CRITICAL AREAS FOR DALL'S SHEEP

(*Ovis dalli dalli*)

IN THE OGILVIE MOUNTAINS

with Recommendations for

Dempster Highway Corridor Management

prepared by

Donna L. Stewart

November, 1980

Table of Contents

Table of Contents (Continued)

List of Figures

List of Tables

ACKNOWLEDGEMENTS

My gratitude extends to all those helped during the field season, but especially to the following: Manfred Hoefs for his patience and direction; Valerius Geist for his infectious enthusiasm and Norman Barichello for his help and support, not to mention a few laughs, whenever needed. I would also like to thank Mark Lesky and Ross Eccles of Foothills Pipe Lines (Yukon) Ltd. Their assistance and support is much appreciated. I would be remiss in not mentionning the able pilots who got us into the air for surveys, and more important back down to earth again: Cliff Hendrix, Kerry Gunter and Ron Zborill.

SUMMARY AND RECOMMENDATIONS

The south Ogilvie Mountains

The Dall's sheep population in this area is most susceptible to disturbance from May 5 to June 20. At this time ewes, lambs and yearlings occupy 2 lambing areas between km 85 and 94 on the east side of the highway. At least 29 lambs were born there in the spring of 1980, vacating the cliffs on or about June 17. Sheep range on both sides of the road and it is likely that there is some crossing occuring. There have been crossings reported but there were none witnessed this year. Although no lambing areas were identified on the west side of the highway, nursery herds do use the area. A maximum of 30 lambs were seen on one day, bringing lamb recruitment for the south Ogilvie Mountains to 59.

One mineral lick was located 15 km east of the road at km 80 but its use was not investigated. It is the only lick known in the area.

The population is estimated to be 221 sheep: 59 lambs, 128 nursery sheep and 34 rams.

The following recommendations are made as a result of this study:

1. There should be no spot developments on the east side of the highway between km 85 and 94. This area is important as lambing grounds and winter range.

2. Construction in the North Fork Pass area should not be permitted in May and June. It should be

limited to times when lambing cliffs are unoccupied.

3. Air traffic should be strongly encouraged to avoid the above mentionned area. Flight oriented over the centre of the valley would be less disturbing to sheep.

4. Further study is necessaary to determine the extent of seasonal movements across the Dempster and to document whether the few observed crossings were random wanderings or regular migrations.

5. The present ban on firearms discharge within the Dempster Highway Corridor should continue. Mature rams are not well-represented in the population and this may be a function of earlier hunting pressure.

The central Ogilvie Mountains

This population of Dall's sheep is probably the least understood of any accessible group in the Yukon Territory. Lambing areas and winter ranges have not been located and there are probably less than 50 sheep in the entire area. However, there are of concern because mineral licks between km 178 and 187 draw them to Engineer Creek and onto the Dempster Highway.

The two major licking areas are at km 180 and km 186. Use is greatly concentrated between 1000-1400 hours and is most intense in mid-June. Rams tended to use the licks earlier in the summer than the nursery sheep and the two groups were never at the licks together. The licks are not heavily used and licking occured during 5.25% of all observed time at the km 180 lick and 17.84% at km 186 lick. Nevertheless, these are the only licks identified and play an important role in supplying the necessary minerals to the sheep.

From the summer's observations the estimated population is 31 sheep: 8 lambs, 9 nursery sheep and 14 rams.

The following recommendations apply specifically to the central Ogilvies:

1. Traffic should be encouraged to drive at reduced speeds in the lick area from km 173-189.

2. Signs should be erected immediately to warm motorists of wildlife in the road. Of special concern is km 180 where sheep cross the road from west to east to reach the lick.

3. Construction should not occur during May, June and July to prevent disturbance of sheep at the mineral lick.

4. Air traffic should completely avoid the narrow Engineer Creek valley between km 173 and 189.

5. Spot developments, especially services, should centre at the Ogilvie River where there is present developments of a campground at Sapper Hill and a highway maintenance camp.

6. Sheep here should be radio-collared and monitored in order to obtain an understanding of their seasonal movements and to locate lambing grounds and winter areas.

There is no evidence at present, examining only Dall's sheep, supporting restricted use or closure of the Dempster Highway. Nor are there major obstacles along the corridor generally. The biggest challenge to management is presented by the Engineer Creek mineral licks. Over time, will the sheep stop using the licks as traffic increases? Or, will the sheep become habituated to people creating a hazard similar to the tame bighorn sheep of the Rocky Mountain parks? This can be avoided with a good public awareness programme. Well-meaning hikers pursuing "non-

consumptive" activities can cause as much disturbance as hunters. Hikers sould be discouraged from chasing animals for photographic or other reasons by education, not regulation. A publication concerning wildlife along the Dempster should be produced immediately to inform travellers about sheep ecology and behavior to encourage better understanding and interaction. The Dempster Highway Corridor is receiving a good deal of air traffic, especially by helicopter. Pilots should be made aware of critical wildlife areas and encouraged to avoid them.

Finally, the management of the Dempster Highway Corridor must not look at these recommendations in isolation. Bears, caribou, moose and falcons must all be considered in order to have a complete view of wildlife of the corridor. Only then will manangement ensure wise use of our valuable wildlife resources.

INTRODUCTION

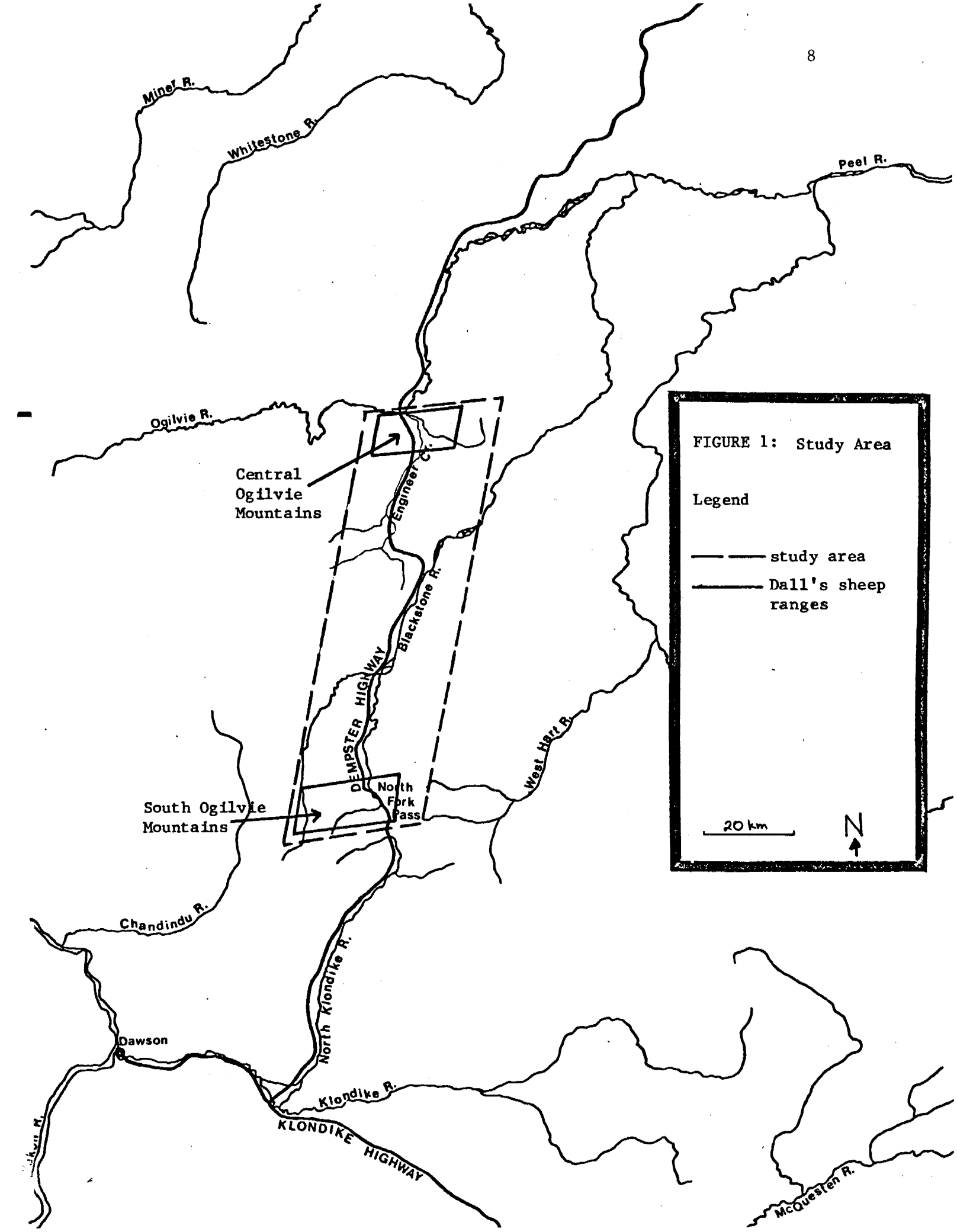
From May to August 1980, a Dall's sheep (*Ovis dalli dalli*) investigation was conducted in the Ogilvie Mountains within the Dempster Highway Corridor. The objectives of the study were to identify the criticial areas for sheep and to document their use in order to anticipate possible conflicts of development along the corridor. The study was directed towards the recommendations of management strategies to mitigate conflicts.

Dall's sheep in the Ogilvie Mountains have been studied previously. Larsen (1978) conducted aerial surveys in order to obtain a population estimate in Game Management Zone 2. Hoefs (1979) and Eccles (1980) identified critical areas in the vicinity of the Dempster Lateral Pipeline. Eccles' was the first study to concentrate on winter ranges.

Lambing areas and mineral licks were of prime concern due to their close proximity to the highway and their importance to the sheep's survival. Study was concentrated in the southern and central Ogilvie Mountains, between North Fork Pass and the Ogilvie River (Fig. 1). Lambing areas were investigated, described and mapped. The lambing period and peak of lambing were determined. Duration and frequency of mineral lick use at Engineer Creek was examined.

The project was funded for the major part by the Yukon Territorial Government from an inventory budget, Canada-Yukon Subsidiary Agreement on Renewable Resource Information and Tourist In-

dustry Development. In addition, Foothills Pipe Lines (Yukon), Ltd. provided funding to aid field expenses for this research which was pursued as part of a Master's Degree Project by the investigator. The University of Calgary, Calgary, Alberta assisted the investigator logistically by providing some of the required field equipment.


Miner R.
Whitestone R.
Peel R.
Ogilvie R.
Central
Ogilvie
Mountains
Engineer Cr.
Blackstone R.
DEMPSTER HIGHWAY
West Hart R.
North
Fork
Pass
South Ogilvie
Mountains
Chandindu R.
North Klondike R.
Dawson
Klondike R.
KLONDIKE HIGHWAY
McQuesten R.
FIGURE 1: Study Area
Legend
study area
Dall's sheep
ranges
20 km
N

STUDY AREA DESCRIPTION

The study area is located in the South Ogilvie Mountains Ecoregion (Oswald and Senyk 1979). It is characterized by rugged mountain topography and lies above 1000 metres a.s.l. The area drains northeast by the Peel River via its tributaries Hart, Blackstone and Ogilvie Rivers (Fig. 1). Precipitation is about 635 mm and the mean annual temperature is -7° C. The study area is underlaid by discontinuous widespread permafrost. The tree line is at 1050 metres and trees are limited to protected valleys occuring as stand of black and white spruce. Shrub birch and willow form the most extensive communities, from valley bottom to well above treeline. Gentle slopes support sedge tussock and hummock fields, which usually contain ericaceouse shrubs, prostrate willows, forbs and moss. Sphagnum is common on the sides of and between hummocks. Alpine areas have tussock fields where drainage is not rapid. Well-drained rocky, but stable, alpine slopes are dominated by prostrate ericaceous plants, willows and lichens. Loose rocky or scree slopes are frequently devoid of vegetation.

The study area chosen is bounded on the north by the Ogilvie River, on the the south by the West Hart River valley and is centred about the Dempster Highway (Fig. 1). Of major interest was the area within the Dempster Highway Corridor itself, stretching 8 km on either side of the road, but topographic characters were chosen for east and west boundaries.

The area was then divided into two portions: the south Ogilvies in the North Fork Pass area (Fig. 2); and the central Ogilvies which included the Engineer Creek mineral lick (Fig. 3).

N

5km

FIGURE 2: South Ogilvie Mountains Study Area

Legend

■ lick

lambing areas
1) Jensen's Cliff
2) Sheep Mountain

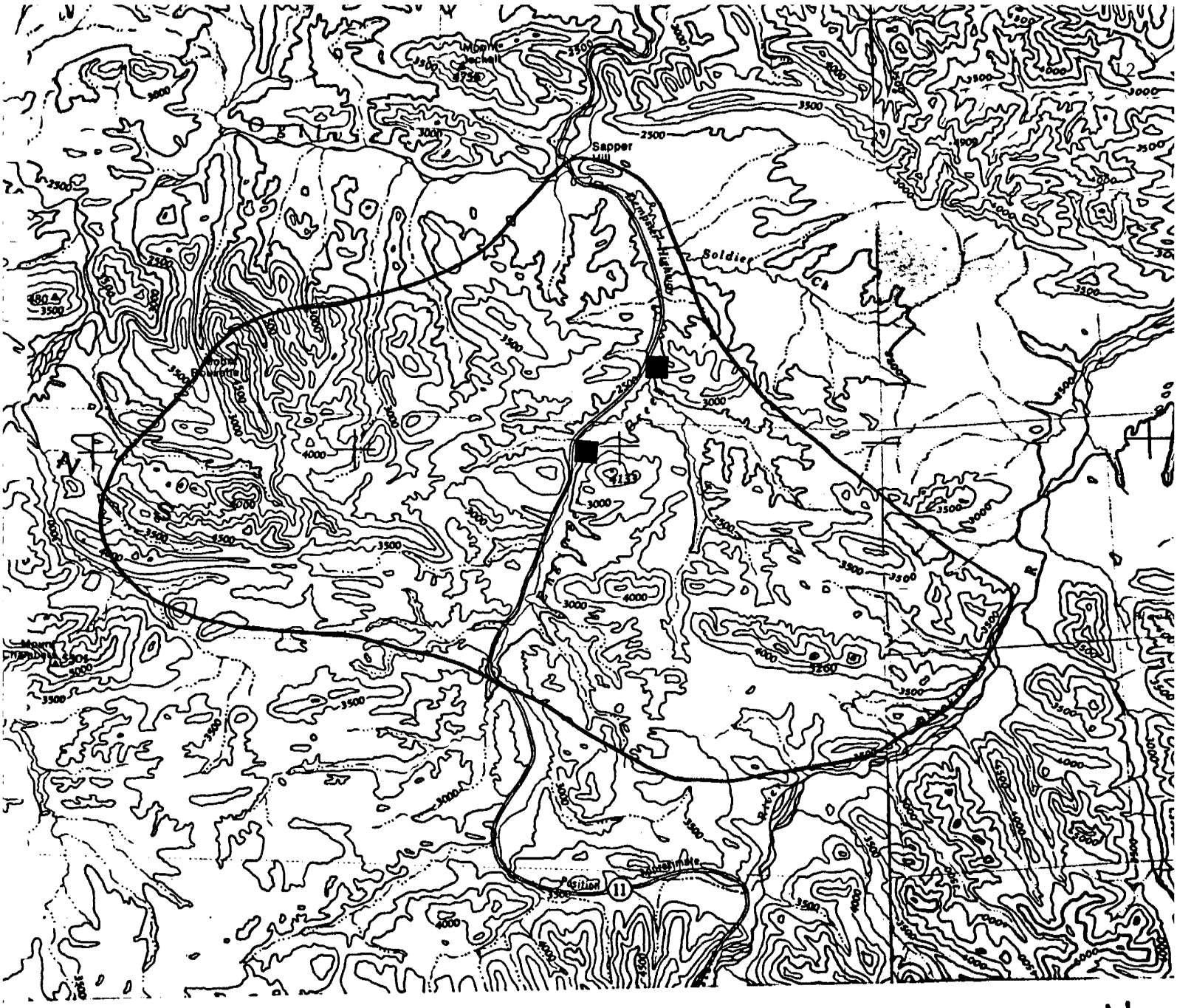


FIGURE 3: Central Ogilvie Mountains Study Area

Legend

■ lick

——— study area

METHODS

Mineral Licks

The licks in the central Ogilvies were observed for a total of 208 hours and 10 minutes. The northern lick was observed for 135 hours and 9 minutes and the south was watched for 73 hours and 1 minute. The day was broken into 6 observation intervals: 0200-0600 hours; 0600-1000 hours; 1000-1400 hours; 1400-1800 hours; 1800-2200 hours and 2200-2400 hours. No observations were made between 2400 hours and 0200 hours. The time observed was not equal in all observation intervals. Observations were made from a vehicle, from the hillside adjacent to the lick or from a concealed place in the willows. The lick areas were also covered on foot.

A camera and intervalometer were set up to film a particular area of the km 186 lick. The interval between photographs was approximately 3 minutes.

Two different areas were monitored: one for 4 days and the other for 27 days. The areas photographed are shown in Photographs 1 and 2 in Appendix 1.

The licks were not easy to monitor as there was no one location from which either lick could be seen in entirity.

Soil samples were collected from various licking spots at both licks.

Lambing Areas

The two major lambing areas identified by Hoefs (1979)(Fig. 2) were monitored regularily in order to obtain an accurate picture of use and the number of lambs born. Observations were generally made from the road with the aid of binoculars, a monocular spotting scope and a binocular 20-40X scope. It was necessary to have 3 stops at the Jensen lambing area and 2 stops at the southern lambing site in order to completely cover the areas. In addition, all western valleys were surveyed with the aid of the large scope on each day. Both lambing areas and several side valleys were covered on foot. A total of 28 days during May, June and July were spent in the south Ogilives, surveying the lambing areas and sheep were seen on 14 of those days.

Population Structure

A helicopter was used to survey sheep populations in both the south and central Ogilvies. A total of 7 flights were made (Appendix 2). During the flights, sheep were classified using Geist's classification (1971a) as ewes, lambs, yearlings, Class I rams, Class II rams, Class III rams and Class IV rams. However, viewing conditions did not always permit this detailed classification and it was not always followed if it would result in undue harassment of sheep. On those occasions sheep were classified as ewes, lambs, nursery sheep and rams.

Observations of reliable observers were included. In particular the following people contributed observations: Norman Barichello, University of British Columbia and World Wildlife Fund gyrfalcon study; Manfred Hoefs, Dan Drummond, Barney Smith, Dave Mossop and Christine Boyd of the the Yukon Wildlife Branch; and local people such as Bob and Julie Frisch and the highway workers at Ogilvie Camp.

All locations given in this report refer to the kilometre posts as they were this summer. Fractions of kilometres were measured using the odometer of a Chevette automobile.

THE SOUTH OGILVIE MOUNTAINS

Mineral Licks

One mineral lick was located in the south Ogilvies (Fig. 2; Photo 5 in Appendix 1). It is approximately 15 km east of the highway. Located on a northwest-facing slope it appears as water seepage on a well-vegetated slope. The lick was not located until July 15 and the extent of its use was not monitored. On the day sighted, 42 sheep were in its vicinity. The muddy lick was completely covered with tracks and well-established trails led to it (Photo 6 in Appendix 1).

Soil samples were collected, but analysis has not yet been completed.

Lambing Areas

East of the highway

There are two major lambing areas east of the Dempster Highway that are readily susceptible to disturbance by activity centred about the highway (Fig. 4). The southern site is located at km 87 and will be referred to as Sheep Mountain (Photo 3 in Appendix 1). The northern lambing cliffs are located directly east of Jensen's outfitting camp at km 93 and are referred to as Jensen's Cliff in this report (Photo 4 in Appendix 1).

These two areas were observed from the highway on 28 days during May, June and July. Lambing began on or about May 5 when one lamb was sighted on Jensen's Cliff while flying survey with Foothills Pipe Lines (Yukon) Ltd. and progressed until May 22

when 9 lambs were seen at Sheep Mountain (Table 1) and 11 at Jensen's Cliff (Table 2). This was the maximum number of lambs sighted at the two areas from ground observations. The peak of lambing was on or about May 15. From ground observations only, the lamb to ewe ratio is 82 lambs : 100 ewes at Sheep Mountain and 92 lambs : 100 ewes at Jensen's Cliff. Aerial observations show that the maximum ratio on a given day was 100 lambs : 100 ewes at Sheep Mountain and 95 lambs : 100 ewes as Jensen's. Minimum ratios sighted were 36.4 lambs : 100 ewes at Sheep Mountain and 40 lambs : 100 ewes at Jensen's. Together, the maximum ratio was 96.7 lambs : 100 ewes on any one day and the minimum was 34.5 lambs : 100 ewes.

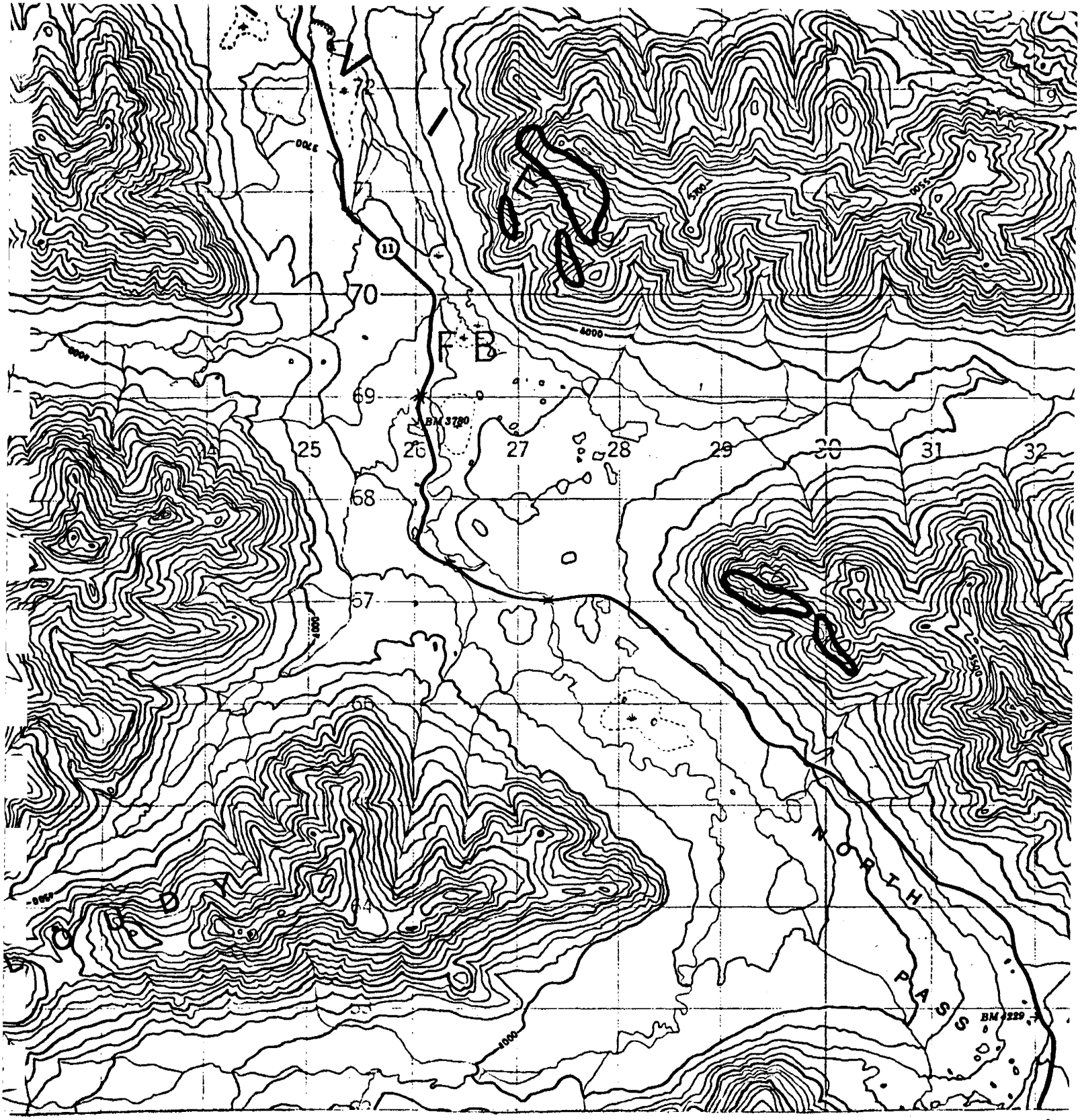


Figure 4: Lambing Areas in the south Ogilvie Mountains

Sheep Mountain to the south, Jensen's Cliff to the north

Table 1. Lambs Sighted at Sheep Mountain

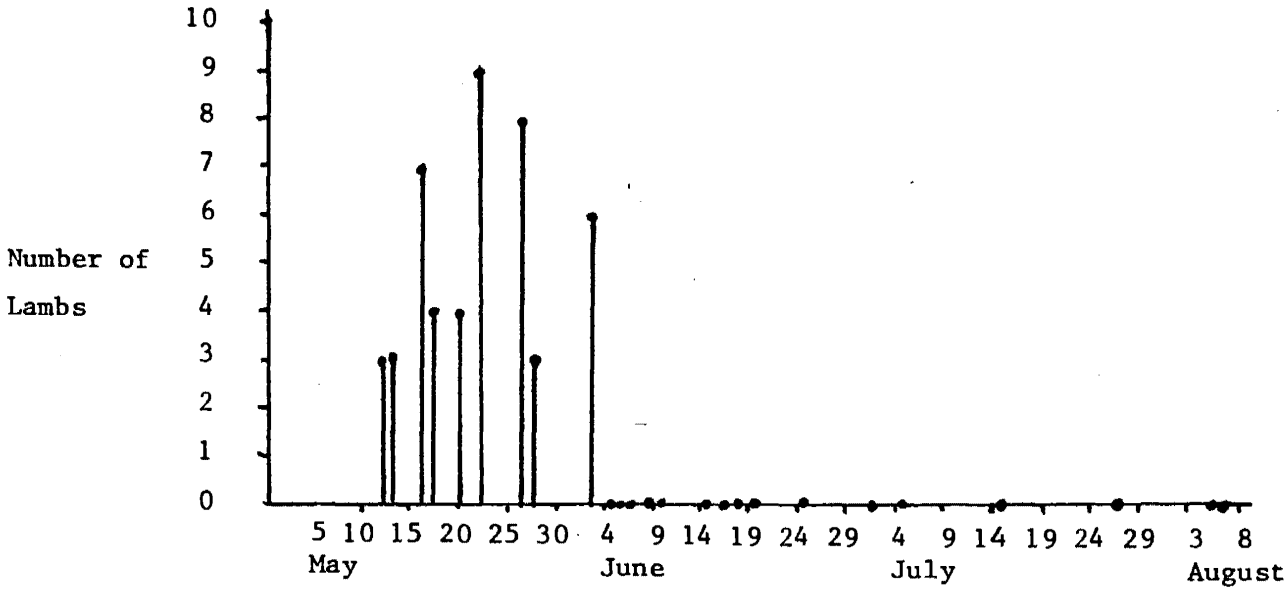
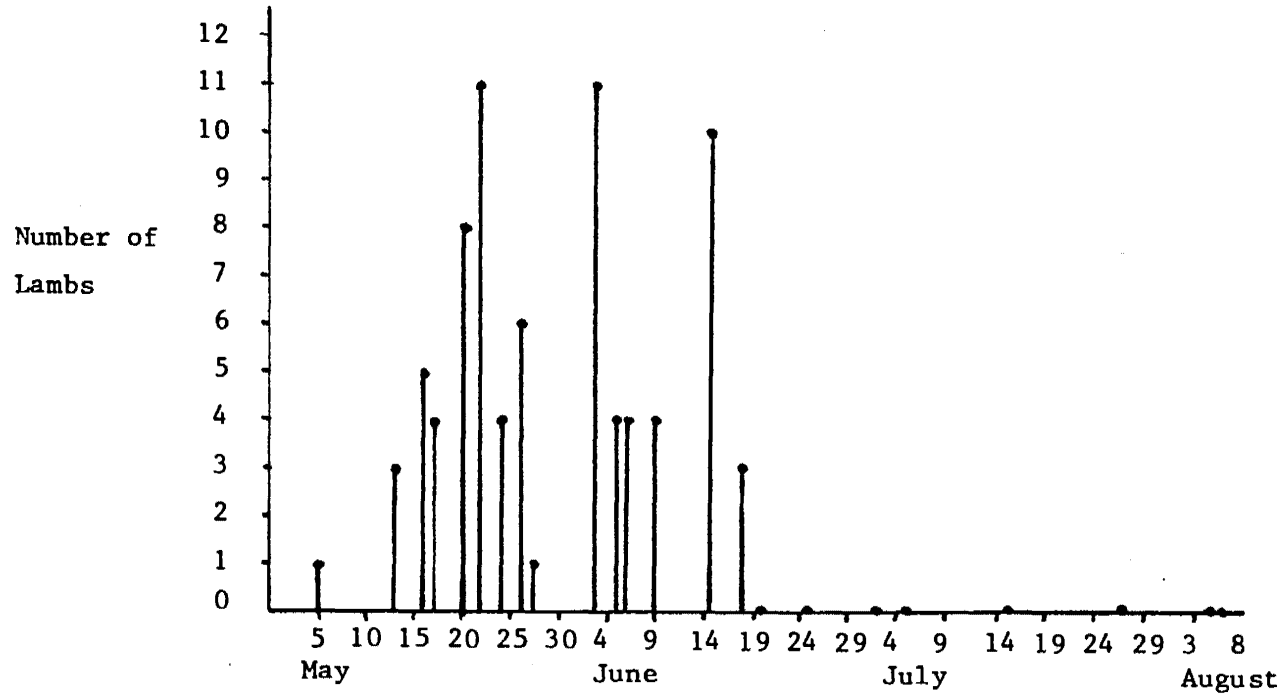


Table 2. Lambs Sighted at Jensen's Cliff



The nursery herds vacated the lambing areas in June: no sheep were sighted at Sheep Mountain after June 3 and at Jensen's, sheep were not seen after June 18. Observations were made at Sheep Mountain on 12 days after the last sighting and 9 observations were made at Jensen's after sheep were last sighted.

Three aerial surveys were made and lambs were sighted on two occasions at the lambing sites (Fig. 5). Observations are summarized in Table 3. The maximum number of lambs seen east of the highway was 29 on June 9. Thus, the lamb recruitment for 1980 was at least 29 on the east side of the highway.

Table 3. Aerial Survey Sightings

	Jensen's Cliff			Sheep Mountain		
	ewes	lambs	nursery sheep	ewes	lambs	nursery sheep
May 24	15	6	0	11	4	0
June 9	20	19	10	10	10	7

Figure 5: Possible Lambing Areas in the south Ogilvie Mountains

Legend:

possible lambing areas

West of the Highway

No specific lambing areas were pinpointed west of the highway although helicopter surveys showed that the area is used by nursery herds (Fig. 5). No sheep were viewed from the highway on this side of the road. The maximum number of lambs sighted on one day was 30. Lambing began on or about May 5 when 1 newborn lamb was seen from the air. Possible lambing areas west of the Dempster Highway are identifed in Fig. 5. These areas are unlikely to be disturbed by the Dempster Highway Corridor due to their distance from it. Rams have crossed the Blackstone River in this area (Barichello, pers comm) but it is unlikely that ewes with young lambs would cross due to the absence of escape terrain.

In summary, the south Ogilvies contain a productive lambing area between the West Hart River valley and Jensen's camp at km 93 and stretching both east and west of the highway. At least 59 lambs were born here during the 1980 season.

Winter Ranges

No winter ranges were identified in this study due to its seasonal nature. However, winter ranges have been documented on both sides of the highway with the majority being on the west (Hoefs 1979; Eccles 1980). Hoefs (1979) identifies winter ranges immediately adjacent to the Dempster Highway on both east and west sides (Fig. 6), but the western ranges were not utilized in 1980 (Eccles 1980). Most of the western groups sighted in 1980 were distributed over the northern half of the area with a single ram band repeatedly observed on the southernmost ridge system (Fig. 7). Eastern bands were sighted most often on the western bounds of the area and at higher elevations iln the ridge system immediately north of the West Hart River (Fig.7) (Eccles 1980).

Hoefs (1979) found that sheep occupy north- and west-facing slopes at the locations outlined in Fig. 6. Eccles (1980) reports sheep on or near southwest-facing cliffs (Fig. 7). The animals generally utilized windblown areas and snow-free, cliff-faced terrain, preferring southwest aspects. Ridge tops and northern aspects were of secondary importance in February and early March, respectively (Eccles 1980). East of the highway, sheep counts ranged from 21 to 46 individuals with an average of 31.8 animals; whereas, the average count westward was 52.2 sheep with counts ranging from 40 to 70 animals (Eccles 1980).

Figure 6: Winter Ranges in the south Ogilvie Mountains (after Hoefs 1979)

Legend:

winter range

Figure 7: Winter Ranges in the south Ogilvie Mountains (after Eccles 1980)

Legend:

areas of concentrated sheep sightings from flights during winter 1980

Population Structure

The sheep population structures east and west of the highway are outlined in Tables 4 and 5 respectively.

Table 4. Population Structure east of the Highway

	May 24	June 9	July 15
ewes	26	30	19
lambs	10	29	14
nursery sheep	0	17	7
Class I rams	2	0	1
Class II rams	2	4	2
Class III rams	0	1	1
Class IV rams	0	0	0
unclassified rams	2	0	0
TOTALS	42	81	44

Yearlings and class IV rams are not represented in this. Lamb recruitment here was reported to be a complete failure in 1979 (Hoefs 1979). This is supported by the lack of yearlings sighted. The absence of class IV rams could be the result of previous hunting pressures.

These figures represent individuals sighted on 4 separate helicopter surveys. It must be remembered that each survey only records the distribution on a given day and cannot be inferred to represent the entire population. There was limited time available for survey and this may account for the wide discrepancy in numbers. Variable viewing conditions, observer inexperience and desire to avoid undue harassment also contributed to variations

in counts.

A rough idea of the population can be extrapolated by adding together the maximum number of individuals in each cohort. Thus, the estimated population structure is outlined in Table 6. Together the sheep population of the south Ogilvies totals 142 individuals.

Table 5. Population Structure west of the Highway

	May 24	June 9	July 15
ewes	23	46	15
lambs	13	20	20
nursery sheep	15	17	31
yearling rams	1	3	0
Class I rams	0	4	3
Class II rams	3	5	4
Class III rams	1	3	2
Class IV rams	0	0	0
unclassifed rams	13	0	3
TOTALS	69	98	87

Table 6. Estimated Population Structure in the south Ogilvie Mountains

East of the highway

ewes	30
lambs	29
nursery sheep	17
Class I rams	2
Class II rams	4
Class III rams	2
Class IV rams	0
unclassified rams	2
TOTAL	86

West of the highway

ewes	46
lambs	30
yearlings	4
nursery sheep	31
Class I rams	4
Class II rams	5
Class III rams	2
Class IV rams	0
unclassified rams	13
TOTAL	136

THE CENTRAL OGILVIE MOUNTAINS

VISIT TO LICKS along Dempster highway.
(Re-designation of licks)

lick

Km 185 (784.4) Lick site
Ram on NE mtn.

Km 180 (789.4)

Km 179.4 (790.0) Lick site 30° (314, 2½)
P.P - Rap — 1330 hrs
(Photo looking N.)

Km 179 (790.4) Lick - fresh. (Photo) / 20-30 m from road

Km 178.3 791.1 Lick (Photo - N.) 25m of high
178.2 791.2 crossing willow between road & creek

Lick Use: Frequency and Duration

There is one large mineral lick area on Engineer Creek that is actually comprised of 2 separate licks. The licks are immediately adjacent to the Dempster Highway and present a serious management concern for sheep along the Dempster Highway Corridor in the central Ogilvies. The licks follow the Dempster from 178.8 km - 185.3 km and 185.7 km - 187.2 km, but the most heavily used areas are 179.1 - 180.3 km and 186.0 - 186.9 km (Fig. 8). The former lick will be referred to as km 180 lick, the latter as km 186 lick in this report.

The valley is quite narrow and the creek and the road consume virtually the entire valley floor. Steep scree slopes flank it. There were numerous licking locations identified with virtually all areas used at some time - the creek flood area, creek bottom, cut banks, roots of fallen trees and even an eroded cut at the road's edge. The sheep licked the mud and drier soil in all areas. Sulphur springs flow into Engineer Creek just south of km post 186 on the east side of the creek (Photo 7, Appendix 1). Both sides of the creek are used for licking and sheep were observed to readily cross the water. In both locations sheep utilize the road to cross the creek valley (Photo 16, Appendix 1) and in one instance the writer observed sheep running along the middle of the road for approximately 300 metres.

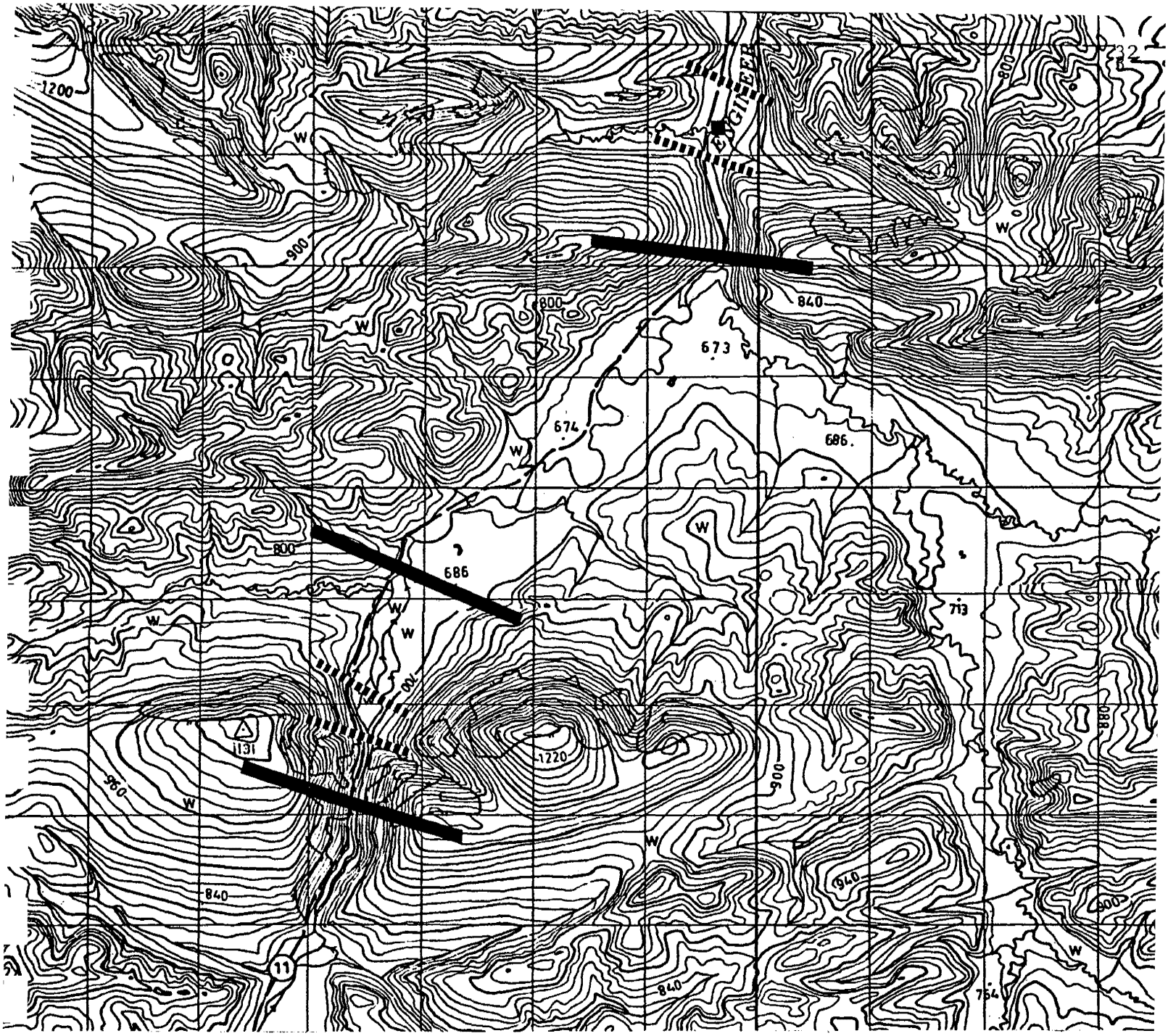


Figure 8: Mineral Licks in the central Ogilvie Mountains

Legend:

▬▬ lick area boundary (km 178.8 - 180.3 and km 185.7 - 187.2)

▪▪▪▪▪▪▪▪ area of heaviest use (km 179.1 - 180.3 and km 186.0 - 186.9)

■ location of sulphur spring

The mineral composition of the soil is unknown at this time, but samples were collected and are being analyzed. However, a water study was done (Schreier 1978) and the water in Engineer Creek is rich in the following: floride, uranium, chlorine, molybdenum, manganese, iron, zinc, sulphate and phosphorus. Iron enters the water upstream and is readily identifiable (Photos 8 and 9, Appendix 1). The black shales of the area are considered to be a substantial source of salts, minerals and metals found in Engineer Creek (Schreier 1978). Salt crusts of bedrock were found to contain gypsum (Ca CO), copper carbonates, elemental sulphur and iron sulphides and oxides. These salts can be seen at some licking spots on the surface of the soil (Photo 10, Appendix 1). Water samples taken from the km 186 lick area were found to have higher salt concentrations than other areas of Engineer Creek (Schreier 1978). Mineral licks are shown in Photos 11 to 35, Appendix 1.

Intensity of Use: Km 180 Lick

Engineer Creek in this area had several channels and km 180 lick comprised several licking areas along its banks (Photos 11 to 14, Appendix 1). Sheep usually came down the scree slope on the west side of the highway, crossing it to get to the water's edge (Photos 15 and 16, Appendix 1). One location was used repeatedly to cross and is marked on Photo 11.

This lick was observed for 73 hours and 1 minute and sheep were witnessed at or near the lick for 7 hours and 8 minutes. This lick was used less than the km 186 lick; having sheep near it for 9.77% of the time. Actual licking time was 3 hours and 44 minutes or 5.25% of the observed time. As is the case for both licks, sheep are attracted to this area solely for the lick (Fig. 9). The heaviest use is during the hours of 1000-1400 when 87.83% of all licking is done (Tables 7a and 7b).

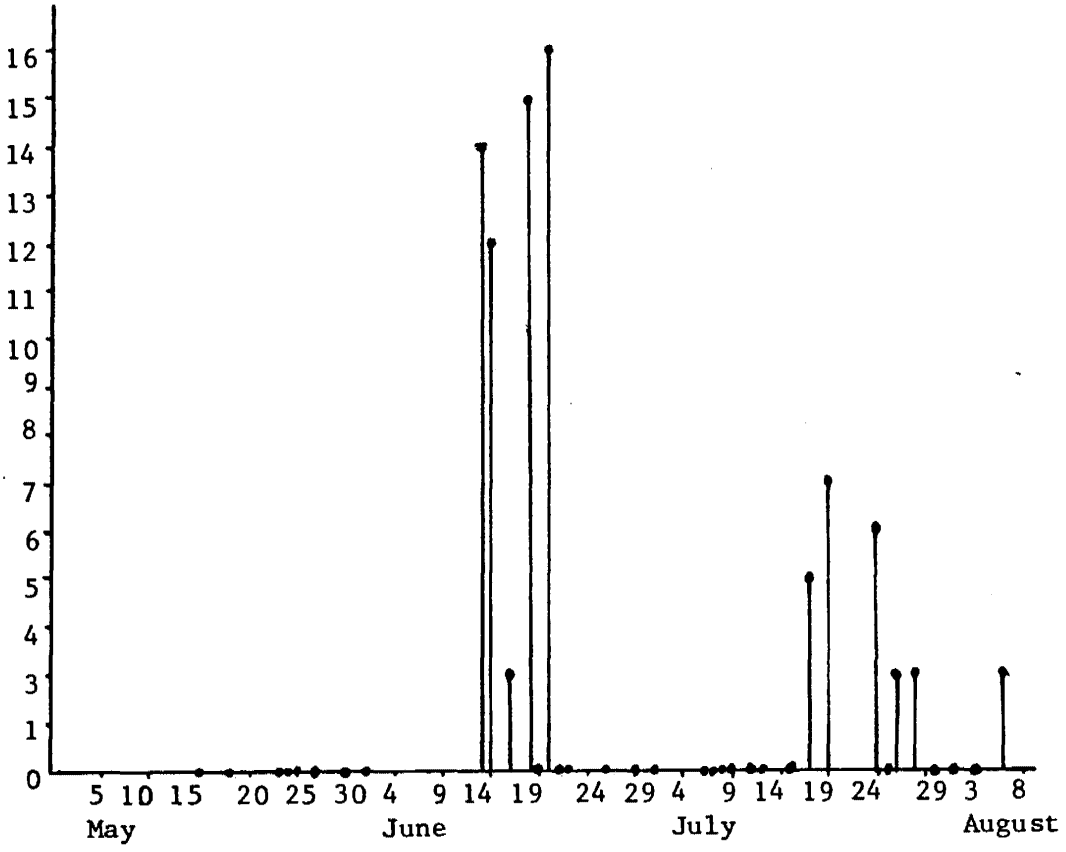


Figure 9. Sheep Sighted at Km 180 Lick

No sightings were made in May of sheep using the lick. Activity was greatest in mid-June with 5 of 11 searches resulting in sheep been seen. In July, use was concentrated in the last

Table 7a. Intensity of Use at Km 180 Lick: Proportion of time spent searching that sheep were seen

	Per cent of search time that sheep were nearby	Per cent of search time that sheep were at lick
Time		
200- 600	0	0
600-1000	1.05%	0.86%
1000-1400	20.24%	13.68%
1400-1800	11.98%	1.71%
1800-2200	1.22%	0.35%
2200-2400	0	0
TOTALS	9.77%	5.25%

Table 7b. Percentage of Sheep Sighted per Time Interval

	Per cent of total time sheep sighted	Per cent of total time sheep sighted at lick
Time		
200- 600	0	0
600-1000	2.34%	4.35%
1000-1400	69.85%	87.83%
1400-1800	26.17%	6.96%
1800-2200	1.64%	0.87%
2200-2400	0	0
TOTALS	100.00%	100.00%

two weeks of the month and sheep were seen on 5 of 15 searches (Fig. 9). Use of the km 180 lick varied with the km 186 lick where there was very little use witnessed during July.

Sheep were generally segregated by sex at km 180 lick (Table 8). Rams tended to use the lick earlier in the summer and after June 16, only 1 ram was seen at the lick.

Table 8. Sex Classification of Sheep Sighted at Km 180 Lick

Date	Rams	Nursery sheep
June 13	5	8
14	5	6
16	2	0
18	9	14
20	0	15
July 17	0	4
19	0	6
24	1	4
26	0	2
28	0	2
Aug 6	0	2

Intensity of Use: Km 186 Lick

The lick consisted of many licking spots along Engineer Creek (Photos 12 to 35, Apppendix 1). and it was observed for a total of 135 hours and 9 minutes. Of this time, sheep were observed at or near the lick for 36 hours and 57 minutes. Thus, sheep were seen 27.34% of the time that the lick was observed. However, the amount of time for which sheep were actually observed licking or right at the lick was much shorter - a total of 24 hours and 5 minutes. This is only 17.8% of the observed time. However, it is safe to say that all sheep seen in the vicinity of the lick have either visited the lick or are approaching it because it is the lick that draws the animals to the area. It is interesting to note that the major portion of licking is done between 1000 and 1400 hours, accounting for 24.95% of the total licking observed (Tables 9a and 9b).

Table 9a. Intensity of Use at Km 186 Lick: Proportion of time spent searching that sheep were seen.

Time	Per cent of search time that sheep were nearby	Per cent of search time that sheep were at lick
200- 600	0	0
600-1000	1.19	1.19
1000-1400	37.12%	24.95%
1400-1800	31.64%	22.08%
1800-2200	22.69%	8.12%
2200-2400	33.33%	0
TOTALS	27.34%	17.84%

Table 9b. Percentage of Sheep Sighted per Time Interval

Time	Per cent of total time sheep sighted	Per cent of total time sheep sighted at lick
200- 600	0	0
600-1000	0.59%	0.90%
1000-1400	47.59%	49.07%
1400-1800	42.99%	46.02%
1800-2200	7.31%	4.01%
2200-2400	1.53%	0
TOTALS	100.00%	100.00%

The greatest activity at the lick was during the latter half of May and all of June. Of 8 searches made in May, 5 were successful in seeing sheep using the lick; 8 of 17 searches in June were successful and only 4 of 18 searches in July resulted in sightings. Except for two sightings, there were no sheep seen between July 3 and August 6 even though 17 searches were made (Fig. 10). The largest group seen using the lick was 19 sheep on July 23.

Contrad. Figure - 4 sightings

Sheep were generally segregated at the lick with ram bands prevalent in the earlier sightings (Table 10).

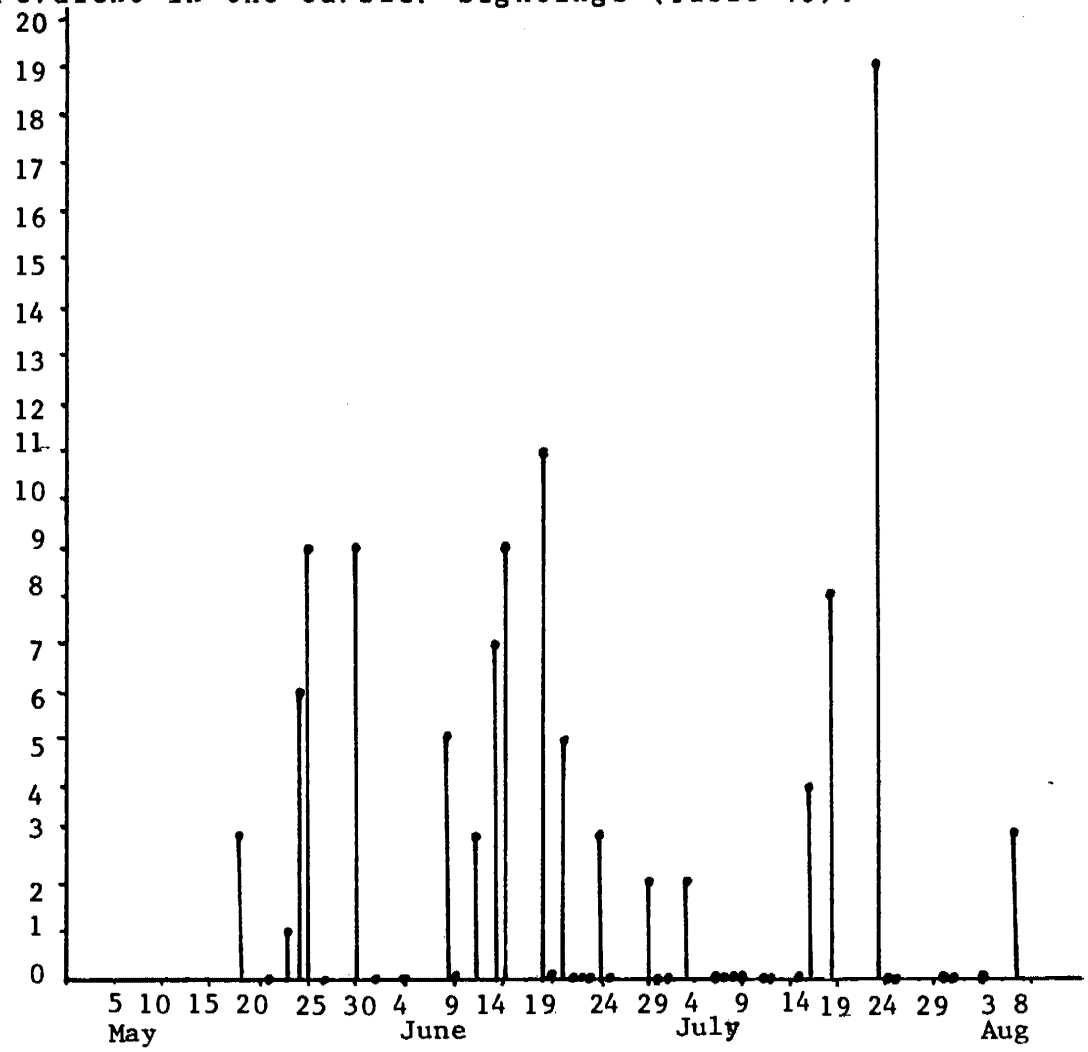


Figure 10. Sheep Sighted at Km 186 Lick

Table 10. Sex Classification of Sheep Sighted at Km 186 Lick

Date	Rams	Nursery sheep
May 18	3	0
23	1	0
24	6	0
25	9	0
30	0	6
June 8	3	2
11	3	0
13	0	7
14	0	9
18	3	8
20	0	5
24	0	3
29	0	2
July 3	0	2
16	0	4
18	0	8
23	2	17

Since the actual lick was utilized only 17.82% of the time, one might infer that it is unimportant to the sheep population. However, it is the only known lick in this part of the Ogilvies and the minerals obtained are necessary to the sheep's survival.

A movie camera and intervalometer were established to photograph a portion of the lick (Photos 1 and 2, Appendix 1). Initially, the camera was placed downstream from the major lick area and photography was directed in a southern direction. From May 24-27, approximately 96 hours were filmed. Sheep at the lick were in 13 frames, approximately 40 minutes time on May 25 from 1100-1140 hours approximately.

On May 27, the camera was moved to photograph the log lick (Photo 2, Appendix 1). It was possible to place the camera close to the lick, to improve resolution. Table 11 outlines the areas covered and the length of time filmed.

Table 11. Results of Log Lick Photography

Coverage	Date and time (hr:min:sec)	number of sheep (number of frames)
May 27-June 1	May 29 12:02:27-12:11:20	2 (3)
	May 30 12:55:08-12:58:05	1 (1)
June 1-7	June 3 17:06:10-17:17:58	5,2,2,2 (4)
	June 4 12:58:10-13:07:01	2,3,3 (3)
	June 4 14:17:49-14:23:43	1 (2)
	June 5 10:06:38-10:15:29	1 (3)
	June 7 06:17:40-06:26:31	3,0,2 (3)
July 11-15	no sheep photographed	
July 23-27	no sheep photographed	
July 30-Aug 3	no sheep photographed	

This data supports the suggestion that use is centred in mid-day and that the lick is not used very intensely. For that alone, it was a useful technology. However, there are problems in accepting the validity of this information. The time of sheep visits to the lick was calculated assuming a constant interval between

photographs. They were then roughly checked by reviewing the film and looking at shadow length and darkness. This gives a very rough correlation of time. The interval length can be affected by factors such as temperature, moisture and battery strength. Calibration of the interval length must be accurate. One hundredth of a second can add up to substanial disparity over a number of days.

The camera and intervalometer used did not permit sex-age classification of sheep due to the distance involved and low resolution. It was useful in providing information on presence or absence of sheep at the lick, especially when the observer could not be present.

Potential Lambing Areas

There were no lambing sites within or near the Dempster Highway Corridor identified by witnessing use. However, there were some cliff areas which could easily provide the necessary escape terrain and cover. These are located very near the Dempster and need to be monitored to confirm or disprove their use as lambing areas. Potential areas are shown in Fig. 11. The only lone ewe and lamb observed was in Area 1 on June 4. This area provides the best potential for lambing within this section of the Dempster Highway Corridor (Photo 36, Appendix 1).

Winter Ranges

There have been no winter ranges identified in the central Ogilvies within or near the Dempster Highway Corridor (Hoefs 1979; Eccles 1980). It is unkown where the sheep winter that use the Engineer Creek licks during the summer months, but Hoefs (1979) suggests that winter ranges are more than 8 to 18 km from the Dempster Highway Corridor.

Population Structure

In the central Ogilvie Mountains, there is a small population of sheep. This study was limited to south of the Ogilvie River, but sheep may cross the river and range northward (Hoefs 1979).

Larsen (1978) estimated the population to be 55 from actual observations of 42 sheep: 9 lambs, 26 nursery sheep and 7 rams. This year, the largest number of sheep sighted was 22. Extrapolating from each cohort, the estimated population is 31 sheep: 8 lambs, 9 ewes and 14 rams. The disproportionate number of rams leads one to suggest that the nursery sheep were undercounted.

This population is not well understood at all. Winter ranges and lambing areas have not yet been identified. It appears to be solely the presence of the mineral licks of Engineer Creek that bring sheep to the area, but it is not known where they spend the remainder of their time. They may travel quite some distance to reach the lick because on one survey there were no sheep sighted within 20 km of the lick.

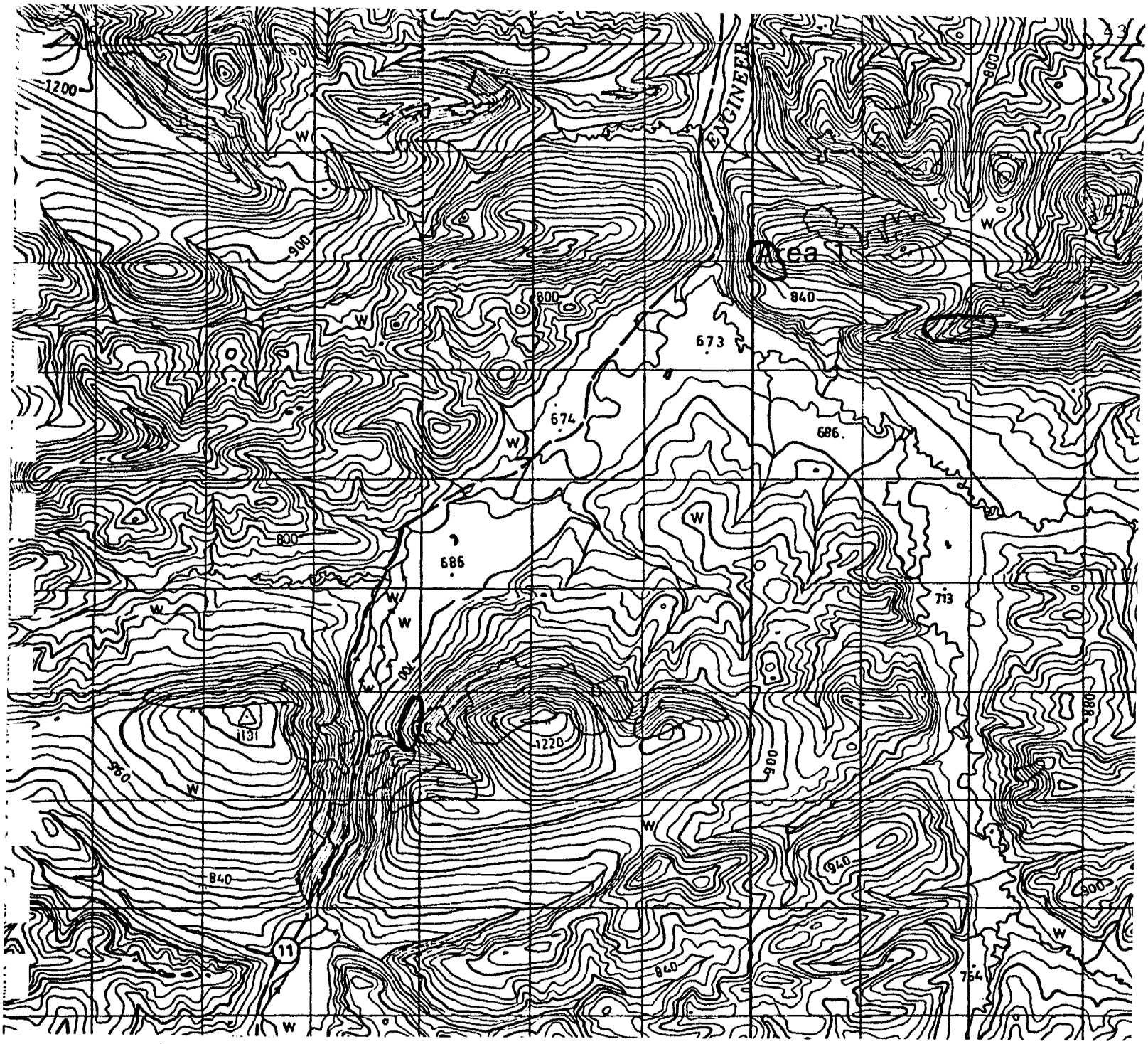


Figure 11: Potential Lambing Areas in the Central Ogilvie Mountains

N
1km

Legend:

potential lambing area (based on presence of escape terrain)

Area 1 location of maternal pair

DEVELOPMENT CONSIDERATONS

Vehicle Use of Present Road

Vehicular traffic increased dramatically over the summer months from 91 vehicles in May to 471 vehicles in June to 1407 vehicles in July. [These figures were taken from gasoline sales at Eagle Plains Lodge, the only gas station for over 400 km. Few vehicles pass by without buying gas there.] Sales for August were not available. It is logical to expect traffic to taper off in August, and decrease into September. The greatest number of vehicles in one day was 71 on July 17.

The greatest proportion of traffic was in late June, July and presumably early August. By this time, use of the Engineer Creek mineral licks had decreased and nursery herds had moved away from the lambing cliffs in the south Ogilvies. Thus, there is little disturbance of sheep by vehicles per se due to the timing of heavy traffic and use of critical areas. Sheep at the lambing cliffs were not generally disturbed by traffic. Early in May, however, ewes and lambs bolted from the grassy slopes, on which they were grazing, and headed into the cliffs when a hiker began climbing toward them. They did not return in the three hours that the area was observed.

Vehicle noise, especially from commercial traffic, can be disturbing. The author witnessed disruptions of activity at km 186 lick when large trucks stopped to view the sheep. The animals generally ignored moving vehicles but those stopping caused

disturbances.

Early in the spring, rams at the lick were quite skittish and ran into willows when the author left her vehicle. Later in the summer, sheep became accustomed to vehicles and people could walk about without disturbing the animals.

There is little in the literature that relates specifically to sheep and roads. Tracy (1977), studied the reactions of Dall's sheep to shuttle-bus traffic in McKinley National Park, Alaska. She found that the park road did not contribute to distributional changes in sheep, even though it received increasingly heavy use. The degree of disturbance varied with the distance of the animal to the road and lambs were never seen within 200 metres.

Actual vehicle traffic may affect the sheep population by increasing mortality in the central Ogilvie Mountains. The road along Engineer Creek is winding and it is a matter of time before sheep are injured or killed. An immediate mitigation would be to erect signs at km 175 heading north and km 187 going south to warn travellers of wildlife on the road. The danger to people stopped to view sheep is also of concern.

At the present time, the condition of the road and its low intensity use preclude major concern about this aspect of disturbance. However, if the traffic increases to justify road upgrading so that higher speeds are possible, the situation may become serious enough to warrant further study into the construction of an overpass or underpass for sheep to safely cross the road, especially at km 180.

It is uncertain whether or not traffic will ever become heavy enough to act as a barrier, creating two smaller ranges. If sheep are unable to travel to mineral licks and seasonal ranges, population decrease is inevitable.

The concern with traffic is not with the presence of the vehicles but rather with their occupants. Increased access will result in an influx of people. This will be addressed later in this report.

Linear Developments

The Dempster Highway Corridor is the initial choice for any type of linear development: pipeline, power line or even railway. The present highway is attractive as an existing facility, even though there are severe engineering problems associated with construction along it, particularily in the Engineer Creek area. Engineering not withstanding, there are valid arguments for a "corridor" concept of development (Berger 1977). Dempster Highway management should continue to embrace this concept and give it all due consideration in planning. If another linear development should occur near but not adjacent to the highway, problems may multiply. Knowledge is not advanced enough to predict if sheep would cross two separate developments of this type. Again, it is the central Ogilvies population that could be affected the most because wintering and lambing areas are not known.

Pipelines appear to be the most likely linear development to occur within the Dempster Highway Corridor. It is unknown whether tradition movements of sheep would be affected by pipeline construction and maintenance. It is reasonable to assume that some range desertion would occur but its permanence and extent is unpredictable. Temporary desertion from 50% of sheep habitat within 8 km of a pipeline has been proposed (Mutch 1977). However there is little evidence to support this figure. Sheep do not readily return to abandonned ranges (Hoefs 1979) but they can become habituated to some disturbances (Geist 1975; Reynolds 1974) such as noise.

Most harmful impacts can be avoided by locating developments away from critical areas and construction should avoid crucial time periods. Construction in the North Fork Pass area should not occur in May or June as it is in these months that potential for disturbance on lambing grounds is at its highest. Construction in the Engineer Creek lick area should be restricted to late summer, fall and winter when lick use is at a minimum. Habitat alteration of rights-of-way should not have a great influence on sheep. Normally, the sheep remain at elevations high above the valley floor. Winter ranges in particular are to be avoided.

Aircraft

Dall's sheep are generally accepted to be among the animals most sensitive to aircraft disturbances but their reponses show great variablity (Lenarz 1974; Nolan and Kelsall 1977; Reynolds 1974). There is agreement though that helicopters are considered more disturbing due to their low, slow and noisy flight (Horesji 1976, Linderman 1972). Because there is so much variation among observations of aircraft disturbance, there is no data available which can be used as a basis for the establishment of flight ceilings or corridors. It is logical to suggest that flights should avoid all critical areas and follow regular routes although a definitive figure for elevation and distance is not possible.

The above studies report that previous exposure to aircraft appears to influence response with sheep becoming habituated to frequent flights. Linderman (1972) found that sheep always appeared nervous though even if they did not run.

My own observations indicate that sheep are almost always running when first spotted from a helicopter and they run until exhausted or, if escape terrain is available, attempt to hide in cliffs.

Site Specific Development and Land Use

In this category are 'spot' developments such as mines, tourist facilities and maintenance camps. These should avoid critical areas at all costs. At the present time, there are no mining operations in the south and central Ogilvies but a great deal of exploration is occuring. Any application should be carefully considered so that conflicts can be identified and resolved.

Tourist facilites are minimal along the Dempster Highway. Campgrounds at North Fork Pass and Sapper Hill on Engineer Creek just south of the Ogilvie River do not affect the sheep population. Care must be taken in the approval of new developments since any increase of facilities will attract more people to the area. No developments should occur in North Fork Pass or near the Engineer Creek licks.

People

The element causing the greatest disturbance to sheep is people. Animals can habituate readily to the presence of objects and to man if there is enough time allowed. Geist (1975) reports Dall's sheep living in an active strip mine in Alaska.

The impact of hunting on sheep populations is well known (Geist 1970, Horesji 1976, Hoefs 1979). The present ban on the discharge of firearms within the Dempster Highway Corridor may help to increase the proportion of rams in the south Ogilvies population.

The damaging aspects of hunting do not always come from a gun. Hunting with a camera can be as disturbing to an animal. In fact it could have greater effect because hikers (and photographers) do not reinforce flight from humans as hunting does (Geist 1971b). Heavy hunting pressure can cause range abandonment as the animals retreat to isolated and perhaps inferior habitats (Geist 1971b). The ban on firearms should be continued and strengthened in order to maintain a sheep population in the Ogilvies.

The key element in looking at disturbance is people. Travelling the Dempster Highway is becoming a popular holiday and, if the amount of coverage it is receiving in the press is any indication, it will increase in popularity (Bingham 1978; Hancock 1980; Road 1979; Wright 1979). In managing the Dempster Highway Corridor, tourism must not be ignored if the road is to remain open and have minimal negative effects on all wildlife. Facilities for tourists must not be allowed to spring up without planning. Travellers must be met with sufficient facilities to channel activity away from areas critical to sheep and other wildlife while maintaining the experience desired.

LITERATURE CITED

Berger, T.R. 1977. Northern Frontier, Northern Homeland: The Report of the Mackenzie Valley Pipeline Inquiry, 2 vol., James Lorimer and Co., Ottawa.

Bingham, John. 1978. Dempster Highway - Road to the Arctic, In Arctic in Colour.

Eccles, Ross. 1980. Dempster Dall Sheep Report, in prep.

Geist, Valerius. 1970. Sheep Management Dilemmas. In Trans. North World Sheep Council, pp 46-49.

Geist, Valerius. 1971a. Mountain Sheep: A Study in Behavior and Evolution. Univ. of Chicago Press, Chicago.

Geist, Valerius. 1971b. Bighorn Sheep Biology, Wild. Soc. News 136:61.

Geist, Valerius. 1975. Harassment of Large Mammals and Birds, Report to the Berger Commission, Exhibit 359, 11 Dec. 1975

Hancock, Lyn. 1980. Roads North-Part III: A Boon or a Threat?, B.C. Outdoors, March, pp 60-86.

Hoefs, Manfred. 1979. Dall Sheep Distribution, Abundance and Critical Areas along the Proposed Dempster Lateral Pipeline Route. Prepared for Foothills Pipe Lines (Yukon) Ltd.

Horejsi, Brian L. 1976. Some Thoughts and Observations on Harassment and Bighorn Sheep. In Northern Wild Sheep Conf., Jackson, Wyo.

Larsen, D.G. 1978. Wildlife inventories in Game Management Zone 2 (Yukon Territory) with an evaluation of Dall sheep populations and harvest. Yukon Game Branch.

Lenarz, M. 1974. The Reaction of Dall's Sheep to a FH-1100 Helicopter. In R.D. Jakimchuk (ed) The reaction of some mammals to aircraft and compressor station noise disturbance. Renewable Resources Consulting Services Ltd., CAGSL Biol. Report Series, Vol. 23.

Linderman, S. 1972. A Report on the Sheep at Dietrick River Headwaters. In Nichols and Heimer Sheep Report Vol. 13, Project-Progress Report. Federal Aid in Wildlife Restoration Project W-17-3 and W-17-4. Alaska Dept. Fish and Game, Juneau.

Mutch G.R.P. 1977. Mammals. In Initial environmental evaluation of the proposed Alaska Highway gas pipeline, Yukon Territory, Alaska highway Pipeline Panel, Winnipeg. pp 217-314.

Nolan J. and John P. Kelsall. 1977. Dall Sheep and their Habitat in Relation to Pipeline Proposals in Northwest Canada. Canadian Wildlife Service, Ottawa.

Oswald, E.T. and J.P. Senyk. 1977. Ecoregions of Yukon Territory, Fisheries and Envt. Canada, Canadian Forestry Service, 115pp.

Reynolds, P.C. 1974. The Effects of Simulated Compressor Station Sounds on Dall Sheep Using Mineral Licks on the Brooks Range, Alaska. In R.D. Jakimchuk (ed) The reaction of some mammals to aircraft and compressor station noise disturbance. Renewable Resources Consulting Services Ltd., CAGSL Biol. Report Series, Vol. 23.

Road, Alan. 1979. The Road to the Wilds. In Observer Magasine, 4 Nov. 1979, Great Britain, pp 65-84.

Schreier, H. 1978. Water Quality Investigations along the Alaska Highway Pipeline Route in the Yukon Territory. Appendix E-Water Quality Processes and Conditions in the Ogilvie and Swift River Basins,Y.T. Dept. of Envt, Inland Waters Directorate, Water Quality Branch.

Tracy, Diane M. 1977. Reactions of Wildlife to Human Activities along Mt. McKinley National Park Road, M.S. Thesis, U. of Al, Fairbanks.

Wright, Allen A. 1979. Yukon Hails Opening of the Dempster Highway, Canadian Geographic, Vol.98, #3, June/July.

APPENDICES

Appendix 1: Photographs

During the summer of 1980, various photographs were taken within the study area. The following are a selection of these showing the mineral licks, lambing areas and other points of interest.

Photo 1. This area was photographed with a movie camera and intervalometer from May 24 - 27. This is the east side of the creek.

Photo 2. The log lick was photographed with a camera and intervalometer From May 27 - June 7, June 11 - 15, July 23 - 27 and July 30 - August 3.

Photo 3. Lambing cliffs at Sheep Mountain, km 86 on the east side of the highway. A small nursery herd can be seen.

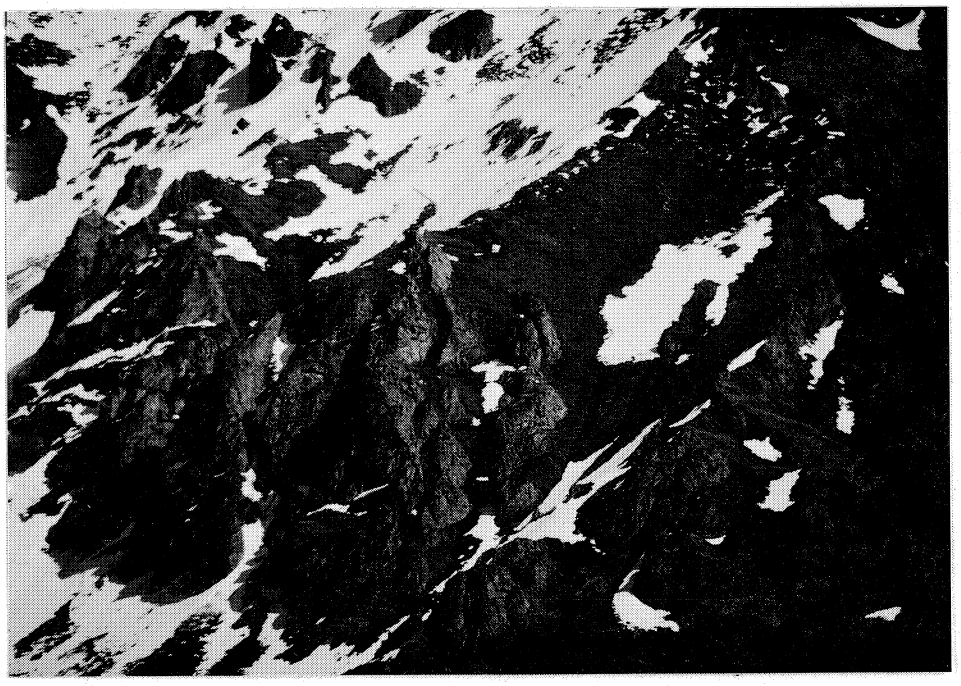


Photo 4. Lambing cliffs at Jensen's Cliff, km 93 on the east side of the highway. A small nursery herd can be seen.

Photo 5. Mineral lick in the south Ogilvie Mountains. It's location is 15 km east of the Dempster at km 80. It was first located on July 15, 1980.

Photo 6. Game trails leading to the above lick.

Photo 7. Sulphur spring flowing into Engineer Creek at km 186, just upstream of the major licking area.

Photo 8. Engineer Creek where it runs through iron-rich shale beds upstream of the km 180 lick.

Photo 9. Iron oxide deposits along Engineer Creek (approx. km 172).

Photo 10. Salt crusts on soil surface of mineral lick, km 186.

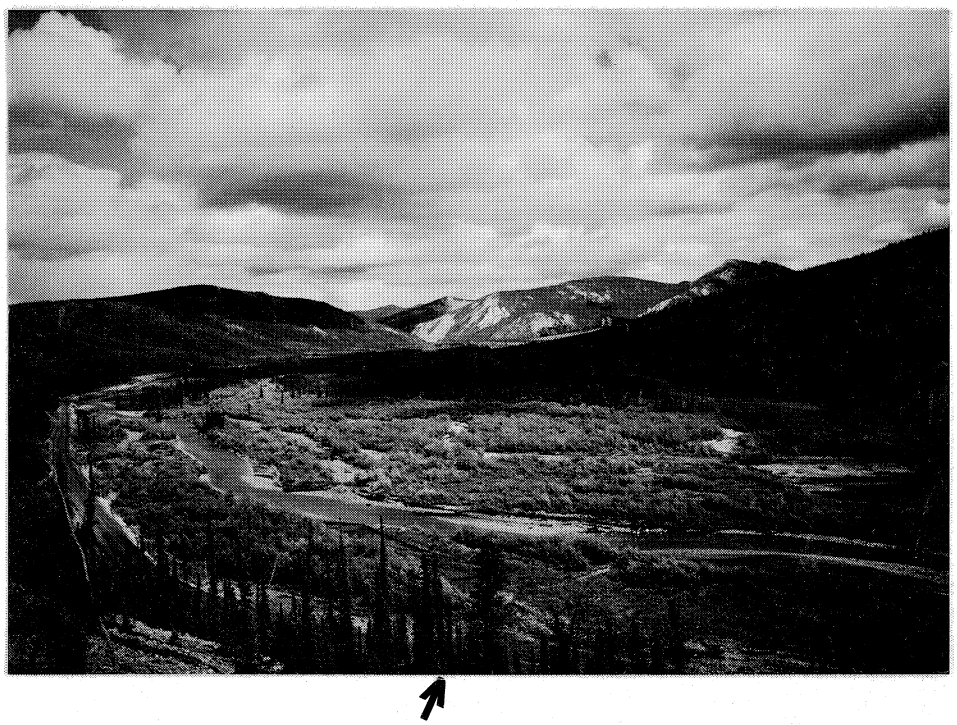


Photo 11. Km 180 lick, the arrow marking the "sheep crossing".

Photo 12. Mineral licks at km 180 on west bank of creek.

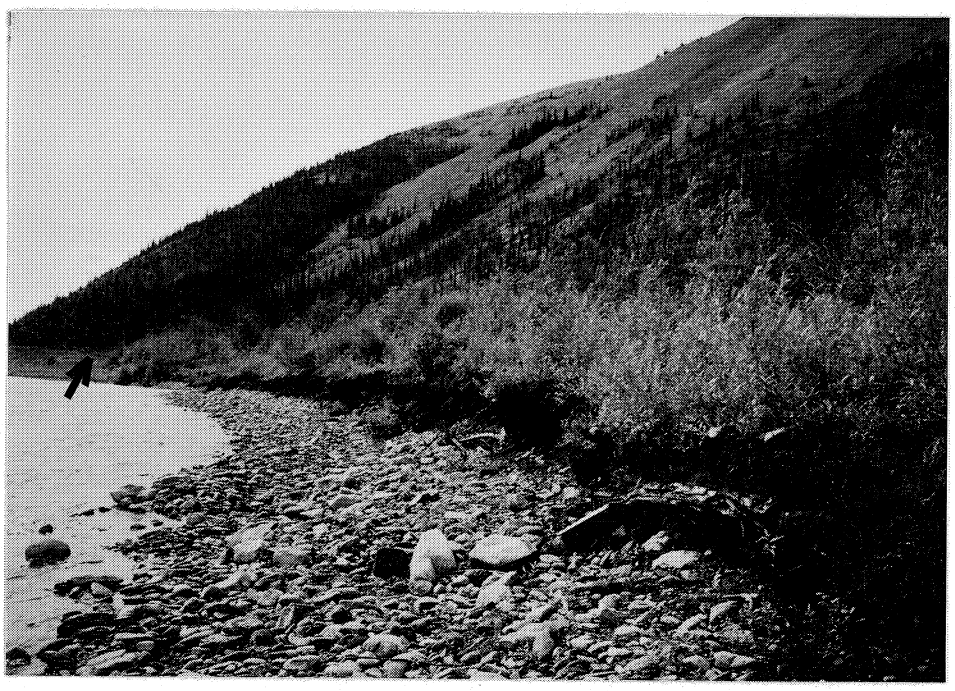


Photo 13. Km 180 lick looking south to the Dempster Highway. The arrow marks the "sheep crossing".

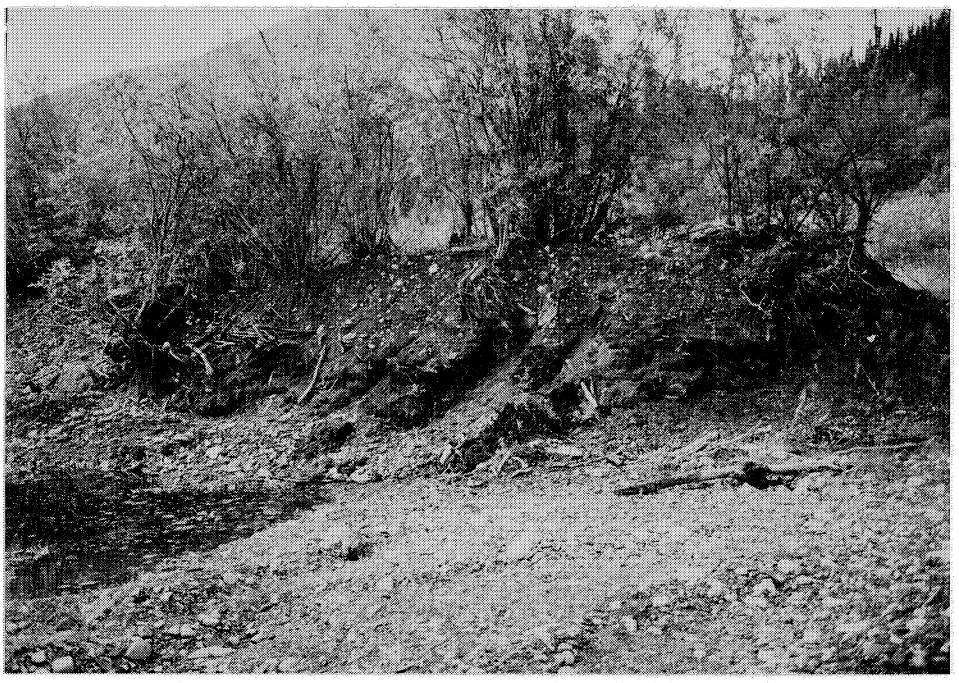


Photo 14. Mound lick at km 180.3 midway between road and main creek channel.

Photo 15. Ewes and lambs on slope on west side of highway at km 180 just above "sheep crossing".

Photo 16. Sheep crossing road at km 180.

Photo 17. Log lick at km 186 lick on east bank of creek.

Photo 18. Ram band at log lick. This was the largest group of rams (9) seen at the lick at one time, May 25, 1980.

Photo 19. Gravel lick on west side of Engineer Creek north of log lick at km 186.

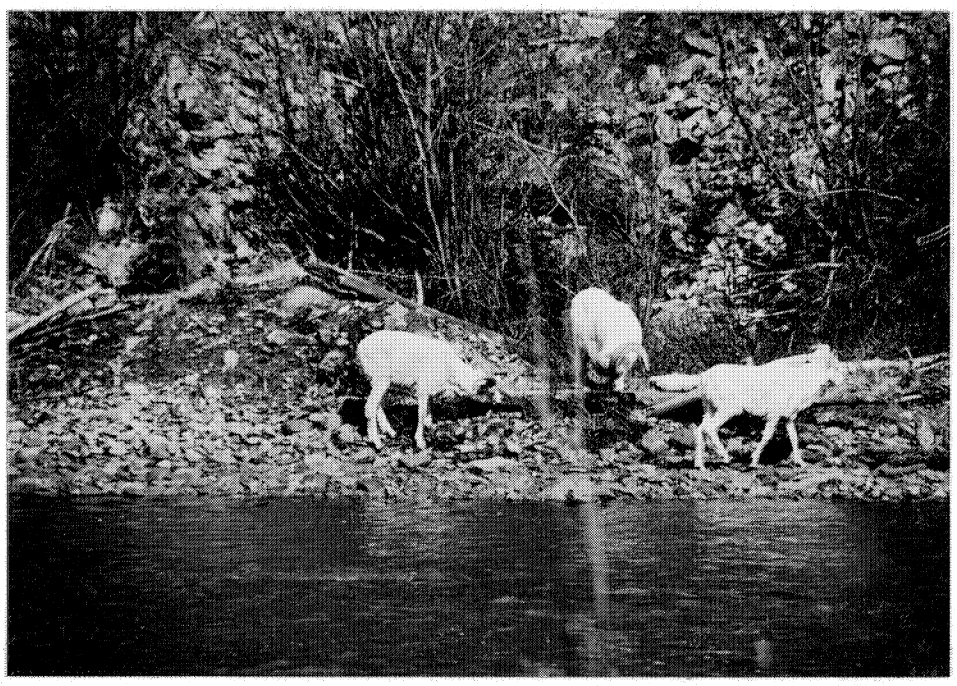


Photo 20. Rams using gravel lick.

Photo 21. Cut-bank lick on east side of creek, north of gravel lick at km 186.

Photo 22. Stump lick on east side of creek, north of cut-bank lick at km 186.

Photo 23. Little gravel lick on east side of creek, north of stump lick at km 186.

Photo 24. Little log lick east of creek, north of little gravel lick at km 186.

Photo 25. Fallen tree lick. Sheep licked the soil caught in its roots. On east bank of creek, km 186

Photo 26. Little hump lick, east of creek, north of previous licks, km 186.

Photo 27. Ram using hump lick on east side of Engineer Creek where creek bed widens. First witnessed use of km 186 lick, May 23, 1980. This lick is north of all previous licks.

Photo 28. Hump lick covered with vegetation in July. It was seldom used after June 1.

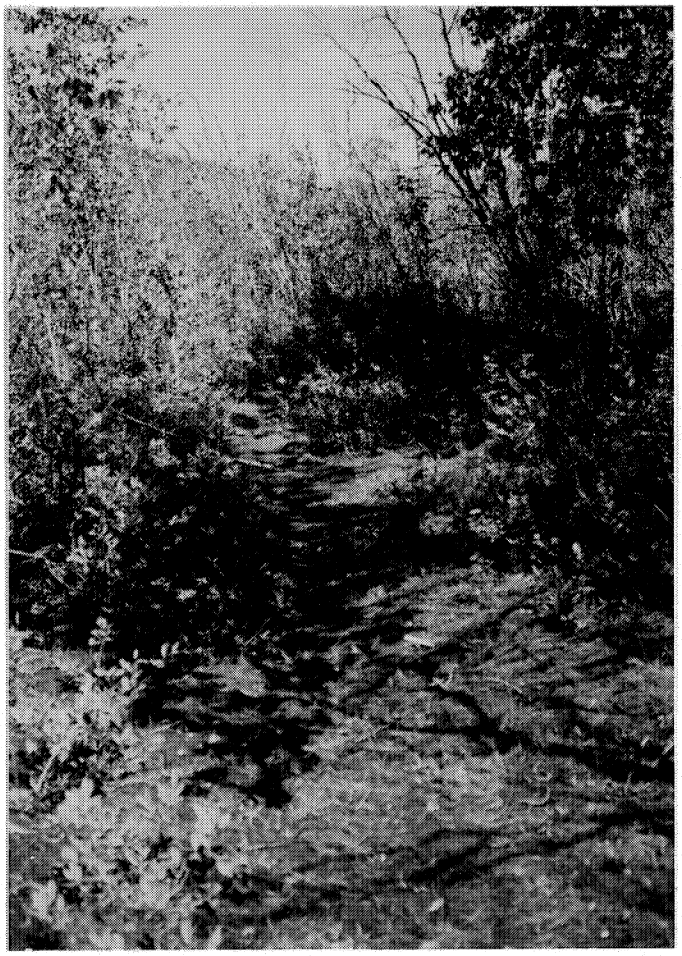


Photo 29. Game trail leading to hump lick from the north, km 186

Photo 30. Flat lick on east side of creek almost at culvert passing under road, km 186.

Photo 31. Ewe at lick just to north of flat lick.

Photo 32. River bank lick on east side of Engineer Creek. Northernmost licking site of km 186 lick.

Photo 33. Lumpy lick on west side of creek across from log lick. Hump lick can be seen in upper right corner. Km 186 lick.

Photo 34. Ram at little road lick at east side of Dempster Highway. Engineer Creek is in front of him. Km 186.

Photo 35. Big road lick on west side of creek, j t before culvert. The roadbed can be seen on the left. Km 186.

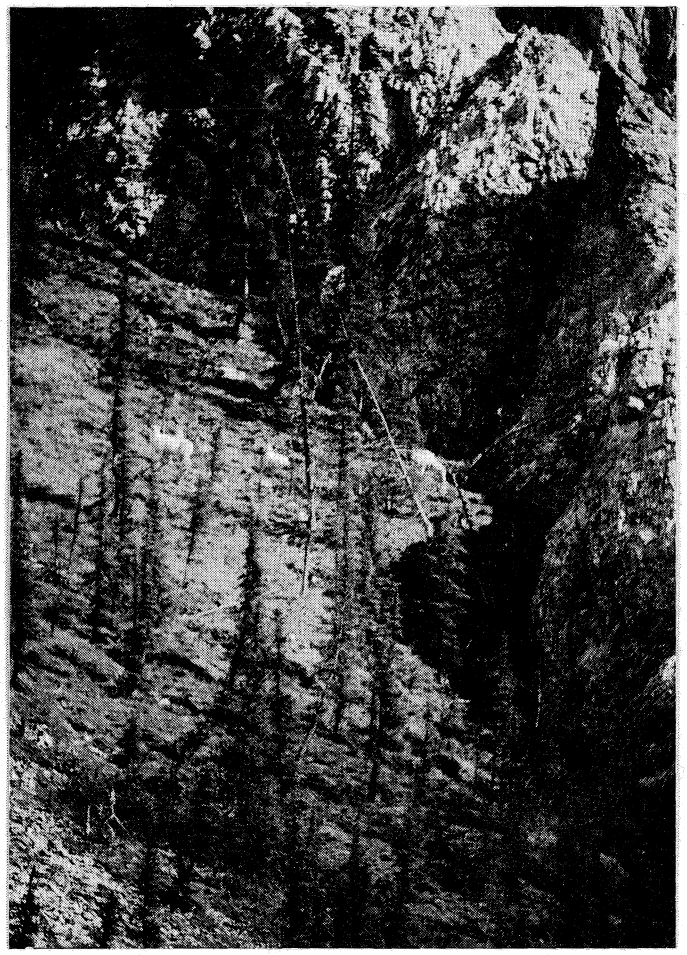


Photo 36. Escape terrain which may be a potential lambing area. South of lick at km 184.

Appendix 2: Aerial Surveys

There were 7 helicopter surveys flown in the study area over the summer months. Two flights covered both the central and south Ogilvies, one surveyed the south Ogilvies and four were in the central Ogilvies.

All except the June 16 flight, were shared with Norman Barichello and both Dall's sheep and gyrfalcons were surveyed.

May 21, 1980 - Central Ogilvies

On this day the Jet Ranger was ferried to Mile 150 and was used for survey along its trip. The pilot was Cliff Hendrix and the observers were Donna Stewart and Norman Barichello. Survey time was from 1548 hours to 1731 hours.

The area surveyed included the Engineer Creek lick and vicinity (Fig. 3). At Mile 123, Bob Hayes, Yukon Game Branch, boarded and became the navigator-observer and the survey purpose was to locate peregrine falcon nests. Stewart remained on as an observer. Sapper Hill and outcrops north of the Ogilvie River crossing to Mile 150 were surveyed but no sheep were sighted.

In total 14 individuals were sighted: 7 ewes, 6 lambs and 1 class III ram. Observations are plotted in Map 1.

May 24, 1980: Central and South Ogilvies

The pilot was Cliff Hendrix and Donna Stewart and Norman Barichello were observers. Survey time was from 1525 hours to 2210 hours. In the south Ogilvies, the southern exposures were pretty well clear of snow but the northern exposures were 70% snow covered.

The total number of sheep sighted in the central Ogilvies was 6: 1 class I ram, 3 class II rams and 3 class III rams. In the south Ogilvies, 111 individuals were seen: 47 ewes, 23 lambs, 16 nursery sheep, 1 yearling, 2 class I rams, 5 class II rams, 2 class III rams and 15 unclassified rams. Observations are mapped in Maps 2 and 3 respectively.

June 4, 1980: Central Ogilvies

On this occassion a Hiller helicopter was used and it was piloted by Kerry Gunter. Observers were Donna Stewart and Norman Barichello. The survey was conducted from 1106 hours to 1350 hours.

The total number of sheep seen was 23: 4 ewes, 4 lambs, 1 yearling, 4 class I rams, 1 class II ram, 4 class III rams and 4 class IV rams. Observations are mapped in Map 4.

June 9, 1980: South Ogilvies

On this flight the Hiller was used with Kerry Gunter pilotting. Donna Stewart and Norman Barichello were observers. Survey time was 1912 hours to 2245 hours.

It was observed during this survey that rams and nursery sheep were often together in mixed herds. There were 180 sheep observed: 76 ewes, 49 lambs, 34 nursery sheep, 3 yearlings, 5 class I rams, 9 class II rams and 4 class III rams. Their locations are plotted in Map 5.

June 16, 1980: Central Ogilvies

Kerry Gunter pilotted the Hiller for this flight. Donna Stewart and Christine Boyd were observers. Flight time was 1310 hours to 1415 hours.

On this occasion, 4 ewes and 4 lambs were seen running down the road for 300 metres before they dashed upslope west of the highway (observation 3 in Map 6). There were 15 sheep sighted: 7 ewes, 7 lambs and 1 class III ram. Observations are mapped in Map 6.

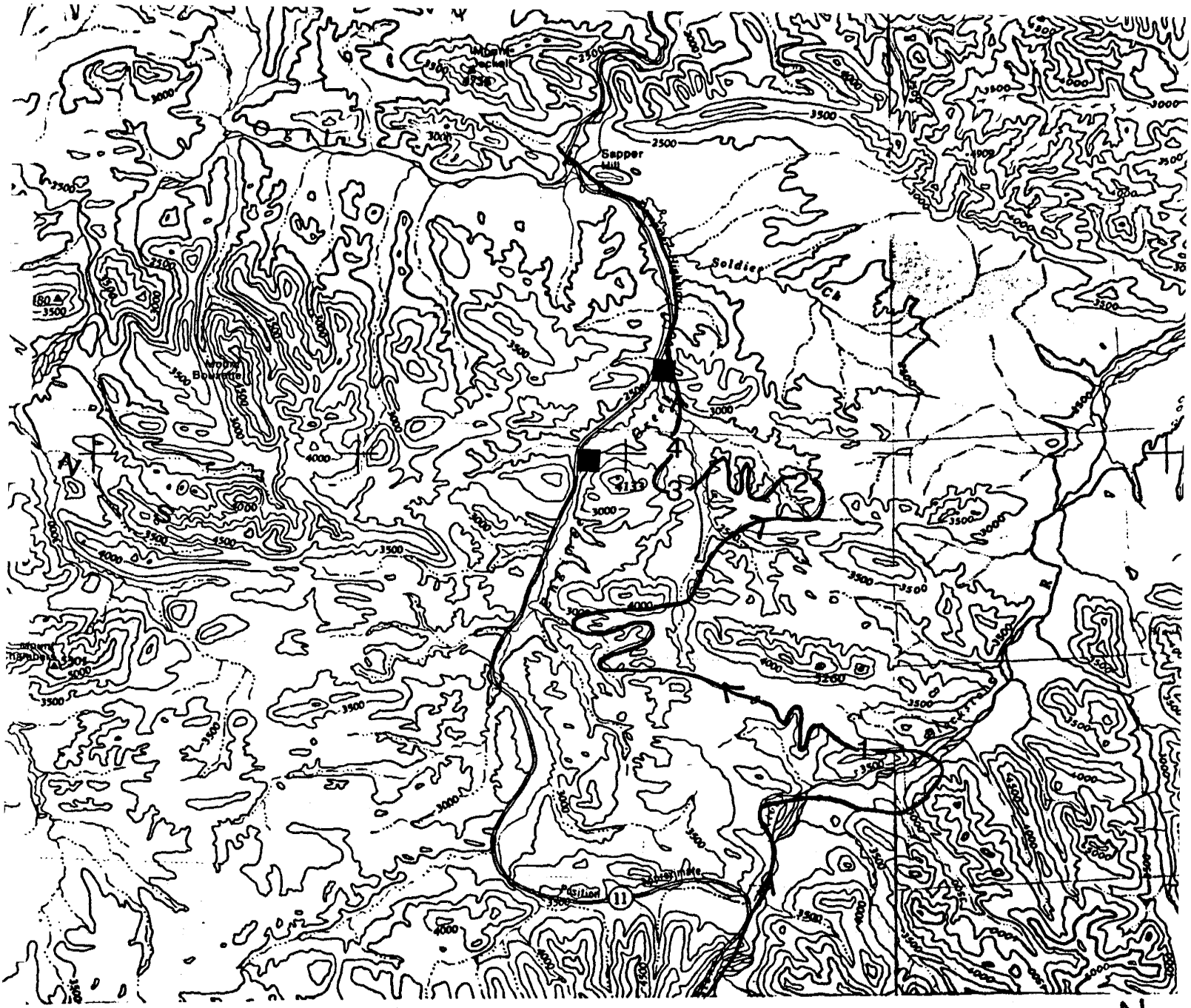
June 30, 1980: Central Ogilvies

The pilot was Cliff Hendrix and Donna Stewart and Norman Barichello were observers.

Mounts Bouvette and Chambers were surveyed as well as the areas east to the highway. Although there were many trails, only 1 group of sheep were seen: 4 ewes and 2 lambs totalling 6 sheep. The observation and flight path are recorded in Map 7.

July 15, 1980: Central and South Ogilvies

Ron Zborill was the pilot and Donna Stewart and Norman Barichello were observers for the survey in the south Ogilvies and Donna Stewart was the observer in the central Ogilvies. The south Ogilvies were surveyed from 0930 hours to 1815 hours. In the evening, the central Ogilvies were surveyed from 1005 hours to 1145 hours. No sheep were sighted in the central Ogilvies (Map 8). In the south Ogilvies, 145 sheep were sighted: 34 ewes, 44 lambs, 52 nursery sheep, 4 class I rams, 6 class II rams, 3 class III rams and 2 unclassified rams. Observations are mapped in Map 9.



MAP 1: Aerial Survey, May 21, 1980 -- Central Ogilvies

Legend

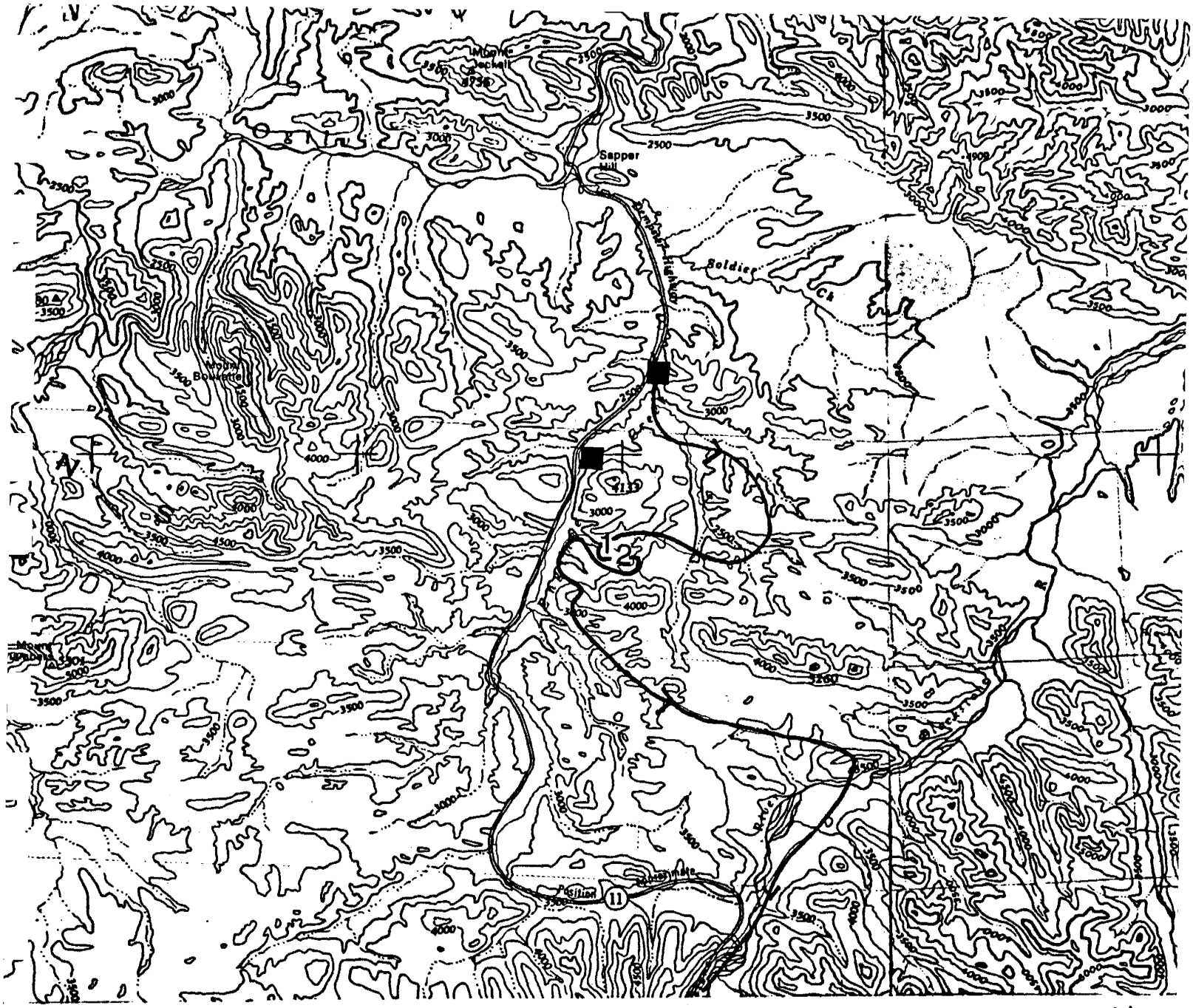
■ mineral lick

1 2 ewes, 2 lambs

2 1 ewe

3 1 class III ram

4 4 ewes, 4 lambs



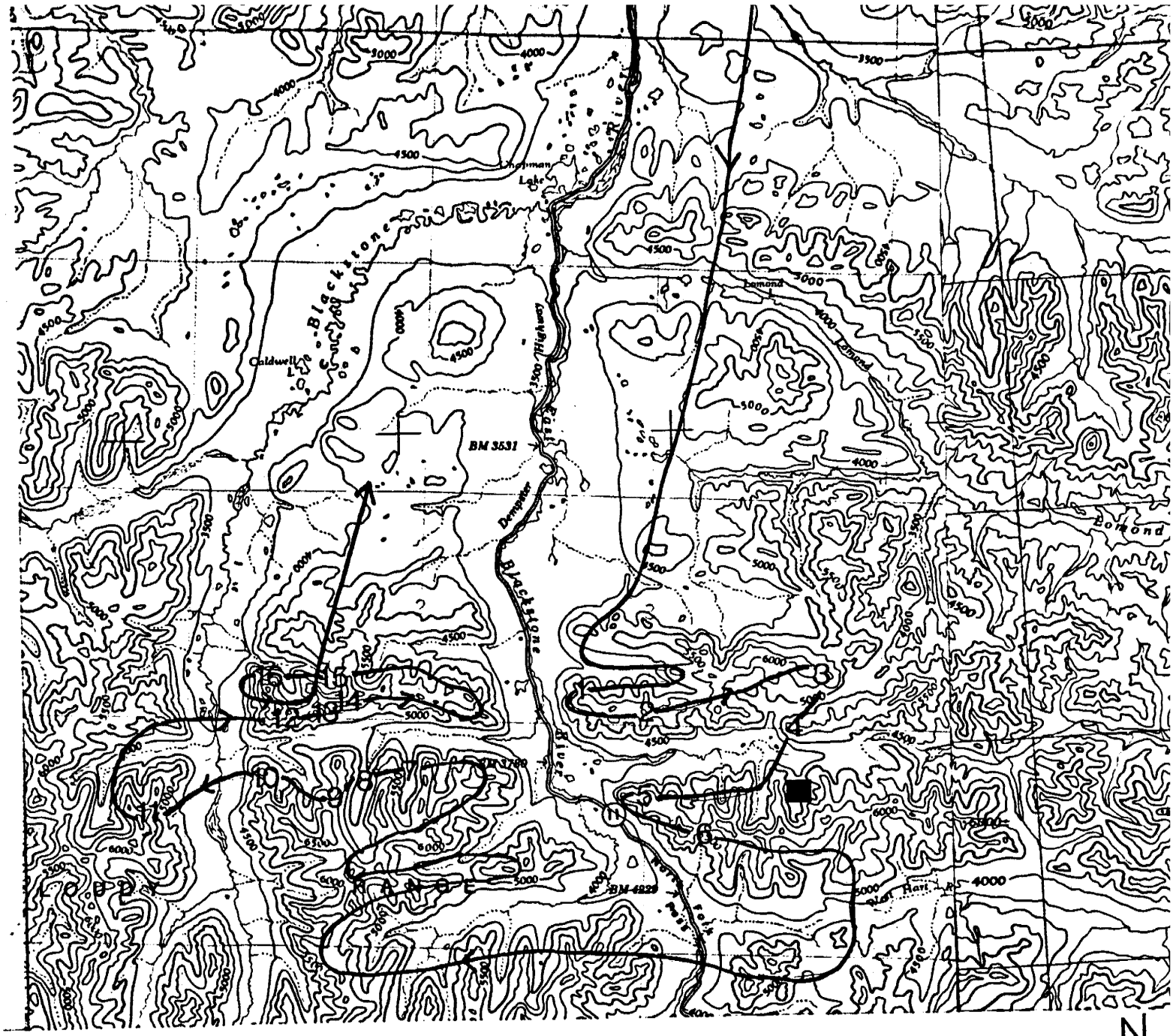
MAP 2: Aerial Survey, May 24, 1980 -- Central Ogilvies

Legend

■ mineral lick

1 1 class I ram, 2 class II rams

2 1 class II ram, 2 class III rams

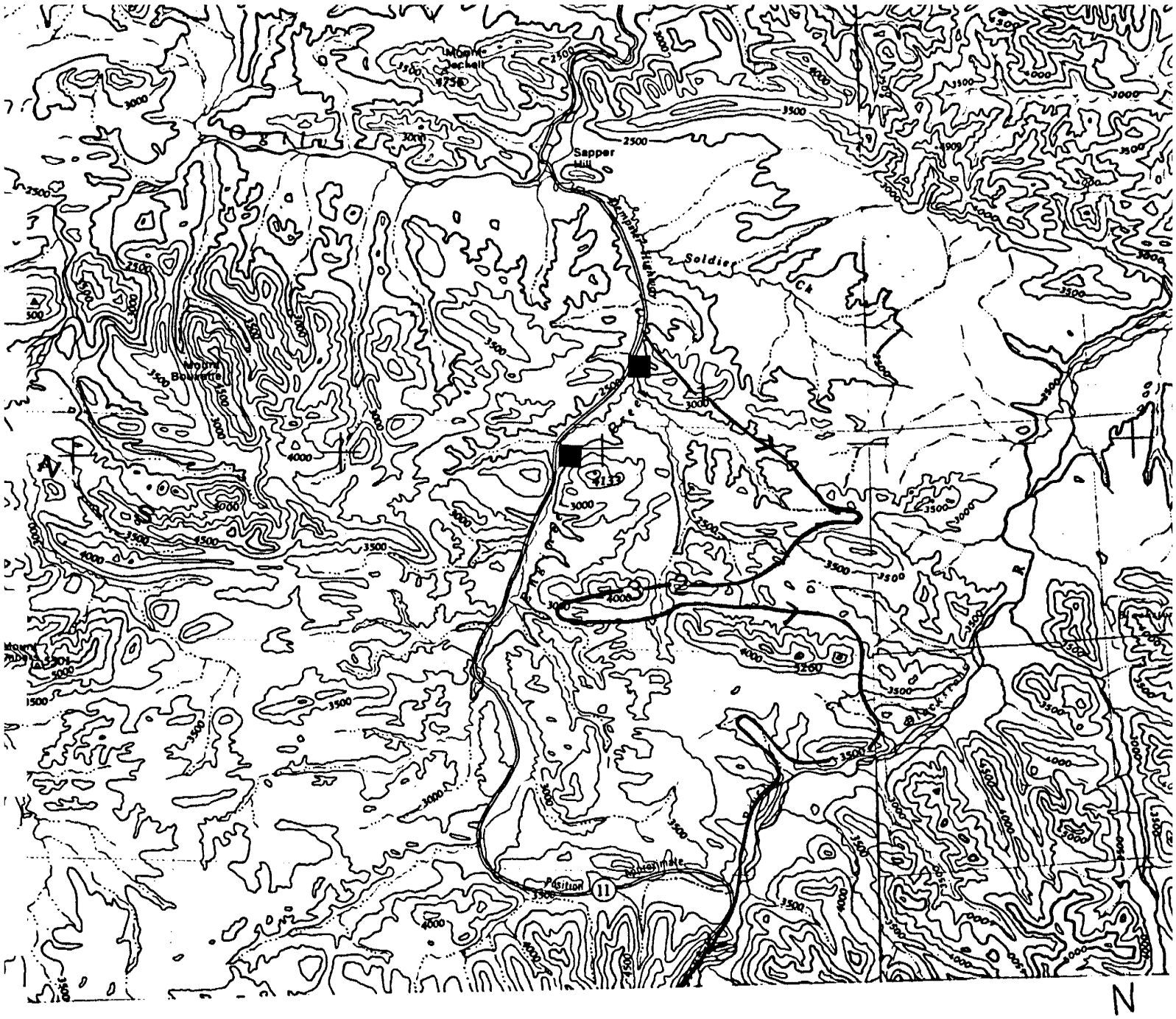


MAP 3: Aerial Survey, May 24, 1980 -- South Ogilvies

Legend

■ mineral lick

1	8 ewes, 4 lambs	12	3 class II rams,1 yearling
2	2 class I rams	13	10 ewes, 4 lambs
3	2 unclassified rams	14	1 class III ram, 1 ewe, 1 lam
4	7 ewes, 2 lambs		2 nursery sheep
5	11 ewes, 4 lambs	15	1 ewe, 1 lamb, 7 nursery shee
6	2 class II rams	16	1 ewe, 1 lamb, 2 nursery shee
7	2 ewes, 2 lambs, 2 nursery sheep		
8	3 ewes, 3 lambs		
9	8 unclassified rams		
10	6 ewes, 1 lamb		
11	5 unclassified rams		



MAP 4: Aerial Survey, June 4, 1980 -- Central Ogilvies

Legend

■ mineral lick

1 4 class I rams, 1 class II ram, 4 class III rams, 4 class IV rams

2 1 class III ram

3 4 ewes, 4 lambs, 1 yearling

MAP 5: Aerial Survey, June 9, 1980 -- South Ogilvies

Legend

■ mineral lick

1	4 ewes, 4 lambs
2	8 ewes, 7 lambs, 4 class II rams, 1 class III ram
3	8 ewes, 8 lambs, 10 nursery sheep
4	9 ewes, 9 lambs, 7 nursery sheep
5	1 ewe, 1 lamb
6	4 ewes, 1 lamb
7	6 ewes, 2 lambs
8	5 ewes, 2 lambs
9	14 ewes, 6 lambs, 1 class I ram
10	2 yearlings, 1 class I ram, 3 class II rams, 1 class III ram
11	10 ewes, 2 lambs, 2 class I rams
12	1 class I ram
13	1 yearling, 2 class II rams, 2 class III rams
14	7 ewes, 7 lambs, 17 nursery sheep

MAP 6: Aerial Survey, June 16, 1980 -- Central Ogilvies

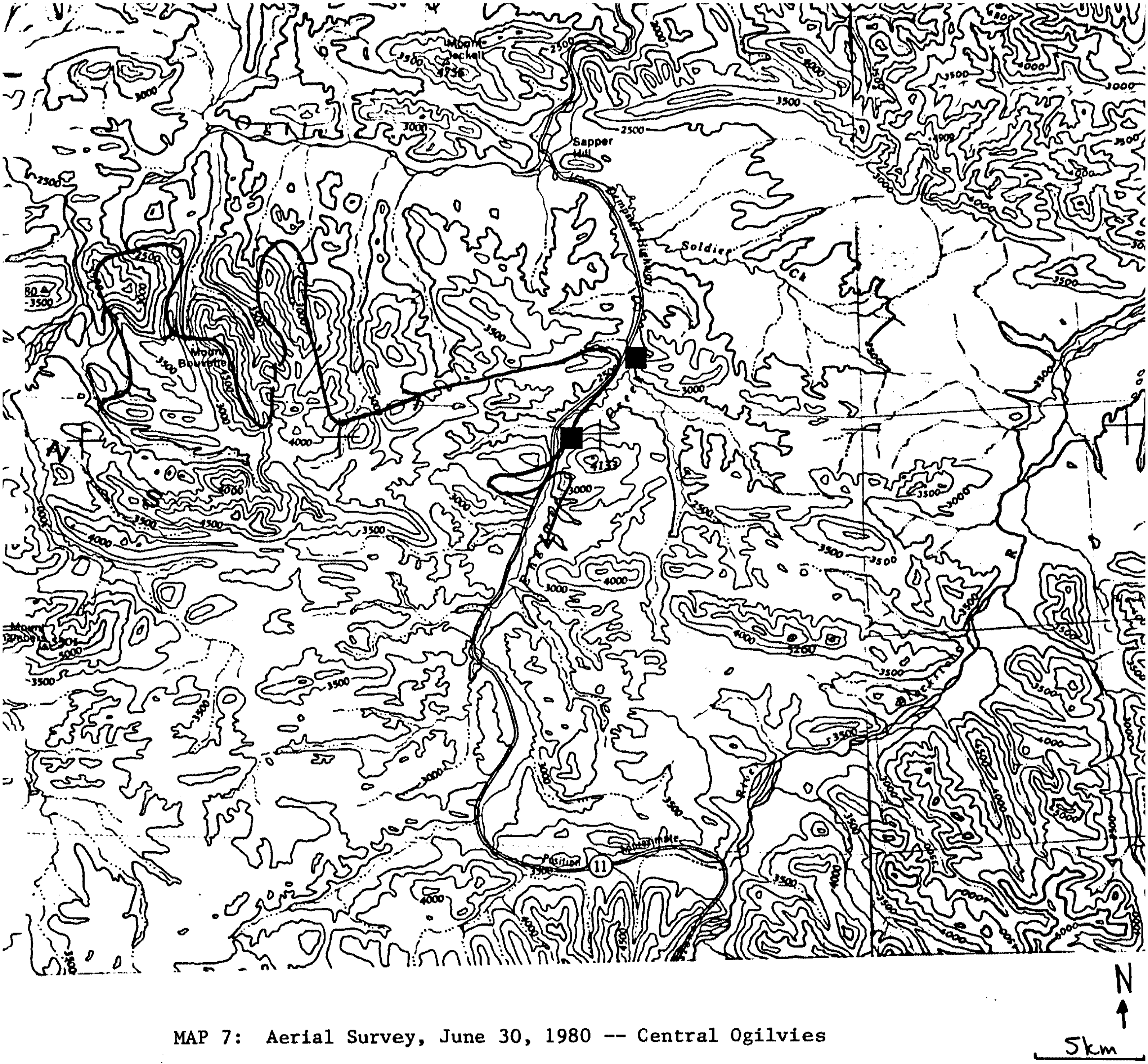
Legend

■ mineral lick

1 1 class III ram

2 3 ewes, 3 lambs

3 4 ewes, 4 lambs

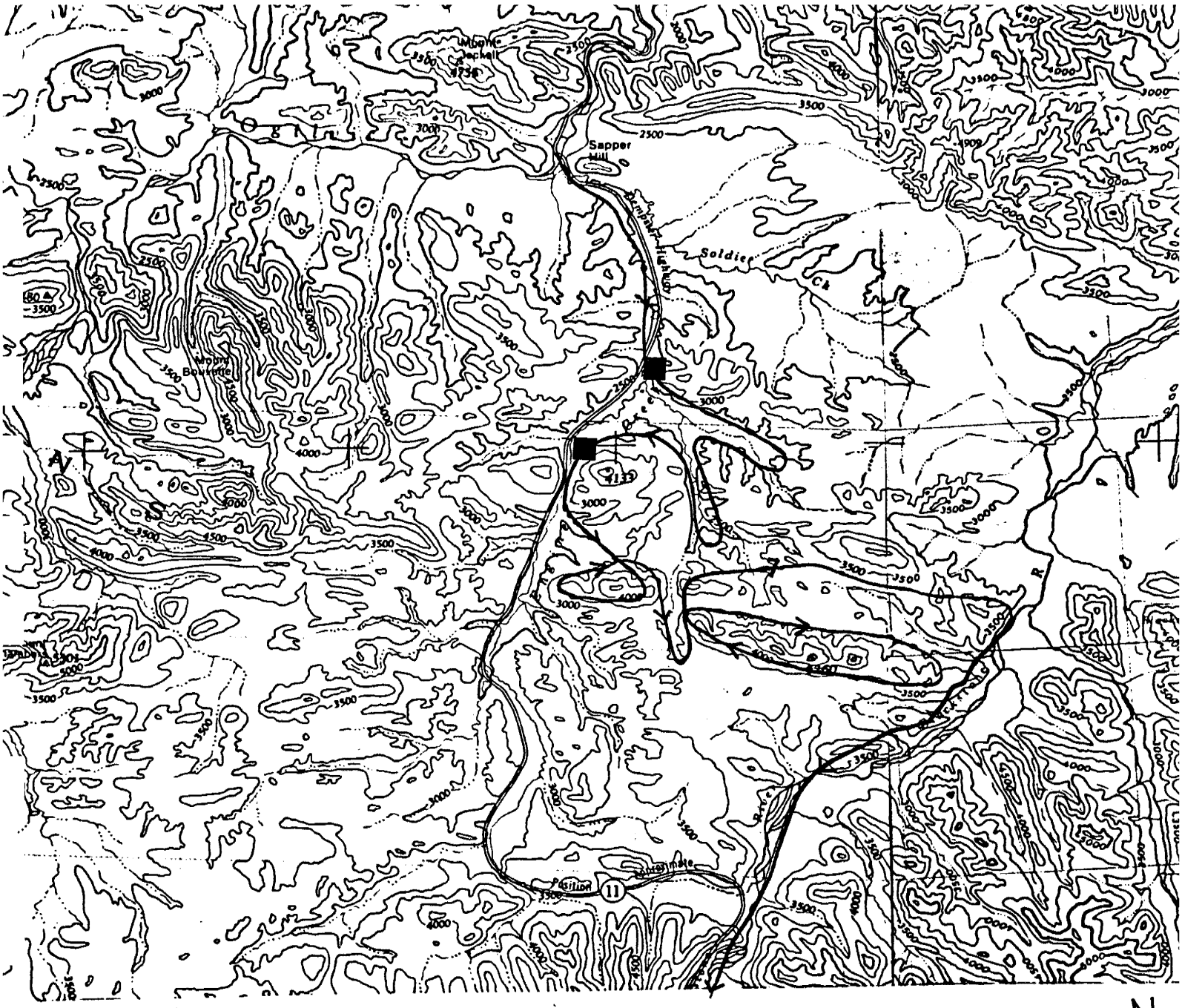


MAP 7: Aerial Survey, June 30, 1980 -- Central Ogilvies

<u>Legend</u>

■ mineral lick

1 4 ewes, 2 lambs

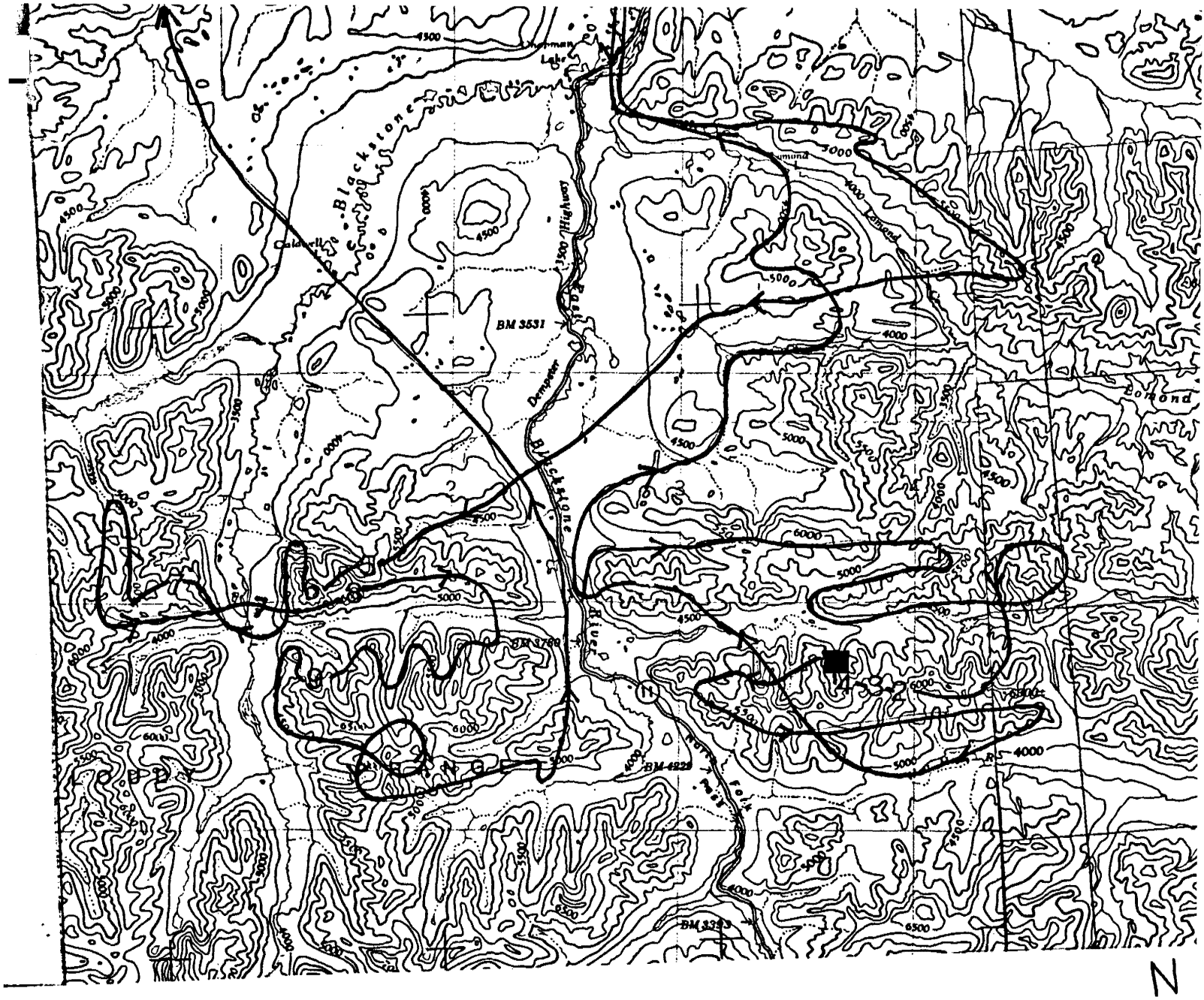


MAP 8: Aerial Survey, July 15, 1980 -- Central Ogilvies

Legend

■ mineral lick

no sheep were sighted



MAP 9: Aerial Survey, July 15, 1980 -- South Ogilvies

Legend

■ mineral lick

1 1 class I ram, 1 class II ram
2 1 class II ram, 1 class III ram
3 6 ewes, 5 lambs, 7 nursery sheep
4 13 ewes, 9 lambs
5 10 ewes, 6 lambs, 2 unclassified rams, 3 class I rams
6 2 class II rams
7 5 ewes, 14 lambs, 14 nursery sheep, 1 class II ram, 1 class III ram
8 1 class II ram, 1 class III ram
9 10 lambs, 31 nursery sheep