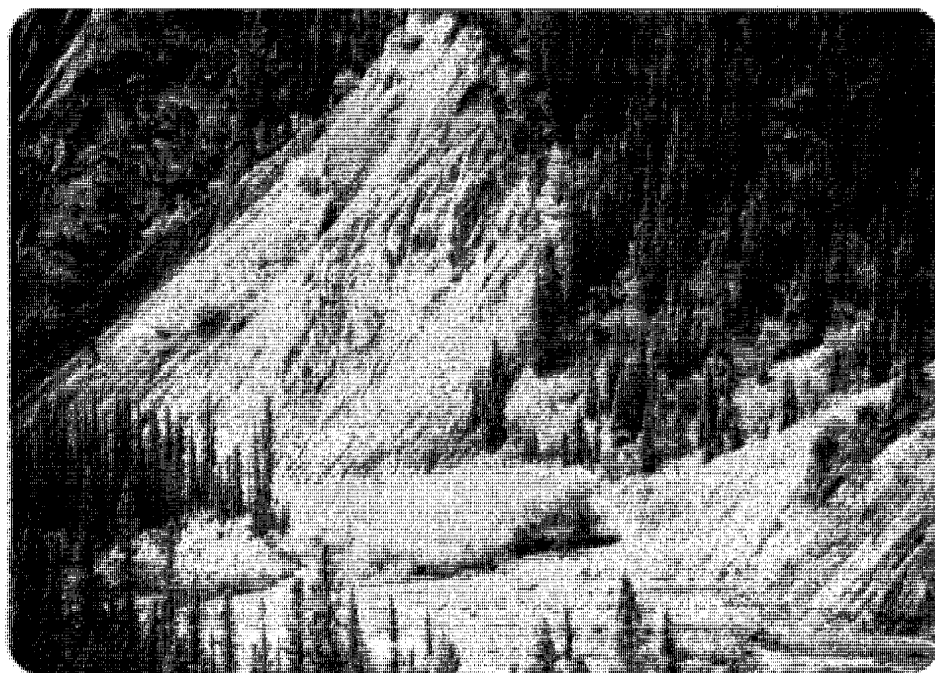
From Table 12 it can be seen that lambs varied considerably in the amount of licking they did while accompanying their ewes at the lick. They spent most of their time up (49% to 76%) and during this time they followed their ewes, stood beside their ewes and frolicked and gamboled about by themselves or with other lambs.

Of interest was the consistency of movement pattern to and from the lick. With one exception, all sheep observed arriving at the lick came along the creek bed from a canyon area upstream. Departure from the lick was always along a trail which began at the lick, crossed up along the blue-grey and yellowish shale slopes to the west, through a patch of timber and out onto the eastern flanks of the Richardsons. See Figures 30, 31 and 32.

Sheep most often arrived in the late morning and departed late in the afternoon. Sheep were often observed to depart en masse even though sheep within the group arrived at different times. Figure 33 depicts the frequency of various known arrival



*Figure 30. Sheep approaching Tetlit lick from upstream along creek bed.*



*Figure 31. Sheep departing from Tetlit lick on trail crossing blue-gray shale slopes west of lick.*

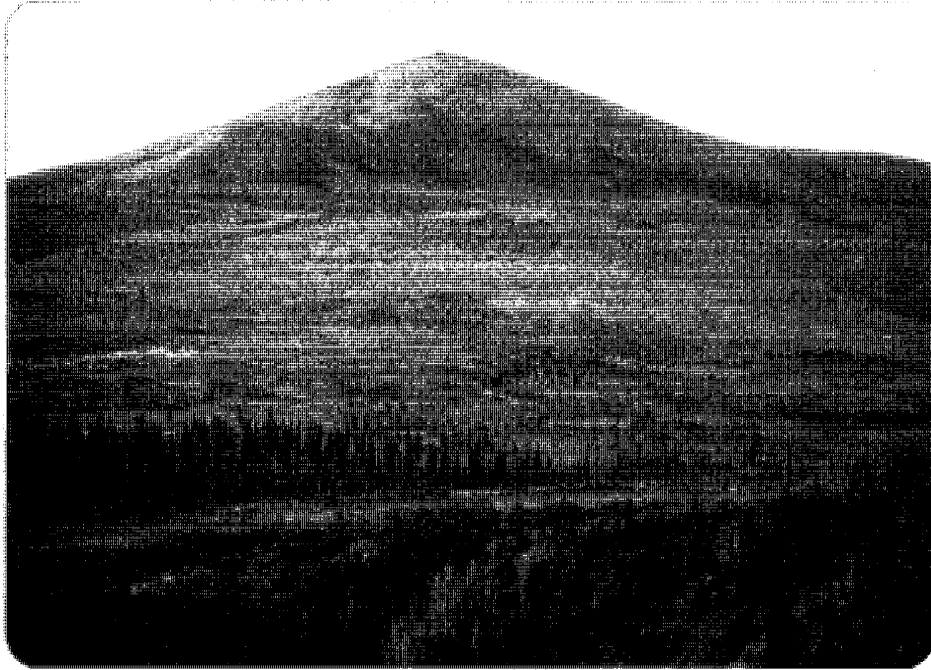


Figure 32. Sheep on trail from Tetlit lick leading onto eastern flanks of Richardson Mountains.



Figure 34. Three salt lick holes at Lick #1, Tetlit Ck

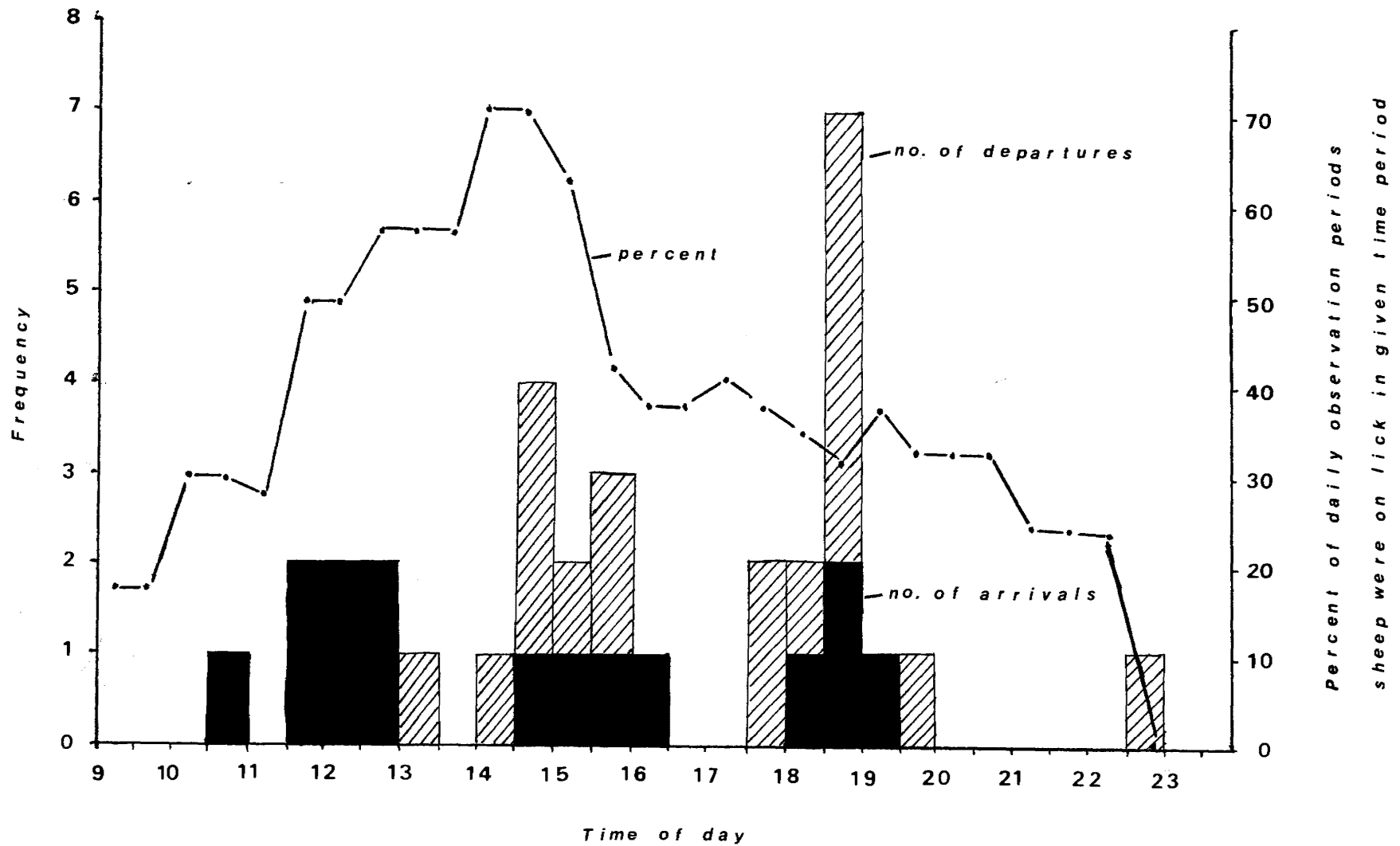


Figure 33. Frequency of known arrival and departure times at Tetlit Creek lick, July 12 - 27, 1978.

and departure times        The most frequent arrival time was 10:30 a.m. - 12:30 p.m. and the most frequent departure time was 5:30 p.m. to 6:30 p.m. It is also evident from this figure that peak activity was from 11:30 a.m. - 3:30 p.m.

Four major licking sites were observed and most sheep licked and chewed at each site repeatedly throughout their time at Tetlit Creek.

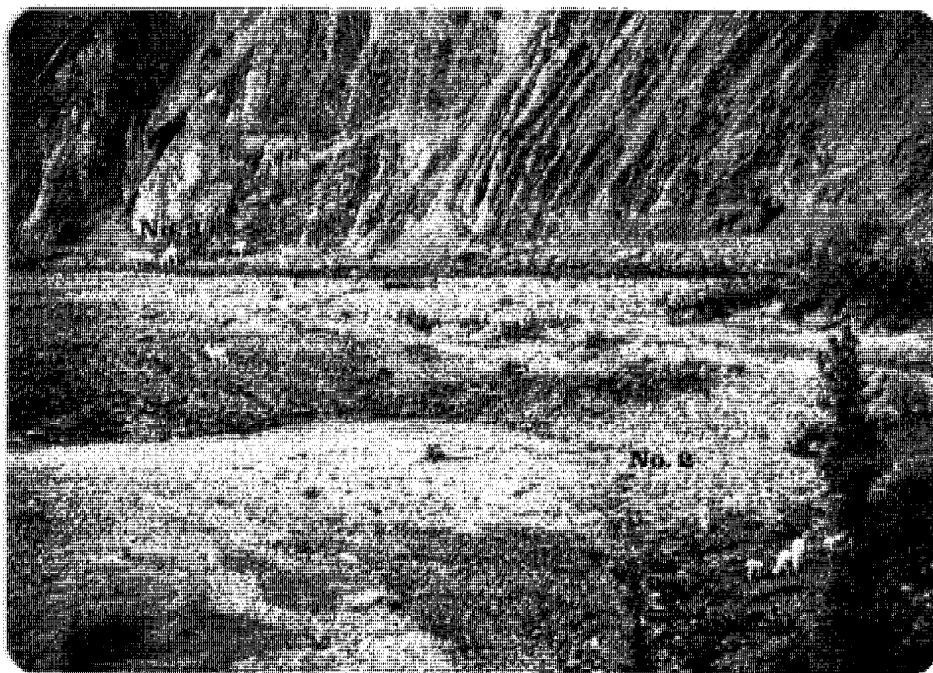
Lick #1 consisted of three holes approximately 20 cm deep and 20 cm in diameter at the base of the bluff (Figure 34). Sodium chloride was crystallized on the inner surfaces of these holes. Sheep often got down on their front knees in order to lick in these holes.

Lick #2 consisted of a rocky, muddy, clayish area on the creek (Figure 35) bed. Several small, shallow, licked-out depressions were apparent.

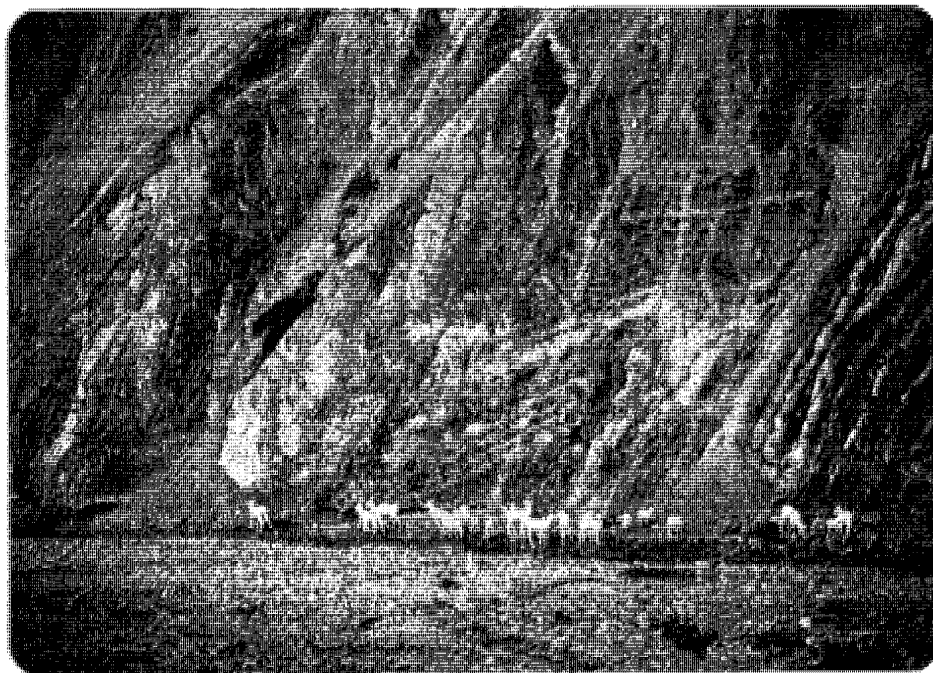
Lick #3 was situated at the base of a rocky outcrop on the bluff face. Sheep often licked and chewed along the rock which exhibited salty precipitates, identified by geologists as potassium chloride. Sheep often took mouthfuls of soil at the base of this outcrop (Figures 36, 37).

Lick #4 consisted of a muddy, rock area on the creek bed, a few metres to the east of Lick #1 (Figure 38).

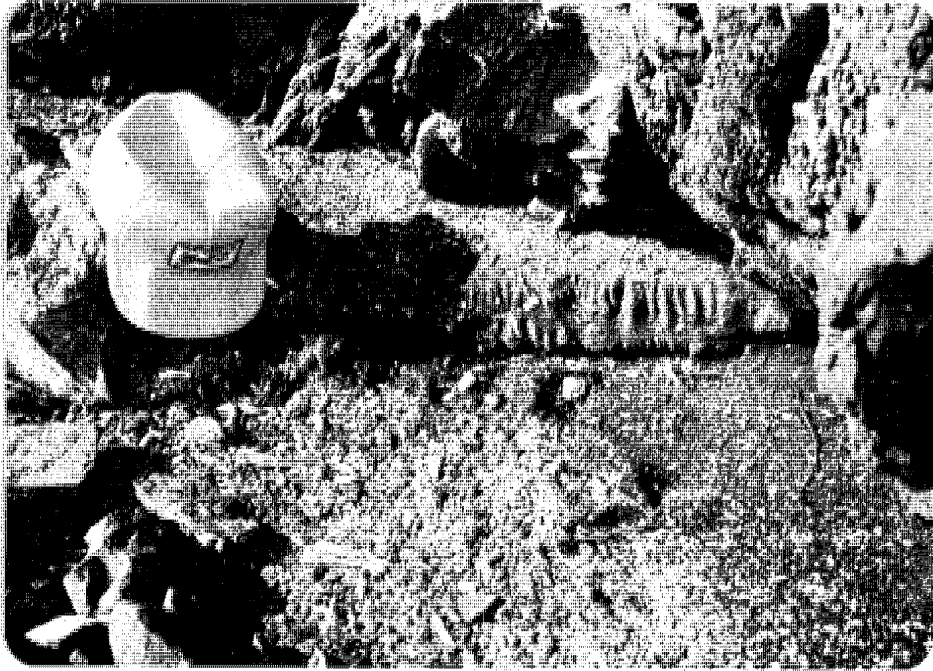
Differential use of these 4 licks is tabulated in Table 13.



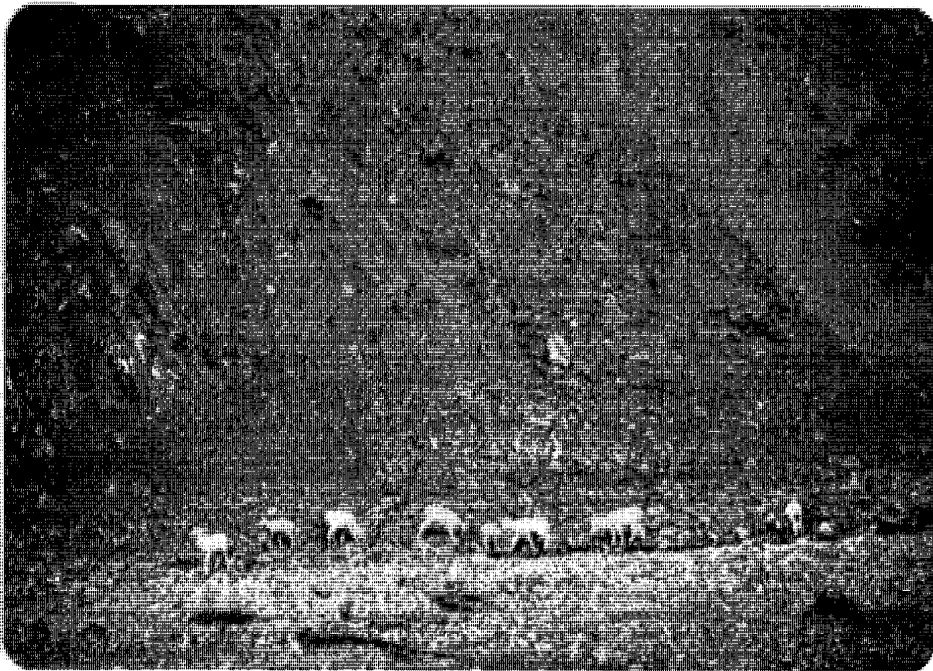
*Figure 35. Sheep at Lick site #2, Tetlit Creek.*



*Figure 36. Nineteen sheep at Lick #3, Tetlit Creek.*



*Figure 37. Chewing site at Lick #3, Tetlit Creek.  
Note teeth marks.*



*Figure 38. Lick #4, Tetlit Creek.*

TABLE 13. DIFFERENTIAL USE OF 4 LICK SITES AT TETLIT CREEK  
JULY, 1978.

Date	Obsvn. Time	No. of Sheep Obsvd.	SHEEP MINUTES OF USE			
			Lick #1	Lick #2	Lick #3	Lick #4
July 16	12:00 -3:30 pm	21	130	530	1230	200
July 23	11:40 am -2:15 pm	9	100	20	940	0
July 25	1:00 -6:20 pm	23	250	650	820	150
TOTAL USE:			480	1200	2990	350

Sheep use of lick sites in descending order of preference was: #3, #2, #1, #4.

It is of interest to note that sheep activity was observed to be influenced by insect harassment, competition and aggression between individuals, debris falling down bluff face, and aircraft overflights. Some ewes were particularly aggressive towards yearlings and lambs and would usurp lick sites and bedding sites from them.

All sheep bedded on the bluff face with the exception of lambs which would bed down close to their ewes when the ewes were licking.

All sheep were observed to browse frequently on two species of willows which grew on the creek bars. They also grazed on *Equisetum* sp., *Artemisia* sp. and ate the flowers of *Rosa acicularis*. These 3 plants were the dominant species growing on the steep

(30 - 45') well-drained, and rocky bluff face of the lick. Mineral and trace element analysis of the vegetation associated with the lick site in addition to analysis of lick material could indicate some of the nutritional needs of this population in relation to the forage available on their range.

### C. WINTER RANGE

No winter range areas were located during this study, but observed sheep distribution and incidental sightings allow some speculation on possible wintering areas as outlined in Figure 7. Hoefs (1978) outlined a range in the southeastern portion of the study area. Other areas outlined are postulated as possible sheep wintering areas on the basis of the following:

- a) In late February, 1978, 4 sheep - of which 3 were rams - were illegally shot on a ridge north of the North Cornwall River, approximately 6.4 km east of the Dempster. Also, 2 mature rams were seen here on the May 19 aerial survey.
- b) In late March, 1978, a road crew working on the Rock River crossing saw 4 sheep on a bluff approximately 1 km to the east of the crossing on the south side of the river. This area was investigated. Willow twigs up to 1/8" diameter had been browsed in a fashion characteristic of sheep. Some areas along well-established trails on the steep slopes were deep with droppings. The dominant shrub was *Salix* sp., the predominant ground cover consisted of sedges and grasses (Figures 39, 40).



*Figure 39. Possible winter range with Dempster Highway, 1 km west, visible in background. Four sheep were seen here in late March, 1978.*



*Figure 40. Another view of area in Figure 39.*

c) The distribution of sheep May 19 and June 17, 1978.

Geist (1971) cites three sheep studies (in the Cassiars, at Kluane Lake, Yukon, and in Banff National Park) wherein the last sheep to leave the wintering areas did so at the end of June. Hoefs (1975) found that most of the Sheep Mtn. population in Kluane was on winter ranges throughout the month of May.

d) The location of probable lambing areas.

Geist (1971) cites sheep studies wherein it was found that lambing grounds were adjacent or in very close proximity to the winter range they utilized.

With these observations, it is reasonable to postulate that some of the Mt. Cronin sheep winter on the western half of their range in close proximity to the Dempster Highway as outlined in Figure 7.

Of the critical areas discussed in this paper, least is known of the winter ranges of this population.

#### D. MOVEMENT ROUTES

Crossings and trails used by sheep were determined by direct observation of sheep utilizing them, by sheep tracks and by presence of sheep hair and wool. The known crossings and trails discussed here are presented in Figure 41 (letters correspond to map locations).

- A. a very well-defined trail from the south ridges to the mineral lick on the Rock River (see Figure 42).
- B. trail along spine of north ridge down to Rock River mineral lick.
- C. a very well-defined trail along bluff top on south side of Rock River leading to a possible winter range.
- D. river trail along Rock River and Tetlit Creek - sheep tracks present even when Rock River frozen over.
- E. trail through timber along base of north ridges.
- F. river crossings at bases of ridges, e.g. a, b, c, d, e - evident even when Rock River frozen over.
- G. trail along spine of south ridges (Figure 12).
- H. trail leading from ridges on eastern flanks of Richardson Mountains to Tetlit Creek mineral lick (Figures 32, 43, 44).
- I. Proposed trail crossing the divide between the western and eastern halves of this population's range. (Sheep were not observed crossing this divide.)

Not included on the map in Figure 41 are the numerous trails which traverse the steep scree slopes of the ridges and which run along every ridge top.

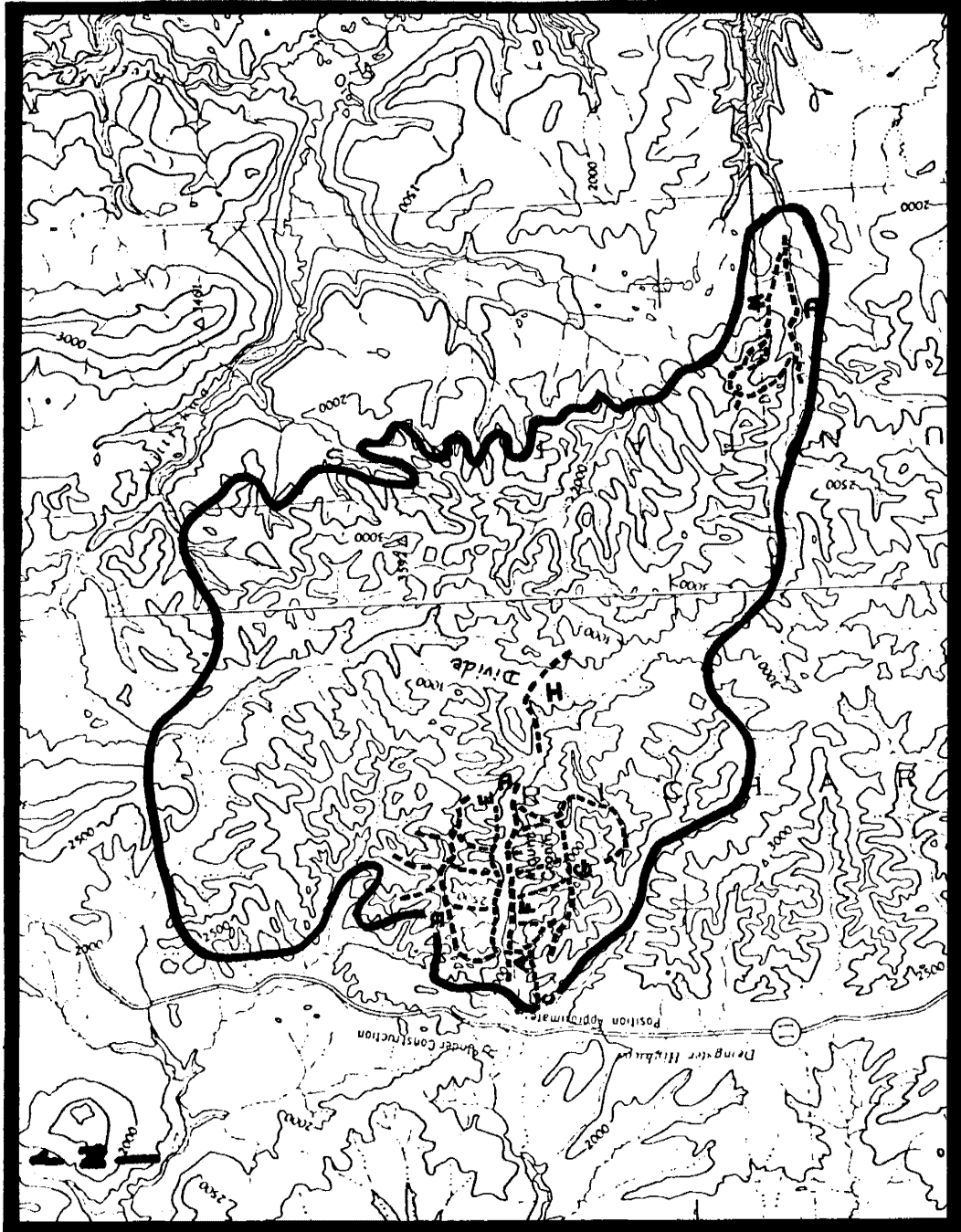
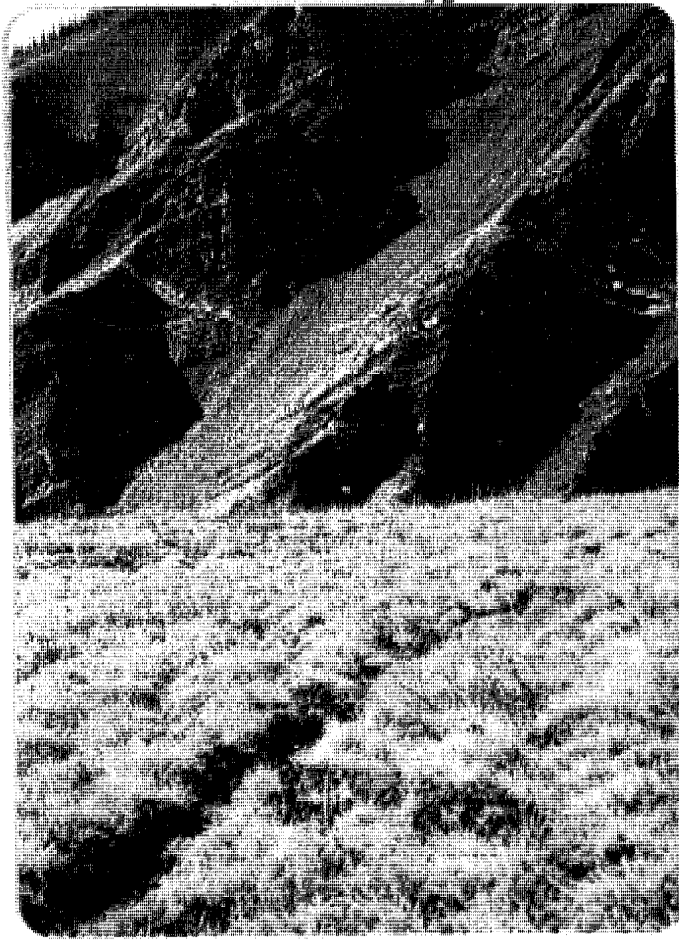
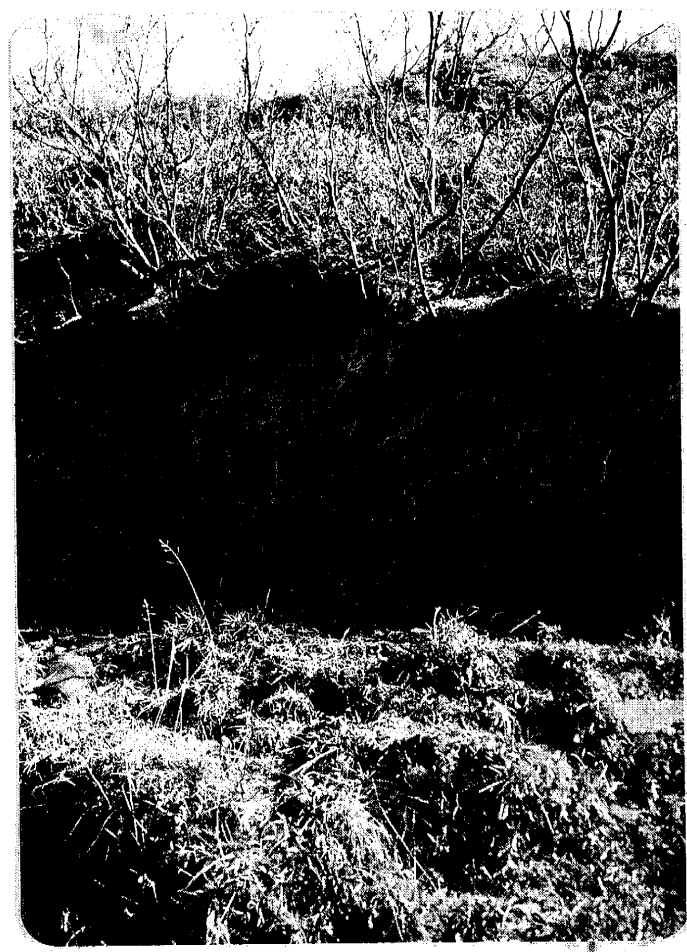


Figure 41. Sheep movement routes.



*Figure 42a.*  
*Trail A from south ridges crosses tussocks to Rock River mineral lick, 2.4 km east of Dempster.*



*Figure 42b*  
*Trail A passes down bluff above Rock River. Note deposition of sheep hair on bank.*



Figure 43.

Trail H leads from eastern flanks of Richardson Mtns. to Tetlit Creek mineral lick in background.

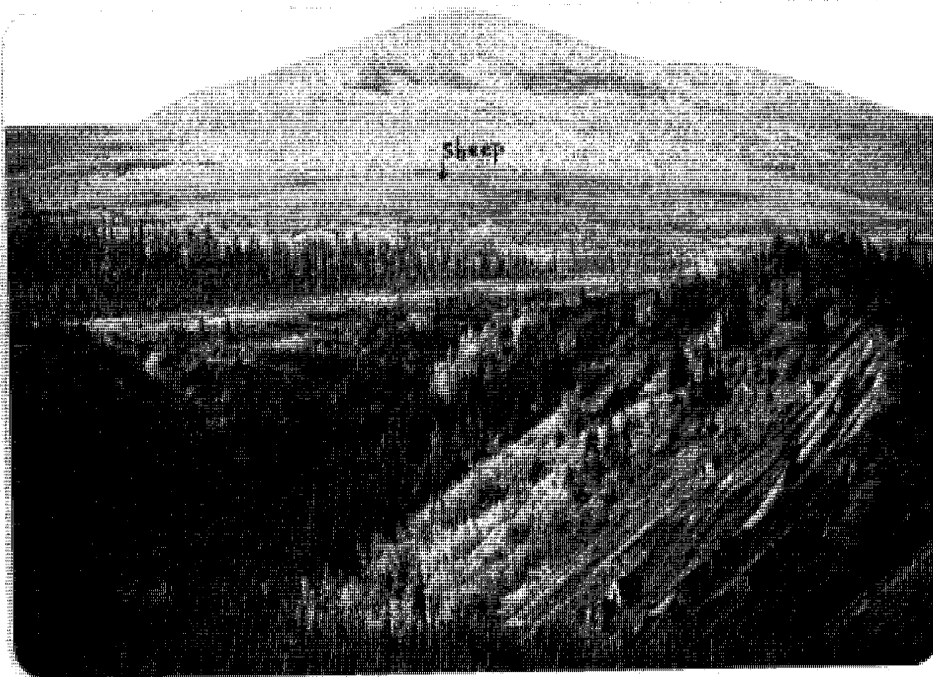


Figure 44.

Sheep on Trail H heading up onto alpine slopes of eastern Richardson Mtns.

It should be noted that most trails and crossings are not used exclusively by sheep. Scats, tracks and sightings indicate that grizzly bears, wolves and caribou also use these trails and crossings.

Certain trails and crossings may be critical to sheep in winter and early spring in that they provide a means of avoiding areas of deep snow in moving to areas favourable to sheep. Trails and crossings may also be critical on a year-round seasonal basis because sheep movements are known to be predictable along traditional routes. To be considered here are routes to mineral licks, lambing grounds, rutting areas, and routes between different seasonal ranges. Frequency of use may deem a specific trail or crossing to be critical.

These criteria must be considered in assessing the potential impacts of man's activity, be that activity short-term or long-term. It is reasonable to assume that those trails and crossings easily accessible from the Dempster Highway are potentially critical in that their sensitivity to disturbance is heightened by such proximity.

## HABITAT

The open mountainous terrain of the Mt. Cronin study area lies above treeline and is vegetated primarily with low growing shrubs, forbs, lichens and bryophytes. Four major vegetation zones can be described:

1. River and creek beds (Figure 46)

The dominant species occurring on the silt, sand and gravel deposits of this zone are *Salix* spp., *Picea glauca*, *Populus balsamifera* and *Equisetum* spp. Associated species are *Potentilla fruticosa*, *Parnassia palustris*, *Epilobium latifolium*, *Oxytropis* spp., *Pedicularis* spp., *Aster sibiricus* and members of the Gramineae.

2. Eriophorum - Carex tussocks (Figure 47)

This zone occurs mainly on poorly-drained flat topography. The dominant species are *Eriophorum* spp. and *Carex* spp. Associated species are *Rhododendron lapponicum*, *Ledum palustre*, *Andromeda polifolia*, *Empetrum nigrum*, *Vaccinium vitis-idaea*, *Vaccinium uliginosum*, *Salix reticulata*, *Salix* spp., *Betula glandulosa*, *Picea mariana*, *Arctostaphylos rubra* and a variety of moss species.

3. Subalpine shrub zone (Figures 39 and 40)

The dominant species are *Salix* spp., *Betula* spp., members of the Gramineae and *Shepherdia canadensis*. Associated species are *Potentilla fruticosa*, *Arctostaphylos rubra*, *Carex* spp., and *Juniperus communis*.



*Figure 46. Sheep in Salix-Picea-forb vegetation typical of creek and river bed areas.*



*Figure 47. Sheep feeding site in Eriophorum-Carex tussocks zone.*

4. Alpine zone (Figures 48 - 51)

The dominant species of the slopes and ridge tops of this zone are *Dryas integrifolia*, *Carex* spp., *Salix reticulata*, *Salix* spp., mosses, lichens (Table 14 for species) and Gramineae. Some associated species are *Cassiope tetragona* and *Arctostaphylos rubra*. Some alpine sites had a 20 - 30% rock cover (Figure 48).

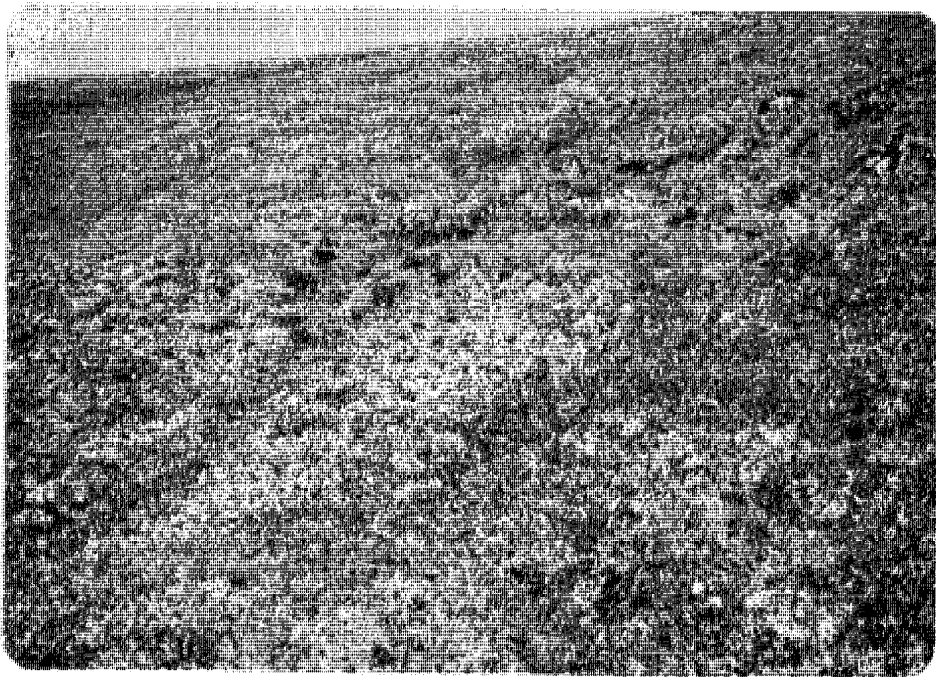
Sheep utilization was confined primarily to the alpine zone although use was made of the subalpine shrub zone and the *Eriophorum* - *Carex* tussocks zone. Use of the river and creek beds was observed only in the Tetlit Creek area.

In late May, sheep were feeding on snow-free south and west-facing alpine slopes and ridge tops where they were often observed scraping and tugging to expose roots which they would eat. These appeared to be the roots of *Dryas* or of a prostrate willow shrub such as *Salix reticulata*.

In June, sheep were feeding lower on the slopes and tended to use the south, southeast and southwest aspects of the sub-alpine shrub zone as snow patches melted away from the lower slopes. They often fed along the perimeter of snow patches and often were seen eating snow. They also ventured into *Eriophorum* - *Carex* tussocks, areas devoid of snow. By June 10, *Carex* species had developed 5 - 8 cm leaves and by June 16 most shrubs were flushing leaves. By late June, northwest and northeast aspects were also used by sheep, which were often seen feeding in the evening sun on northwest aspects (Figure 52). Browsing of willow continued throughout July.



*Figure 48. Dryas-moss-Salix feeding site on rocky north-facing alpine slope above Rock River in July (see also Fig. 19).*



*Figure 49. Dryas-lichen-moss-Carex-Cassiope feeding site on northwest facing alpine slope in July.*



Figure 50.  
Moss-Carex-Salix  
feeding site on lower  
north facing alpine  
slope in July.

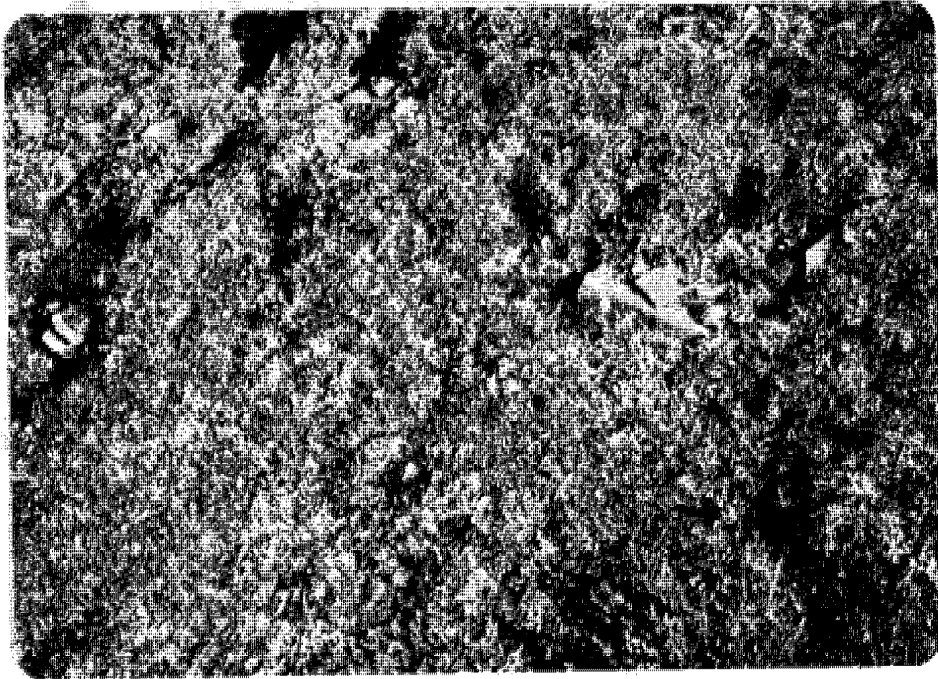


Figure 51.  
Lichen-Dryas-Carex  
feeding site on west  
facing alpine slope,  
June.

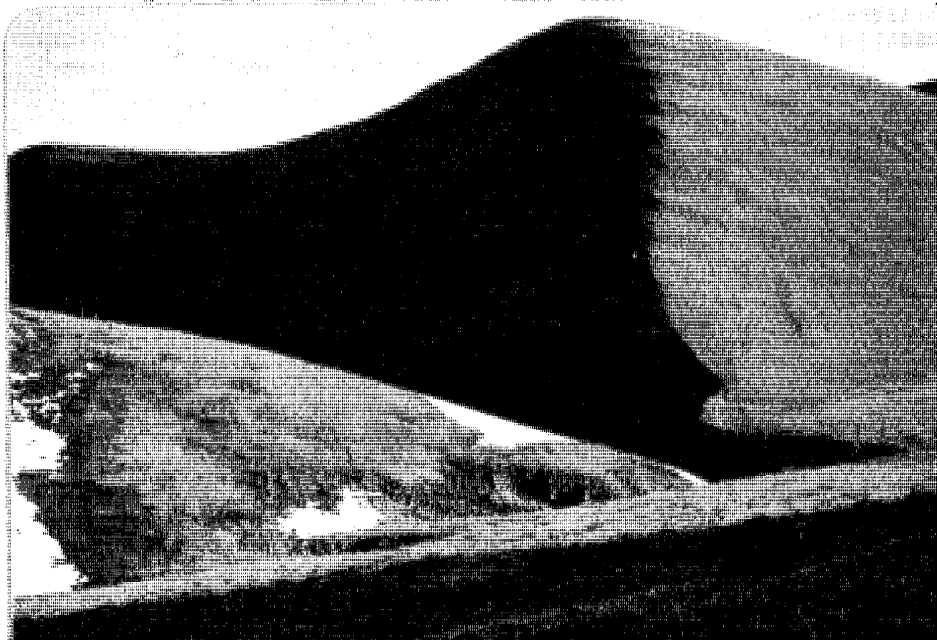


Figure 52.  
Two ewes and two  
lambs feeding in sun-  
light on northwest  
facing alpine slope  
at 9:00 p.m., June 10

Little time was spent inventorying feeding habitats selected by sheep. Ten vegetation plots were established in areas where sheep were observed feeding in May, June and July. With the exception of two, all plots were in the alpine zone. Feeding sites occurred on all aspects and were on slopes of 30 - 84%. Plot locations are given in Figure 53. These plots were conducted to gain some idea of the species composition of communities utilized by sheep and to determine some of the species sheep were selecting. Table 14 lists plant species recorded in the vegetation plots in June and July. Species significance and distribution values used are given in Table 1.

From Table 14 it is obvious that the most significant species in 90% of the plots were *Dryas integrifolia*, *Carex* spp., lichens and mosses. Other plants common to this *Dryas* community are *Salix reticulata*, *Arctostaphylos rubra*, *Oxytropis* spp., *Pedicularis Kanei*, *Salix arcticus*, *Cassiope tetragona*, Gramineae and *Vaccinium uliginosum*. The most common lichen species were *Cetraria culiculata*, *C. islandica*, *C. tilsii* and *Thamnolia* sp.

Table 15 lists those plant species which sheep were observed eating or which were grazed in known sheep feeding areas. The researchers were not familiar with the vegetation in its various phenological stages of development and found it was also difficult to get close to the sheep. The number of species in Table 15 reflects these factors. Various northern sheep studies indicate that sheep utilize a very wide variety of plant species. Hoefs (1975) listed 63 species utilized in August alone for the Sheep Mountain population.

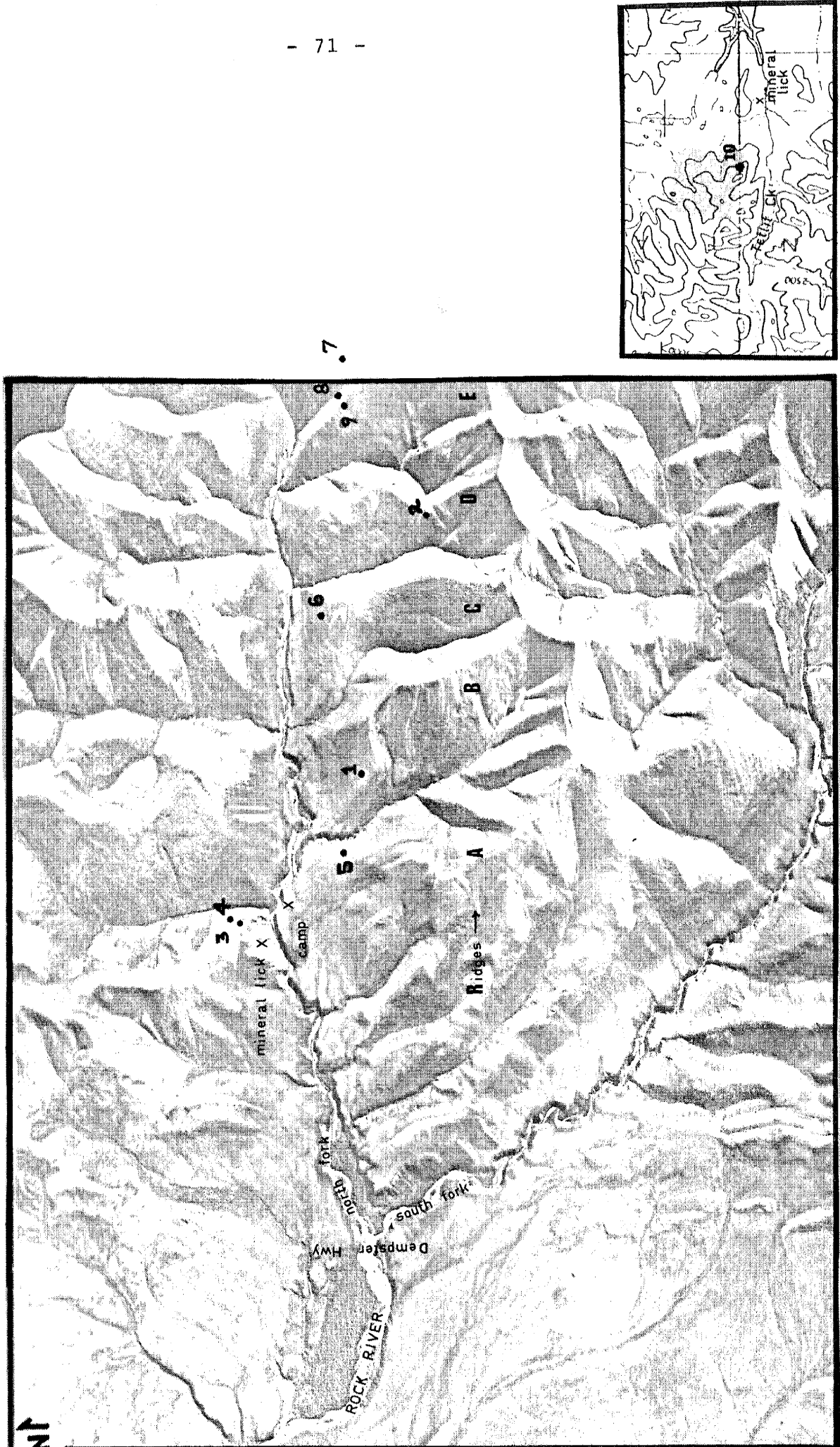


Figure 53. Vegetation plot locations. Airphoto #15-A37499

TABLE 14. PLANT SPECIES RECORDED IN VEGETATION PLOTS  
(JUNE - JULY)

Stratum	Species	No. of Plots in which Species Present	Average Cover Value *
TREES	<i>Picea glauca</i>	2	2
SHRUBS	<i>Betula glandulosa</i>	1	2
	<i>Cassiope tetragona</i>	5	4
	<i>Empetrum nigrum</i>	1	2
	<i>Ledum palustre</i>	1	2
	<i>Rhododendron lapponicum</i>	3	3
	<i>Salix</i> sp.	1	3
	<i>Vaccinium uliginosum</i>	5	4
LOW SHRUBS AND FORBS	<i>Andromeda polifolia</i>	1	2
	<i>Androsace chamaejasme</i>	4	2
	<i>Anemone drummondii</i>	4	2
	<i>Arctostaphylos rubra</i>	9	3
	<i>Astragalus umbellatus</i>	2	2
	<i>Calamagrostis canadensis</i>	1	2
	<i>Carex</i> spp.	9	5
	Caryophyllaceae	3	1
	<i>Draba</i> sp.	2	2
	<i>Dryas integrifolia</i>	9	6
	<i>Epilobium</i> sp.	1	2
	<i>Equisetum scirpoides</i>	1	1
	<i>Eriophorum vaginatum</i>	1	2
	<i>Eritrichium</i> spp.	1	2
	<i>Geum glaciale</i>	1	3
	Gramineae	5	3
	<i>Lagotis glauca</i>	1	2
	<i>Lupinus arcticus</i>	3	4
	<i>Oxytropis nigrescens</i>	7	3
	<i>Oxytropis</i> sp.	7	3
	<i>Papaver</i> sp.	3	3
	<i>Parrya</i> sp.	3	1
	<i>Pedicularis capitata</i>	5	2
	<i>Pedicularis Kanei</i>	6	2
	<i>Pedicularis labradorica</i>	1	2
	<i>Pedicularis</i> sp.	4	2
	<i>Petasites palmatus</i>	1	2
	<i>Polygonum bistorta</i>	1	2
	<i>Primula</i> sp.	1	1
	<i>Pyrola</i> sp.	1	2

...cont'd.

Stratum	Species	No. of Plots in which Species Present	Average Cover Value *
LOW	<i>Salix reticulata</i>	10	3
SHRUBS	<i>Salix</i> spp.	5	3
AND	<i>Saussurea</i> sp.	1	2
FORBS	<i>Saxifraga oppositifolia</i>	3	2
(cont'd)	<i>Saxifraga</i> sp.	1	1
	<i>Saxifraga tricuspidata</i>	2	2
	<i>Senecio</i> sp.	2	2
	<i>Silene acaulis</i>	5	3
	<i>Thalictrum alpinum</i>	1	2
	<i>Tofieldia pusilla</i>	2	2
	<i>Vaccinium vitis-idaea</i>	1	2
	<i>Woodsia</i> sp.		
LICHENS	(Lichen species were present)	10	5
AND	<i>Alectoria</i> spp.	5	
BRYO-	<i>Cetraria culiculata</i>	10	
PHYTES	<i>Cetraria islandica</i>	8	
**	<i>Cetraria richardsonii</i>	5	
	<i>Cetraria tilsii</i>	6	
	<i>Cladonia alpestris</i>	2	
	<i>Cladonia mitis</i>	1	
	<i>Cladonia rangiferina</i>	1	2
	<i>Dactylina arcticus</i>	5	
	<i>Nephroma</i> sp.	4	
	<i>Peltigera apthosa</i>	4	
	<i>Stereocaulon</i> sp.	1	2
	<i>Thamnotia</i> sp.	8	
	Mosses	9	6

\* Average cover value was calculated by averaging the mid-point value of the percent cover range that each cover value represents.

e.g. 4 (5-10% cover) has a mid-point of 7.5%.  
Cover values are from Table 1.

\*\* Lichen species were lumped together when assigned a cover value.  
Moss species were not identified.

TABLE 15. PLANT SPECIES OBSERVED EATEN BY SHEEP

---

Species

*Anemone drummondii*

*Artemisia* sp.

*Astragalus umbellatus*

*Carex* spp.

*Dactylina arcticus*

*Epilobium latifolia*

*Equisetum* sp.

*Geum glaciale*

**Gramineae**

*Lupinus arcticus*

*Oxytropis nigrescens*

*Pedicularis* sp.

*Potentilla fruticosa*

*Rosa acicularis*

*Salix reticulata*

*Salix* sp.

*Salix* sp.

*Salix* sp.

*Saxifraga* sp.

---

A plant collection was made for the study area and a complete listing of all species collected awaits the completion of identification of specimens. A partial listing is contained in Appendix C.

## BEHAVIOUR

### Feeding Activity:

No discernible pattern of feeding activity was evident. Most observations were made throughout the month of June, which at this latitude (66° 50'N) has almost 24 hours of daylight. Sheep were observed feeding throughout the evening hours to midnight. Observations were not made after midnight.

### Suckling:

Ten ewe-lamb pairs were observed in the period July 6 - 26. Each pair was observed once for a period of 2 - 7 hours. Twenty-one successful suckles were observed in 47 attempts. Average suckling time: 11.4 ±5.7 sec. (range: 2 - 21 sec.) Average suckling interval: 59.0 ±40 min. (range: 9 - 135 min.) Average seconds suckling: 7.2 ±2.8 sec. (range: 5.1 - 11 sec.)

---

Hr. of ewe's activity

Average no. suckles : 0.62 ±.35 suckles (range: .25 - 1.0 suckles)

---

Hr. of ewe's activity

Assuming most lambs were born by June 7, the July 6 - 26 suckling observations were of lambs 4 - 7 weeks old at the youngest.

Additional suckling observations were made in June (n= 4) and in July (n = 11 + 21).

June average suckling time: 19.7 ±2.1 sec. (range: 17 - 22 sec.)

July average suckling time: 12.7 ±5.9 sec. (range: 2 - 24 sec.)

Most suckling was initiated by the lamb from the side but successful frontal and rear initiations were also observed. Attempts by lambs to suckle resting ewes usually failed. Ewes terminated suckling by stepping over the lamb and no lamb quit suckling voluntarily. Two attempted suckles by a yearling on an older ewe were observed.

Response to predators, aircraft and machinery and human presence:

PREDATORS: The strategy employed by the wolf to hunt sheep suggests that downhill chases and surprise (or ambush) are probably the two most successful strategies employed by wolves to kill sheep in the alpine (Child, K.N., *et al*, 1978).

The wolf-sheep interaction observed at the Rock River mineral lick July 3 (see "Other Mammals" section) supports this suggestion. See "Other Mammals" also for a description of a second wolf-sheep interaction.

A pair of golden eagles nesting on the cliff face at the Rock River lick were twice observed circling over a ewe and her lamb. The lamb huddled close in under the ewe, which remained motionless, watching the eagles overhead.

June 29, a yearling and a lamb slowly approached within 3 km and 1.8 m, respectively, of the golden eagle nest along the nest ledge. With 2 chicks in the nest, an

adult eagle remained sitting on the nest edge watching the two sheep, but made no overt response to their presence. The sheep left about 2 minutes later.

AIRCRAFT  
AND  
MACHINERY:

Responses to aircraft and machinery were noted as follows:

June: A group of 6 feeding sheep bolted a short distance in response to a single blasting report from the Dempster Highway, 5.6 km distant.

June 3: A group of 3 ewes and 1 yearling on Ridge A near cliff bluffs, did not run when a helicopter landed at our Rock River camp.

June 9: Seven sheep on Ridge 1 ran along the ridge as a helicopter approached camp. Sheep on the cliff face moved up the face as the helicopter approached, then stopped and watched after it had landed. The sheep remained on the face for 2 hours.

June 10: A fixed-wing flew low directly over a mature resting ram. He remained resting, turning his head to follow the plane as it flew past. At the same time, a nursery band of 10 sheep ran out of sight over the crest of the ridge.

June 17: Five nursery sheep on cliff face of Ridge 1 ran up the face as a helicopter approached. They stopped running when it landed. Three rams feeding on the ridge above the cliff face showed no reaction and continued to feed.

June 21: Seven nursery sheep ran a short distance on Ridge 1 cliff face, then stopped and watched as the helicopter landed.

June 30: Eight nursery sheep continued grazing and licking on Ridge 1 as a 'very loud' flatbed truck passed over the Rock River crossing.

July 13: Four sheep licking on creek bed at Tetlit Creek lick ran up onto rock face as a fixed-wing flew overhead.

July 25: Eight sheep on Tetlit Creek Lick creek bed ran up onto rock face as a fixed-wing flew over. Sheep bedded on the rock face stood up.

August 4: A group of 31 nursery sheep ran initially as a helicopter flew over, then stopped and watched. A young ram resting on Ridge 1 stood up as a helicopter landed at camp, ran when it took off and then lay down again.

From the foregoing it is obvious that many variables affect the response sheep exhibit (sheep experience, sex, type and height of aircraft, time of year, etc.). Also, the possibility that overt behavioural responses mask physiological stress and its effects must not be overlooked. Sheep may become accustomed to man-related stimuli, but at what cost if that process is not managed?

HUMAN  
PRESENCE:

In the last two weeks of May, nursery sheep would run for great distances when researchers approached within 1.2 - 1.6 km. This response was possibly related to the lambing period at that time.

May 30: Two ewes at the base of Ridge A didn't run as we approached within 46 m of them. They watched us, then lay down.

June 2: A single ewe responded as on May 30.

July 16: Five sheep left the Tetlit lick, then returned. Geologists were working up the creek bed where the sheep had headed.

July 17: Five sheep approaching the Tetlit lick stopped and turned back when they saw geologists at their campsite on the creek bed upstream from the lick.

July 18: After researchers had investigated salt lick holes, sheep coming to them would jump and run away at the scent but would lick the holes within 5 minutes of their initial reaction.

August 8: Ten nursery sheep resting and licking on Ridge 1 cliff face were disturbed when 3 unknowing hikers approached on a bluff opposite the face. Seven of the ten sheep left and did not return that day. The sheep were undisturbed when researchers slowly and cautiously approached the site earlier.

September 1: Two mature resting rams left the Ridge 1 cliff face when two observers approached on the south side of the river.

The researchers' experiences with these sheep indicate that they can become accustomed to the presence of humans if they are habituated very slowly over a period of time. These sheep have had previous experience with men as attested to by snowmobile tracks, old fluorescent flagging along Tetlit Creek, old stove pipe 3 km up the Rock River, axe-cut stumps along Rock River and Tetlit Creek and aircraft sched flights over the area. It is not possible to make any inferences about the effects of this earlier experience on this sheep population, but sheep were visibly disturbed to some degree as evidenced by our observations during the study period.

## MOLT

The first indications of molting were observed June 5 in a ewe and yearling. A three-year old ram was still shedding on July 3. By July 20, many sheep were still shedding but on July 21 two ewes, a yearling and a  $\frac{1}{2}$ -curl ram were completely shed out. On July 23, only one old ewe in a group of 8 sheep had not completed her molt. All sheep observed after this date had finished molting.

During the molt, sheep were often seen rubbing their bodies on rock outcrops, shrubs and dead trees. One erosion site used for rubbing was located on the slopes above the Rock River lick.

## OTHER SPECIES OBSERVED IN STUDY AREA

### Birds:

Species seen and their breeding status are contained in Appendix A.

### Small Mammals:

Arctic ground squirrel (*Spermophilus parryii*)

Northern red-backed vole (*Clethrionomys rutilus*)

Snowshoe hare (*Lepus americanus*)

### Large Mammals:

Caribou (*Rangifer tarandus*)

Grizzly (*Ursus arctos*)

Wolf (*Canis lupus*)

Wolverine (*Gulo gulo*)

### Caribou

A lone bull caribou was seen June 3 lying on Ridge C where he remained for the day. Many antlers were noted throughout the study area, indicating that caribou have wintered in this region and have used it as a movement route. (Numerous trails are obvious when observed from aircraft.)

Grizzly

Ten sightings were as follows:

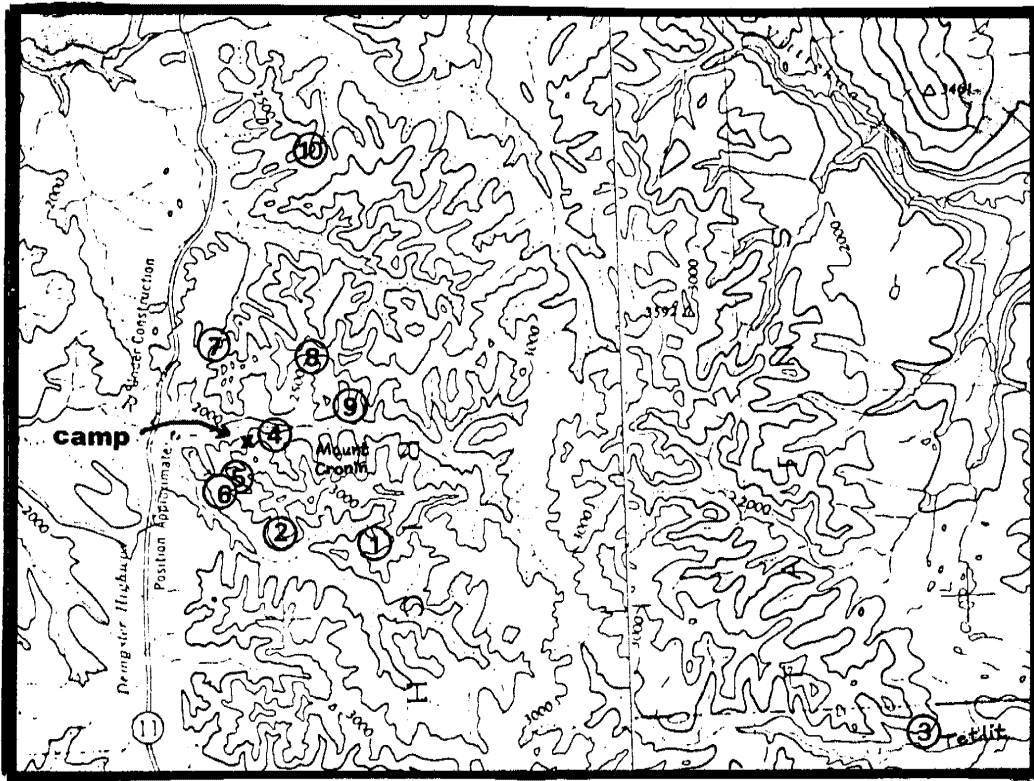
<u>Date</u>		<u>No.</u>	<u>Map Location</u>
*May 17	1 grizzly	1	1
*May 19	1 sow and 2 cubs; 1 grizzly	4	2 & 3
June 10	1 grizzly	1	4
June 12	2 grizzly	2	5 & 6
June 14	1 sow and boar	2	7
July 5	1 grizzly	1	8
July 9	1 grizzly	1	9
*Aug. 19	1 grizzly	1	10

\* aerial survey

Droppings and diggings were seen throughout the study area. It is interesting to note that of the 13 bears seen, 7 were identified as different individuals on May 19, June 12 and 14. A grizzly was also in the area between May 26 and 29. Upon our return on May 29, grizzly tracks were present in the frozen overflow on the Rock River.

Sighting locations are given in Figure 45. Note the proximity of all sightings to the Dempster Highway. This should be considered in planning the location of developments such as campsites along the highway. Bear marking trees, droppings and trails are to found along the Rock River immediately east and west of the Rock River crossing.

Figure 45. Grizzly sightings in Mt. Cronin area.



### Wolf

Three different, single wolves were seen, all near sheep. One wolf was seen July 3 giving chase to a young ram that was feeding on the slopes above the Rock River mineral lick at 9:45 a.m. The young ram bolted onto the cliff face, the wolf stopped, turned and walked off in the direction it had come from. May 30, 11:25 a.m., a lone wolf loped past us and 2 ewes we were observing at the base of Ridge A. June 5, 3:30 p.m., a lone wolf was met on Ridge A.

### Wolverine

A single wolverine was seen in late May on an alpine ridge top.

## SUMMARY OF STUDY OF MT. CRONIN DALL SHEEP POPULATION

1. An ecological investigation of this northern-most resident sheep population was conducted from May 17 to August 19, 1978.
2. The study area encompasses the known range of this population as determined by aerial surveys, and is bounded for at least 16 km on the west by the Dempster Highway. The area is approximately 518 km<sup>2</sup> in size and is situated above treeline in a zone of continuous permafrost.
3. Two camps were established in the study area and investigations were conducted on foot for the most part. Five complete aerial surveys of the population's range were flown by helicopter.
4. Information was collected on the following aspects:
  - population size, structure and distribution
  - progression of lambing
  - location of lambing grounds, mineral licks, movement routes and potential wintering areas
  - habitat use
  - sheep behaviour
  - plant species found in the area
  - birds observed in the area
  - other mammals utilizing the area
5. During the study period, the total population count was 103 animals consisting of 20 rams, 46 ewes, 11 yearlings and 26 lambs.

6. The expected number of rams is 30 - 35 and it is postulated that rams have been illegally hunted and/or they range beyond the study area.
7. The observed natality rate was 56 lambs per 100 ewes for 1978. No twinning was observed.
8. Mortality during the first year of life is unknown.
9. The observed yearling: ewe ratio was 24%.
10. The lamb:ewe ratio is considered average for a northern sheep population.  
  
The yearling:ewe ratio is considered average and sufficient to keep a population stable.
11. The population was concentrated on the western half of their range in May and June. Nursery sheep shifted to the eastern half for July and August while the majority of rams observed were on the western half.
12. The lambing period began May 19 at the latest and was completed by June 7.
13. The only known lambing ground was located within 8 km of the Dempster Highway. During the lambing period, 85% of the total lamb crop was observed in this area on one day.
14. Two mineral licks were located and sheep use was observed at various times throughout the study at both lick sites. The Rock River lick is 2.4 km east of the Dempster Highway. The Tetlit Creek lick is 26 km east of the highway in the southeast corner of the study area. Samples were collected for analysis.

15. Movement routes and crossings were located and mapped.
16. Suspected winter ranges are outlined.
17. Observed forage species were recorded and vegetation plots established on sheep foraging areas.
18. A plant collection was made for the study area.
19. Sheep response to aircraft and human presence was recorded. Sheep at or near the Rock River mineral lick became accustomed to the helicopter traffic into and out of the researchers' camp.
20. Seven different grizzlies were observed in the study area. Three single wolves were also observed.
21. Illegal hunting of sheep in this population occurred in 1978.
22. Hikers, naturalists, snowmobilers and geological researchers were present in the study area in 1978.

#### MANAGEMENT CONCERNS AND RECOMMENDATIONS

The western boundary of the Mt. Cronin population's range is paralleled by the Dempster Highway for approximately 16 km. Management concerns stem from that fact. A discussion of these concerns is contained in Hoefs, 1978: Dall Sheep in the Richardson Mountains - distribution, abundance and management concerns. In review, those concerns were:

- a) Potential impact of highway construction activity on the Mt. Cronin sheep population.
- b) Effects of increased access provided by the Dempster Highway.

c) Locations of critical areas relative to the highway.

These areas include:

- lambing grounds
- mineral licks
- winter ranges
- movement routes

d) Effects of aircraft overflights.

The information gained during the 1978 study of this population lends credence to the stated concerns and further indicates the vulnerability of these sheep.

Aerial surveys and ground surveys indicate that most nursery sheep were within 16 km of the Dempster Highway in May and June (95% in mid-May). An apparent shift of nursery bands from the western half of their range and hence away from the highway, occurred in late June. The majority of nursery sheep were in the eastern half of their range during July and early August. In contrast, the majority of rams observed were located in close proximity to the highway throughout the study period. While on the western portion of their range (within 16 km of the highway), the Mt. Cronin sheep are within an easy day's hike from the Dempster.

Critical habitat may be defined as those areas that are essential to the survival and stability of the population and which limit sheep to restricted terrain and restricted movement within that terrain on a seasonal or year-round basis. Included within that definition are traditional movement routes and

crossings, mineral licks, lambing areas and winter ranges.

It is reasonable to assume that the sensitivity of critical areas is heightened in close proximity to a development such as the Dempster Highway. Consider that within 8 km of the Dempster Highway:

- at least 5 key movement routes and crossings are located;
- one of two known mineral licks is located (2.4 km from highway);
- all known lambing grounds are located;
- two of three suspected winter ranges are located.

Therefore, this sheep population is vulnerable to harassment, poaching or other disturbance not only while on one of their summer ranges, but also during the critical periods in their annual cycle - winter, lambing and mineral lick utilization.

Hikers, naturalists, geologists, hunters and snowmobilers were present within the study area in 1978. One case of illegal hunting is known in which four sheep were shot in late February, 1978. Machinery noise was easily audible to human ears 6.4 km from the highway. The initial construction phase of the highway had been completed prior to the initiation of this study.

In light of the information this study yielded concerning the relationship of this sheep population to the Dempster Highway, it is imperative that management recommendations as made by Dr. M. Hoefs in 1978 be considered and implemented as follows:

1. Access into the Mt. Cronin sheep range should be restricted to minimize disturbance of sheep. Controlled use of the

area by people could be incorporated within a program of habituation of sheep to the presence of man and his activities. Research investigations within the area should be on an enforced permit basis only. Naturalists and geological researchers with helicopter support were working in the study area in 1978 - without permits.

2. Airflights in this area should be subject to altitudinal limits as suggested by Dr. Hoefs (2000' above the height of mountains) to minimize disturbance of sheep on known critical areas in proximity to the highway. Of special concern is the lambing period from mid-May to early June.
3. Maintain the closure on the hunting season in Game Management Zone 1. Further research is needed into population dynamics before a possible harvest removal rate could be determined. The Mt. Goodenough and Mt. Millen sheep populations in the Northern Richardson Mountains have declined and overharvesting is considered a contributing factor. The range of the Mt. Millen population is 51 km to the north of the Mt. Cronin population.
4. Manage the Mt. Cronin sheep range for non-consumptive use. The physiography of the area and the access provided by the Dempster Highway make it an ideal area for managed public use. It is recommended that a long-term research program be proposed to monitor and to further investigate this population in view of the proposed opening of the highway in 1979.

## RESEARCH NEEDS

This population lends itself ideally to a long-term research program. The population is small, apparently discrete and its range is easily accessible from the Dempster Highway. Data derived from such a study could be applied to other northern sheep populations. Considering the dearth of information regarding this population the following research needs appear to the authors to have a basic priority in facilitating management of this population.

### 1. POPULATION STRUCTURE

This population needs to be monitored for a number of years to determine population status and trends. An accurate census of the ram segment to further elucidate its structure and seasonal distribution is needed. Mortality factors should be further investigated. During the course of this summer's investigations few (2) skulls were located. If possible, a life-table for the population should be constructed.

### 2. CRITICAL AREAS

An effort should be made to document lamb births on the described lambing grounds and to locate any other lambing areas. Very little is known of winter ranges of this population. Aerial surveys should be conducted over the winter period to locate these areas. Furthermore, little is known of movement routes

and crossings between the western and eastern portions of this population's range and throughout the northern portion of the range.

### 3. HABITAT USE

More needs to be known on the range requirements of the population as well as the productivity of both summer and winter ranges.

### 4. BEHAVIOUR

Since animals were not tagged in this population, little information could be gathered on frequency of use of the licks and differential use by rams, ewes, yearlings and lambs. A program involving tagged individuals would facilitate assessment and evaluation of a research project to accustom individual animals within the population to human activity. Such a program would enable this population to slowly accept man in their environment.

LITERATURE CITED

- Child, K.N., K.K. Fujino and M.W. Warren. 1978. A Gray Wolf (Canis lupus columbianus) and Stone Sheep (Ovis dalli stonei) fatal predator - prey encounter. Canadian Field-Naturalist 92(4): 399 - 401.
- Geist, V. 1971: Mountain sheep. A study on behaviour and evolution. The University of Chicago Press.
- Hoefs, M. 1975. Ecological investigation of a population of Dall sheep (Ovis dalli dalli) Nelson. Ph.D. Thesis (Part II), University of British Columbia, 213pp.
- Hoefs, M. 1978. Dall sheep in the Richardson Mountains - distribution, abundance and management concerns. Yukon Game Branch. Unpublished report.
- Oswald and Senyk. 1977. Ecoregions of Yukon Territory. Dept. of Fisheries and the Environment, Canadian Forest Service.

## ACKNOWLEDGEMENTS

We thank the following people for their very capable field assistance: J. McDonald, C. Boyd and D. Russell of the Yukon Game Branch.

Thanks to our helicopter pilot, K. Guenter of Trans North Turbo Air and to D. Mossop of the Yukon Game Branch for logistical assistance.

Thanks to Dr. V. Hume, D.I.A.N.D., Northern Roads and Airstrips Division, for federal funding assistance for this investigation.

Special thanks to Betty Gautier and Janice MacKay for typing this report.

## APPENDICES

## APPENDIX A:

BIRD SPECIES OBSERVED ON MT. CRONIN  
STUDY AREA, MAY - JULY 1978.

---

<u>SPECIES</u>	<u>DATE FIRST SEEN</u>
American golden plover	May 20
American kestrel	
Baird's sandpiper	
Bohemian waxwing	
* Golden eagle	May 15
Gray-crowned rosy finch	May 31
Gray jay	
Gray-cheeked thrush	
Green-winged teal	May 25
* Harlequin	June 5
* Horned lark	
Lapland longspur	May 18
* Long-tailed jaeger	June 14
Northern junco	May 25
Raven	May 18
Robin	May 18
* Rock ptarmigan	May 20
Sandhill crane	June 5
Say's phoebe	
Smith's longspur	
Spotted sandpiper	
** Surfbird	July 6
Townsend's solitaire	
Tree sparrow	
* Wandering tattler	
Water pipit	
White-crowned sparrow	
* Willow ptarmigan	June 14
Wilson's warbler	
Yellowrump warbler	June 10

---

\* Species known to breed on study area.

\*\* Northern-most breeding record.

APPENDIX A: BIRDS IN RICHARDSON MOUNTAINS - 66° 33' to 66° 50'N  
OBSERVED MAY 20 - JULY 30, 1978 - BY R. FRISCH.

<u>SPECIES</u>	<u>DATE FIRST SEEN</u>
* Canada goose	May 30
Black brant	May 25
Mallard	May
Green-winged teal	May
Scoter	May 25
Goshawk	May 21
* Sharp-shinned hawk	
Bald eagle	July 28
* Harrier	May 21
* Merlin	
* American kestrel	May 27
* Willow ptarmigan	
Rock ptarmigan	
Sandhill crane	July 2
* Golden plover	May
* Surfbird	May 22
* Snipe	May 21
Whimbrel	May 29
* Upland sandpiper	May 21
* Spotted sandpiper	May 31
* Wandering tattler	May 24
Baird's sandpiper	May 22
Parasitic jaeger (?)	May 29
* Long-tailed jaeger	May 22
Herring gull	May 29
* Hawk owl	July 24
* Short-eared owl	
* Flicker	May 21
Arctic three-toed woodpecker	
* Say's phoebe	May 30
* Horned lark	May 21
Cliff swallow	May 29
* Gray jay	
* Boreal chickadee	
* American robin	May 20
* Varied thrush	May 20
Swainson's thrush	May 29
* Gray-cheeked thrush	July 1
* Wheatear	May 30
* Townsend's solitaire	May 28
* Ruby-crowned kinglet	May 21
* Water pipit	May 21
Bohemian waxwing	
Orange-crowned warbler	July 17

- cont'd -

SPECIESDATE FIRST SEEN

* Yellow warbler	July 2
* Yellow-rump warbler	May 21
* Northern waterthrush	May 30
* Wilson's warbler	May 31
* Pine grosbeak	May 20
* Rosy finch	May 28
* Redpoll	
White-winged crossbill	
* Savannah sparrow	May 25
* Northern junco	May 21
* Tree sparrow	May 20
White-crowned sparrow	May 21
Golden-crowned sparrow	July 3
* Lapland longspur	May
* Fox sparrow	May 21
* Smith's longspur	May 30

---

\* Species known or believed to breed in the region ( R. Frisch)

APPENDIX B

SHEEP USE OF ROCK RIVER MINERAL LICK

Date	Total Sheep	Ewes	Yearlings	Lambs	Rams	Nursery
May 17	6	4			2	
May 18	5	4	1			
May 19	1	1				
May 29	6	4	2			
May 30	6		2			4
May 31	12	8	4			
June 1	1	1				
June 2	1	1				
June 4	1				1	
June 8	3				3	
June 9	11	4	3	1	3	
June 10	5	3		2		
June 11	6	3	1	2		
June 15	4				4	
June 16	6	1		1	4	
June 17	9	2	1	2	4	
June 28	7	4	2	1		
June 29	8	3	1	1	1	2
June 30	6	4	1	1		
July 1	6	3		2	1	
July 2	5	3		2		
July 3	6	1			5	
July 11	4	2		2		
July 15	15	1		1	3	10
Aug. 4	1				1	
Aug. 8	10	5	1	2	2	
Aug. 9	3	2		1		
Sept. 1	2				2	
<b>TOTALS:</b>	<b>155</b>	<b>64</b>	<b>19</b>	<b>21</b>	<b>36</b>	<b>16</b>

SHEEP USE OF TETLIT CREEK MINERAL LICK

Date	Total Sheep	Ewes	Yearlings	Lambs	Rams
<u>July</u>					
12	8	2	3	1	2
13	9	4	2	3	
14	0				
15	0				
16	21	11	2	8	
17	7	5	1	1	
18	0				
19	0				
20	2	1		1	
21	7	3	1	2	1
22	1				1
23	9	6	1	1	1
24	1				1
25	23	12	1	9	1
26	2	1		1	
27	0				
<b>TOTALS:</b>	<b>90</b>	<b>45</b>	<b>11</b>	<b>27</b>	<b>7</b>

## APPENDIX C

Plant species collected on Mt. Cronin study area.

(Not yet completed since some critical specimens were sent to experts for identification)

## APPENDIX D

Surveys on winter distribution of the Mt. Cronin sheep population

# Government of Yukon



BOX 2703, WHITEHORSE, YUKON Y1A 2C6

TELEPHONE 403-667-5811

TELEX 036-8-260

## WILDLIFE BRANCH

OUR FILE 3997-5-18  
YOUR FILE

79 02 15

### Sheep Survey Report - Mt. Cronin Population, February 4, 1979

Time: 1:10 P.M. - 3:05 P.M.

Temp.: -23°C

Recorder: D. Russell

Observers: Art Martell, C.W.S.  
Dan Drummond, Wildlife Branch

Pilot: Ed Olsen

Helicopter: 206B

On February 4, 1979 we left Dawson to conduct a survey of the Mt. Cronin sheep population in the Richardson Mountains. Total flying time for the day was 6.2 hours.

In the survey area (see accompanying map) most slopes were windblown and much vegetation was exposed. Sheep were located on ridges, normally at the heads of side valleys. No tracks were observed crossing valley bottoms. Since only two hours were available for the survey only the western half of the range was covered and not completely. We did not attempt to segregate the sightings since we tried to avoid harassment at all costs. It appeared that rams were mixed with the nursery in a higher proportion than found in the summer. Sightings below refer to map references.

.../2

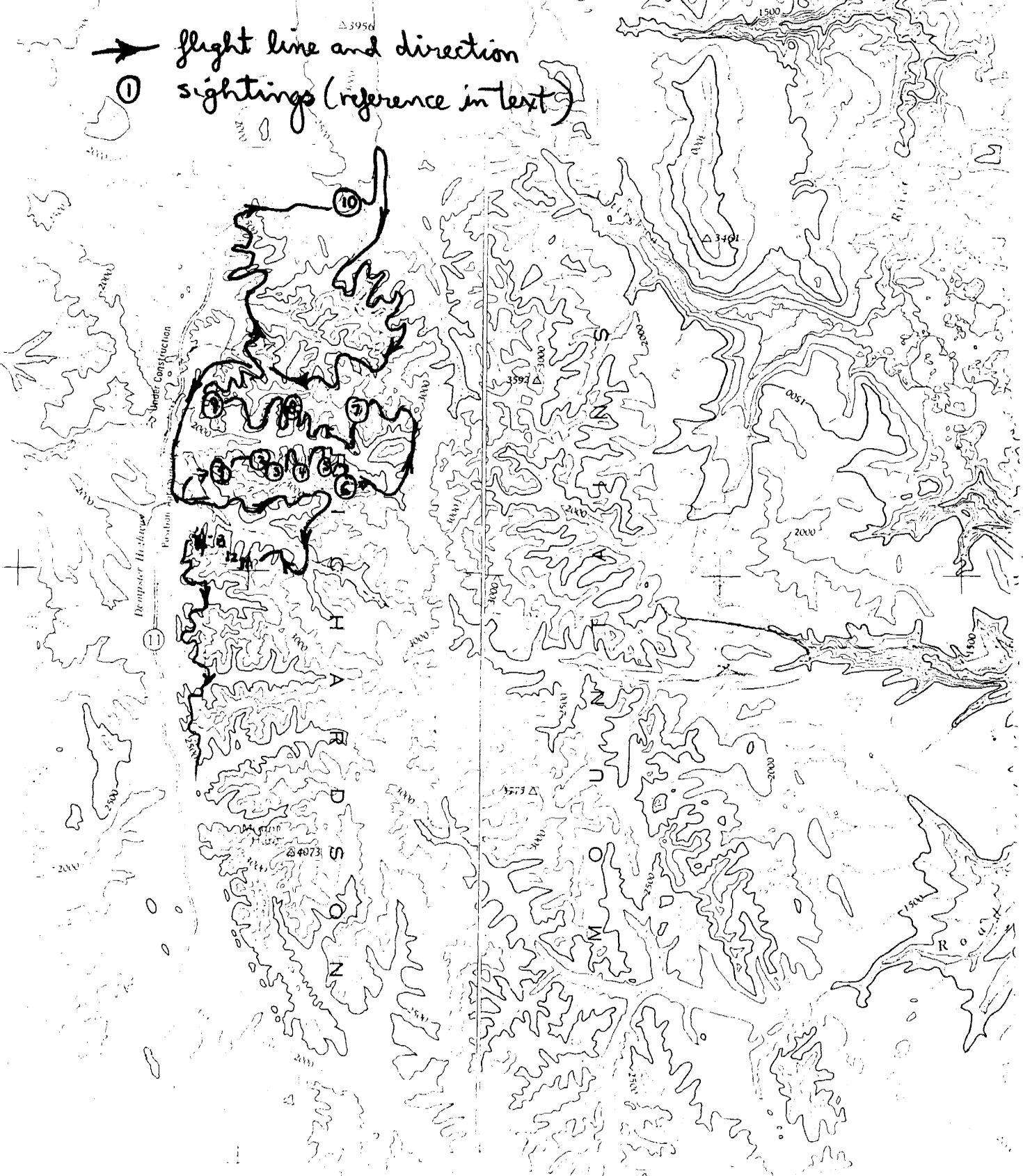
1 2 wolves on ridgetop  
2 3 sheep  
3 9 sheep  
4 1 sheep  
5 5 sheep  
6 2 sheep  
7 11 sheep  
8 4 sheep  
9 4 sheep  
10 4 rams, large, full curl  
11 3 sheep (including 1 full curl ram)  
12 10 sheep  
13 3 sheep  
14 1 sheep

---

60 sheep observed

30' 15' N W T 136°00' 45' 30'

→ flight line and direction  
① sightings (reference in text)





## WILDLIFE BRANCH

OUR FILE 3997-5-18

YOUR FILE

79 04 17

### OBSERVATION ON SHEEP IN MT. CRONIN AREA

Date: March 29, 1979

Recorder-Observer: Dan Drummond, C.O. (Dawson)

Observer: C. McPherson, R.C.M.P. officer

Weather: Sunny and cold (-25°C)

Aircraft: T.N.T. Jet Ranger helicopter  
Rod Watt - Pilot

Altitude flown was basically from mountain top to mountain top.

This was not a survey, but a brief over-flight when returning from Ft. McPherson on an enforcement issue.

While the locations where sheep were observed can be considered winter ranges, they are not all winter ranges since the flight route was in a straight north - south line, nor will the number of sheep seen on them be a complete assessment of sheep wintering in this area at this time.

The following observation points refer to numbers on the map attached.

- (1) 4 rams (3 Class IV, 1 Class III)
- (2) 2 ewes, 1 lamb
- (3) 3 sheep (all appeared to be ewes)
- (4) 1 ram, 5 other sheep (ram was Class II)
- (5) 3 sheep - no mature rams
- (6) 3 sheep (one Class II ram)
- (7) 3 sheep - no adult rams

TOTAL 25 sheep

Mt. Cronin Survey  
Page 2

This distribution is very similar to the one found by Don Russell, Art Martell and Dan Drummond on February 4, 1979, except that some sheep (#7) were found even farther south. Observations #5, 6 and 7 extend the range of this population for a considerable distance to the south. During summer sheep have not been observed to use these ranges.

M. Hoefs

(written from notes supplied  
by Dan Drummond)

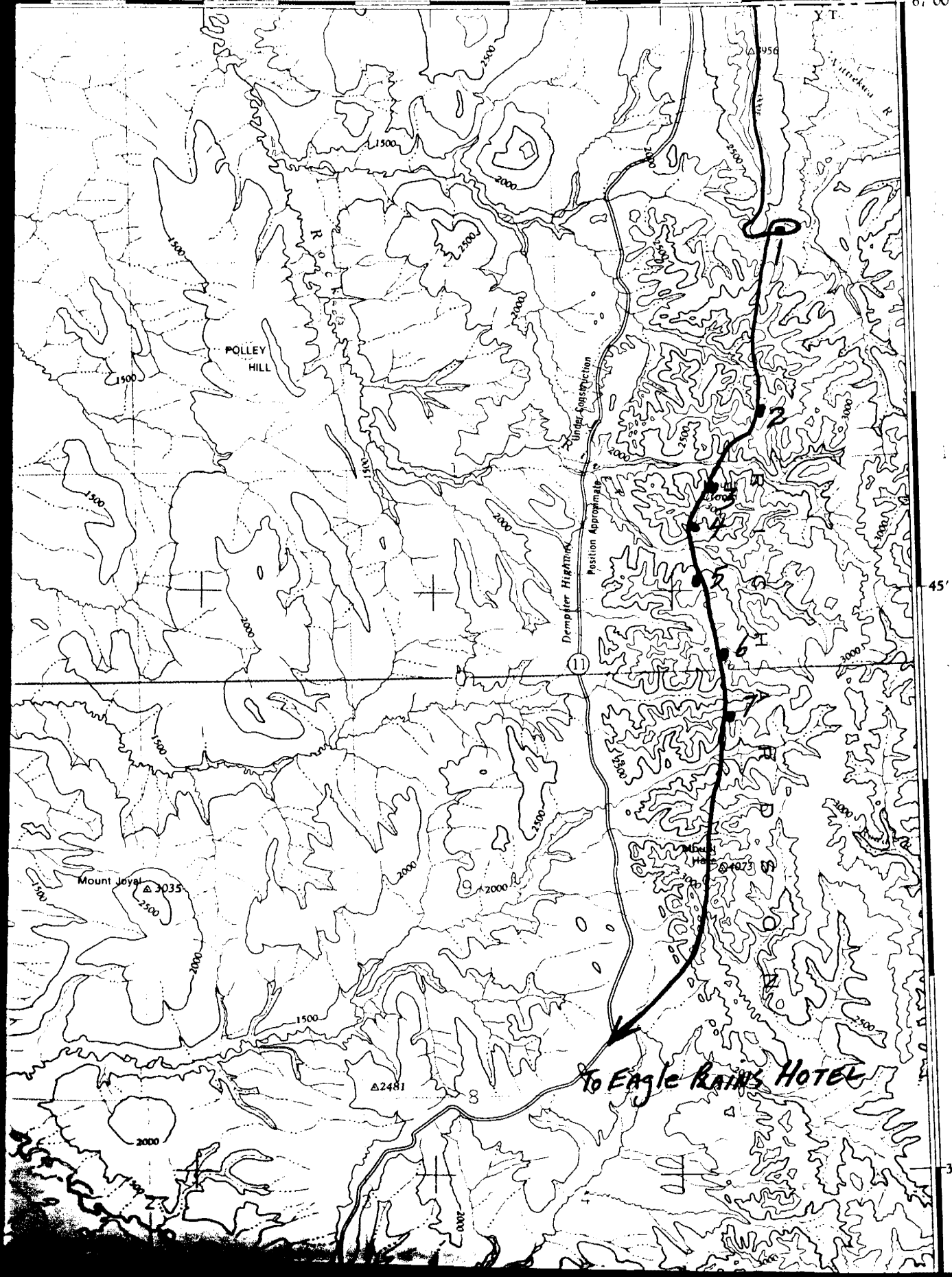
45'

30'

15'

N W T 136° 00'

67° 00'



APPENDIX E

APPROXIMATE COST OF PROJECT

A. D.I.A.N.D. Contribution		B. Y.T.G. Contribution	
1) Salary and fringe benefits			
M. Hoefs, project leader -			
planning, supervision,			
aerial surveys, editing			
report, etc.			1,500.00
S. Russell, field biologist			
\$7,545.41			
P. Lortie, lab technician -			
plant identification and			
mounting			2,000.00
2) Travel costs:			
	280.95		400.00
3) Office supplies:			
	17.78		
4) Materials and Supplies			
(field equipment, food,			
aircraft gas, etc.)			
	6,619.22		
5) Rentals (aircraft, truck)			8,997.00
	4,813.99		
6) Labour and maintenance			
	189.00		
	<hr/>		<hr/>
TOTALS	\$19,466.41		\$12,897.00

Overall cost of project: \$32,363.41