A STUDY OF DALL SHEEP IN THE MOUNT WELLGREEN AREA OF THE KLUANE WILDLIFE SANCTUARY

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ABSTRACT

A proposed open-pit mine in the Kluane Wildlife Sanctuary prompted the investigation of demographic and range-use characteristics of a Dall sheep (Ovis dalli dalli) population.

Sheep demographic characteristics, seasonal distribution and the delineation of critical habitat were determined through six intensive helicopter searches in 4 seasonal periods including late winter (March), post lambing (mid-June), summer (July) and the rut (late November), from 1985 to 1990.

The study area supports a high density of sheep through all seasons, with a relatively high proportion of rams. The geographic range of the population was not discrete. There appeared to be a large seasonal movement of predominantly nursery sheep away from the study area and into Kluane National Park. Traditional winter range was believed to be restricted, based on the localized and consistent distribution of sheep in late winter. Nursery sheep were concentrated in June suggesting that lambing cliffs were restricted and of critical importance. During the rut, rams joined nursery sheep on ewe winter ranges, during all other periods sexes were segregated. In the summer sheep were found dispersed and at uniform density across the study area.

An apparent aversion of sheep to the area in the immediate vicinity of the mine and exploration area was postulated to be the result of direct loss of habitat, past disruptions in seasonal movement patterns and consequently altered traditional movements, in addition to the current activities which include hunting and vehicular traffic.

The possible influence of previous mining activity on sheep distribution and the apparent integration with sheep populations in Kluane National Park underline the importance of careful and co-operative management in the Kluane Wildlife Sanctuary.

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INTRODUCTION

A proposed open-pit mine, which could include an all-weather road, on-site mill, smelter, and community development, has raised fears that a Dall sheep population may be at risk. The proposed mining development could result in loss or abandonment of sheep range, disruption of seasonal movements, and direct mortality. Highlighting this concern is the proximity of the mine to Kluane National Park (KNP) and the implications to wildlife resources in the park.

Sheep are particularly susceptible to impacts associated with industrial development. Sheep are a climax-type species with a relatively low reproductive rate and very specialized range use patterns. A number of sheep habitats are believed to be restricted and essential, including winter range, lambing cliffs, mineral licks, and rutting or pre-rutting aggregation areas. In addition sheep are easily distressed by disturbances such as all-terrain vehicles, helicopter overflights, etc. (MacArthur et. al 1979, Cornish et. al 1980, Stemp 1982).

In the Kluane Wildlife Sanctuary (KWS), and specifically the area surrounding the proposed mining development on Mt. Wellgreen, sheep distribution patterns were poorly known. Critical habitats had not been delineated and the relationship between these sheep and populations in KNP were unknown. Without such information it is impossible to guide developments in KWS to minimize impacts and successfully prescribe reclamation.

The objectives of this study were to:

(1) estimate sheep density and assess demographic characteristics;
(2) determine seasonal distribution, delineate critical sheep habitat, and predict range use patterns.

STUDY AREA

The Mt. Wellgreen mining property is located within the KWS in Game Management Subzone (GMS) 6-08. The specific area of study included that area bordered by the Donjek River, Burwash and Wade Creeks, and the Alaska Highway (Fig. 1), and was approximately 250 km^2. The survey area was expanded to include an adjacent area in Kluane National Park, bounded by the Donjek River, Granite and Hoge Creeks, and the Burwash Uplands, to provide a demographic assessment of sheep over the larger area thought to encompass the entire population.

The study area lies in the rainshadow of the St. Elias Mountains, flanked by numerous icefields and glaciers. Much of the area is above treeline, relief is dramatic, and peaks extend to 2228 m.a.s.l. (Oswald and Senyk 1977). The combination of rugged terrain with extensive lush alpine summer pastures that receive relatively little snow produce conditions that are ideal for mountain sheep.

The community of Burwash Landing (population 93) is located on the eastern edge of the study area.

METHODS

Sheep demographic characteristics, seasonal distribution and the delineation of critical habitat were determined through six intensive searches in 4 seasonal periods including late winter (March), post lambing (mid-June), summer (July) and the rut (late November), from 1985 to 1990. A complete search of potential sheep habitat was accomplished by contouring mountain blocks with a helicopter flying at approximately 100-130 km per hour at approximately 185 m above the ground (Hoefs 1978). A number of flight passes were made at various elevations to provide complete visual coverage.

Sheep were located, and classified according to sex and horn curl of rams. Lambs were classified on the basis of relative size and horn development. We refer to "nursery sheep" as all sheep with slender horns of less than 1/2 curl configuration, typically including ewes, yearlings and two-year-olds. When rams were distinguished from ewes they were assigned a horn curl category based

on horn configuration, including half, three-quarter or full curl. "Ram groups" include only classified rams.

March and July census flights were repeated in subsequent years to provide an assessment of interannual changes in sheep numbers, sex composition, and distribution.

Within year changes in group size were tested with t-statistics, assuming equal variances.

Sheep distribution at the time of the survey was assumed to represent a typical distribution for that time of year. This assumes a relatively small within-season variation in sheep distribution. Observations were grouped according to their location in one of 6 equal-sized blocks (40 km^2) in the study area. Chi-square goodness of fit tests were applied to compare the seasonal and interannual distribution of sheep within mountain blocks. We also compared seasonal changes in the elevational distribution of sheep through analysis of variance.

The locations of nursery sheep in mid-June, and all sheep in mid-November and March were believed to accurately delineate lambing, rutting and late-wintering areas, respectively. Lambing typically occurs from mid-May to mid-June, the rut peaks in the third week of November, and winter prevails until mid- to late April (Hoefs and Cowan 1979).

All census flights were believed to account for a relatively high proportion of the population present. Mid-June surveys have been found to yield the greatest accuracy based on seasonally replicated survey flights of a discrete sheep population in the northern Yukon (Barichello et al. 1987). It is in June, following lambing, that green-up has occurred on south-facing slopes while north exposures are almost entirely snow covered. This provides a natural stratification, on the assumption that all sheep are exploiting snow-free pastures at this time of high energy demands. We assume that at least 90% and 68% of the sheep present were observed during July and March surveys, respectively, based on the northern Yukon study (Barichello et al. 1987). With the possible exception of the rut when solitary rams are believed to wander

between groups (Geist 1971), we believe that ram and nursery groups had an equal chance of being observed.

RESULTS

Population demography

Total sheep counts and, to a lesser extent, sex composition varied between surveys (Table 1). However, there were consistently fewer nursery sheep observed in July than in other months, resulting in a disparate summer sex ratio. Excluding the July surveys, the population count ranged from 209 to 307, and averaged 273 (sd=47; n=4). Allowing for sheep missed during winter surveys, we concluded that there was a relatively stable winter population of approximately 300 individuals.

Nursery sheep made up between 12% and 68% of the population at different times of the year. The greatest number and proportion of nursery sheep were observed during the rut and the fewest during the summer months (June, July). During the winter (March) the percentage of sheep classified as nursery sheep in the population was 51% and 63% in 1989 and 1990, respectively. The disparate sex ratio in the study area in July, 1990 was offset by inclusion of sheep in the adjacent Wade Mountain area. Over the expanded area the percentage of nursery sheep observed in July (52%) was similar to that in March 1990 in the study area. We observed proportionally more solitary rams in November (43% of ram groups were single rams; n=42) than in other months (23%; n=92).

Productivity, as determined in June and July, was 15, 14, and 28 lambs/100 nursery sheep in 1985, 1989 and 1990 respectively. Including the surrounding area (Wade Mountain-Hoge Creek) productivity was 22 and 30 lambs/100 nursery sheep in 1989 and 1990, respectively (Table 1).

Group size

With the exception of observations made during the rut, most groups were segregated into "nursery" or "ram" groups, with less than 13% of all groups

having both nursery sheep and mature rams. During the rut all classified rams were either observed in mixed groups or as individuals.

Group size ranged from 1 to 26 sheep. Nursery groups (not including lambs) were statistically larger in June (mean group size = 12; n=2 groups) than in other months (mean group size less than 7; $p=0.05$; n=36 groups). The size of ram groups was similar between months, averaging 4.1 ($p<0.01$; n=97 groups). No differences in the group sizes between sexes were observed ($p=0.17$).

Distribution

When all observations were combined, sheep were more frequently observed in some grid blocks than in others. More than 73% of all sheep observations were found in three grid blocks (50% of the study area), all bordering the Alaska Highway. Only 14% of all sheep observations occurred in the two mountain blocks bordering Wade Creek and the Burwash Uplands. Also, proportionally fewer sheep (12%) were observed in the block where an old mine and extensive exploration trails are located (Fig. 2).

Seasonal comparisons revealed a dissimilar distribution of sheep among months ($p<0.01$; Fig. 3). However, in November and March, 1988-89, the distribution of nursery sheep was similar ($p=0.23$), and in November rams and nursery sheep were equally distributed ($p=0.66$). With the exception of one sparsely used block in the study area, sheep were uniformly distributed among blocks only in July ($p=0.29$; Fig.3).

Interannual differences in sheep distribution were not apparent in March ($p=0.23$), but were significant in July ($p=0.01$).

Seasonal differences were apparent in the location of sheep with respect to elevation ($p<0.01$). A significant downslope movement occurred from March to November by both rams ($p<0.01$) and ewes ($p<0.01$; Table 2). The clumped distribution of nursery sheep in June was on southwest exposed slopes (Fig. 4).

Key habitat

Key habitat, based on the distribution of sheep observed in November (rut) and March (winter), and of nursery sheep in June (lambing), is illustrated in Fig. 3 and 4. No licks were identified during the surveys but one is known on Arch Creek (Fig.5).

We were unable to identify movement corridors although we suspect a traditional movement, of predominantly nursery sheep, in the spring and fall. We suggest a probable migration route from the study area toward Wade Mountain (Fig. 5).

DISCUSSION

The higher proportion of nursery sheep observed during the rut may have been a result of solitary movements of rams seeking estrous females, and therefore the increased likelihood of rams being missed.

Demography

Trends in the population count and composition suggest that there was a large movement of predominantly nursery sheep away from the study area in the spring after lambing, and a corresponding return to the area in the fall. Similar ratios of rams to nursery sheep were observed during the winter (November and March), and consistently disparate ratios were observed in July. The fact that the July, 1990 ratio of rams to nursery sheep in the expanded survey area was similar to the March, 1990 ratio within the study area infers a movement of nursery sheep toward the Hoge Creek-Wade Mountain area in KNP. Such a movement would entail a line-of-sight movement of approximately 15 km. over rolling terrain with little, if any, escape terrain.

The density of sheep was relatively high in the study area, attaining 1.4 per km^2 over the entire study area, comparable to other good quality sheep ranges in the southern Yukon (Barichello et al. 1987).

The percentage of nursery sheep observed in the study area (mean=59%) was at the lower end of the range observed in other northern studies (range=59-69%),

which perhaps reflects the light harvest of sheep in KWS (Murie 1944; Hoefs and Bayer 1983; Heimer 1984; Spindler 1984). Light harvest pressure would minimize the losses of older rams, thus increasing the relative proportion of rams in the population.

Within ram groups (3+ year old rams) between 40 and 73% of all rams observed during surveys were full curl. On Sheep Mountain in Kluane National Park where sheep are not hunted, 49% of all 3+ year old rams were full curl (Hoefs and Bayer 1983; Hoefs and Cowan 1979). We suspect that a combination of high quality range and minimal predation have contributed to rapid horn growth and relatively low rates of mortality of middle-aged rams, resulting in a relatively high percentage of rams in the population.

Distribution (movement patterns and critical habitat).

It is probable that sheep, particularly nursery sheep, are migrating shortly after lambing to exploit mineral licks in KNP, and returning to the study area in September and/or October. Between year differences in the proportion of nursery sheep observed in July suggest that this annual dispersal from the study area varies, perhaps reflecting density or weather. It has been conjectured that lick requirements are exaggerated during wet years (Heimer 1988). A traditional long distance movement by nursery sheep to secure minerals infers that the demand for minerals is important and sex-specific.

Within the study area, distribution (movement) patterns were predictable. The late winter distribution was localized and consistent between years, the distribution of nursery sheep was highly concentrated during the lambing period, and the summer distribution was dispersed and uniform across the study area. Three dispersal periods were noted, April-June, July, and August-November.

Typically winter range was at high elevation (above 1500m) and characterized by steep, wind-swept slopes on southern exposures. These high elevation sites were prone to high winds which prevented extensive heavy snow cover. These characteristics and the consistent clumping of sheep in March suggest that winter range is restricted in the study area and is traditionally used.

In the spring there was an apparent dispersal and concentration of ewes to lambing sites, and a downslope movement of both sexes to early green-up slopes with south-westerly aspects. Lambing cliffs were characterized by rugged terrain at low elevation, oriented to the south-west.

Prior to the rut, there appeared to be a return of nursery sheep to the lower slopes of their winter range with a corresponding shift of rams to ewe ranges. This movement pattern was similar to one observed in the Northern Richardson Mountains (Barichello and Carey 1989). We suspect that there is a selection for habitat on lower slopes if movement is not impaired by snow. The return of sheep to high elevation late winter ranges is suspected to be a result of snow accumulation which impedes access on lower slopes.

With the exception of the rut, sexes were largely segregated; distributions were dissimilar and mixed groups were few. Sexual segregation is characteristic of thinhorn sheep populations (Geist 1971; Hoefs and Cowan 1979).

The most heavily used sheep range in the study area is characterized by rugged relief, wide elevation range, and windy southern exposures. An exception to this association between habitat characteristics and sheep occurrence is a block where mining developments, recent and historic, have occurred and into which a seasonal road is maintained. Site disturbances to this area includes a previously developed mine, an extensive network of exploration roads, trails and trenching, and an exploration camp. There is ample evidence that the land was disturbed by mineral exploration in the area. The current level of activity is unknown, although the road is sporadically used by trucks and snow machines. We suspect a limited amount of hunting occurs in the vicinity. The combined effects of disturbance and hunting may be reflected in the present distribution pattern, indicating an apparent aversion of sheep to this area.

MANAGEMENT IMPLICATIONS AND RECOMMENDATIONS

1. The geographic range of sheep in the study area is not discrete. This implies that sheep range is contiguous with KNP and therefore impacts to sheep occupying the study area will likely affect the density and distribution of sheep in a portion of the Park.
Recommendation: manage conservatively.

2. The limited distribution of sheep during the winter (including the rut period), and of nursery sheep immediately following lambing, infers that habitat is restricted during these periods.
Recommendation: strict protection of key habitat.

3. The apparent dispersal (migration) of nursery sheep to and from the area and the typically disparate ratio of ewes to rams, (a) emphasizes the importance of mineral licks to lactating females, and (b) emphasizes the importance of identifying and protecting mineral licks and migration corridor(s).
Recommendation: protect these key sites as they become known.

4. The aversion of sheep to one mountain block which appears to be excellent sheep habitat infers that past or present activities and disturbances have altered habitat or movement patterns, thereby alienating prime sheep habitat.
Recommendation: Vehicle access, the use of all-terrain vehicles, and hunting opportunities should be regulated, and habitat should be reclaimed by the mining company responsible for the exploration. Serious consideration should be given to eliminating destructive exploration practices.

5. The study area has a relatively high summer density of rams in an aesthetically appealing landscape with relatively easy access.
Recommendation: develop a wildlife interpretive area in the Mt. Wellgreen area.

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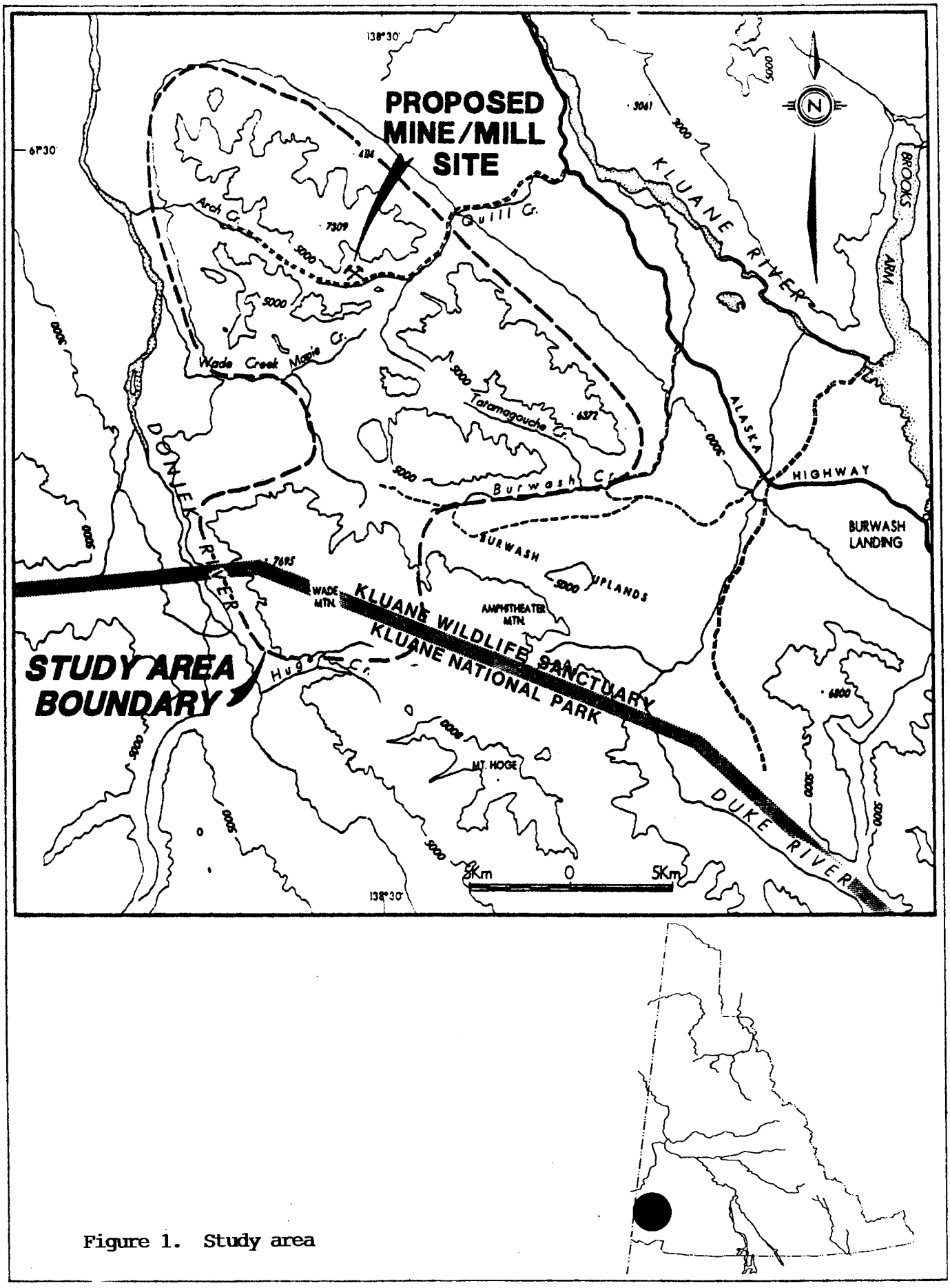


Figure 1. Study area

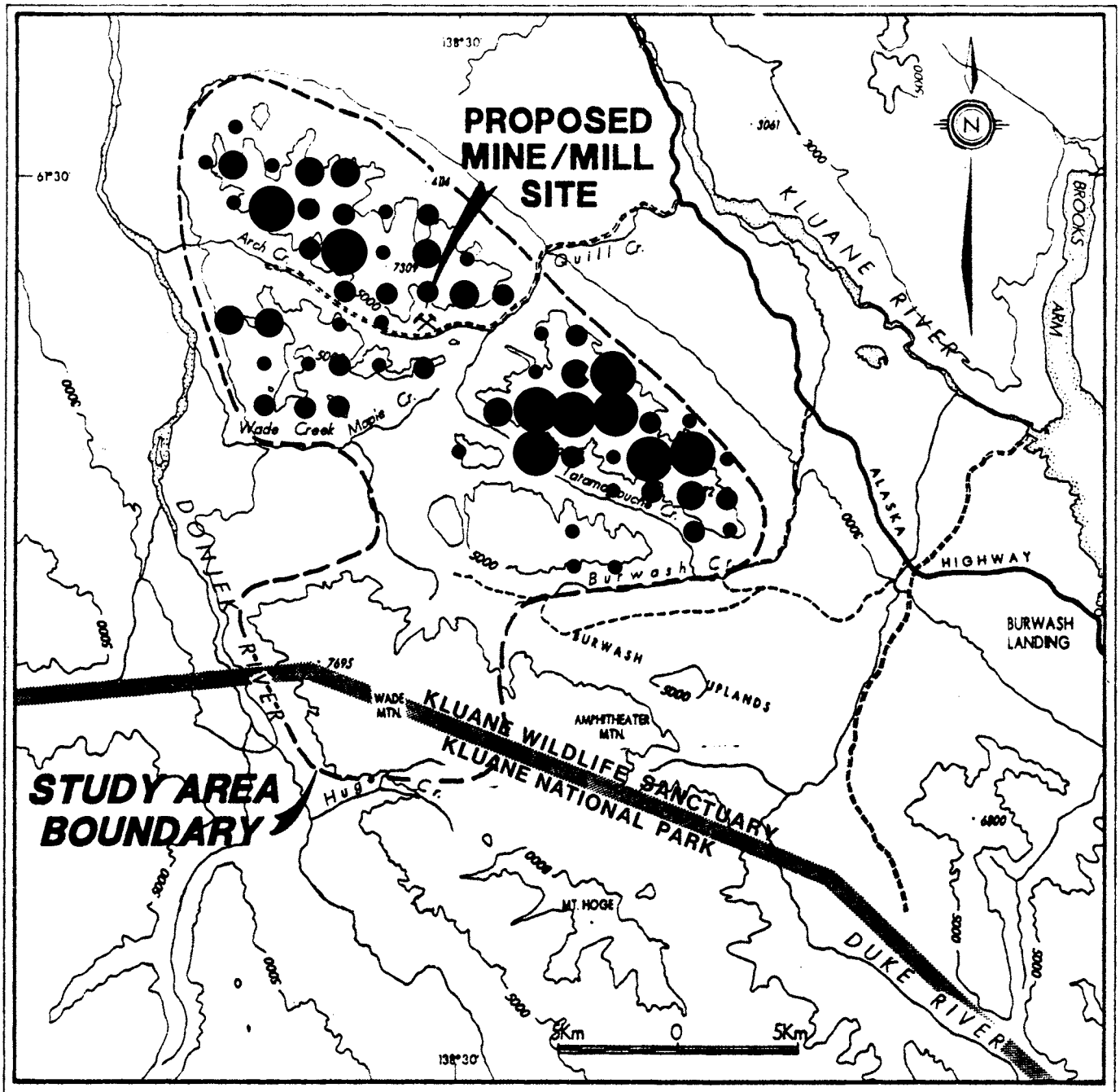
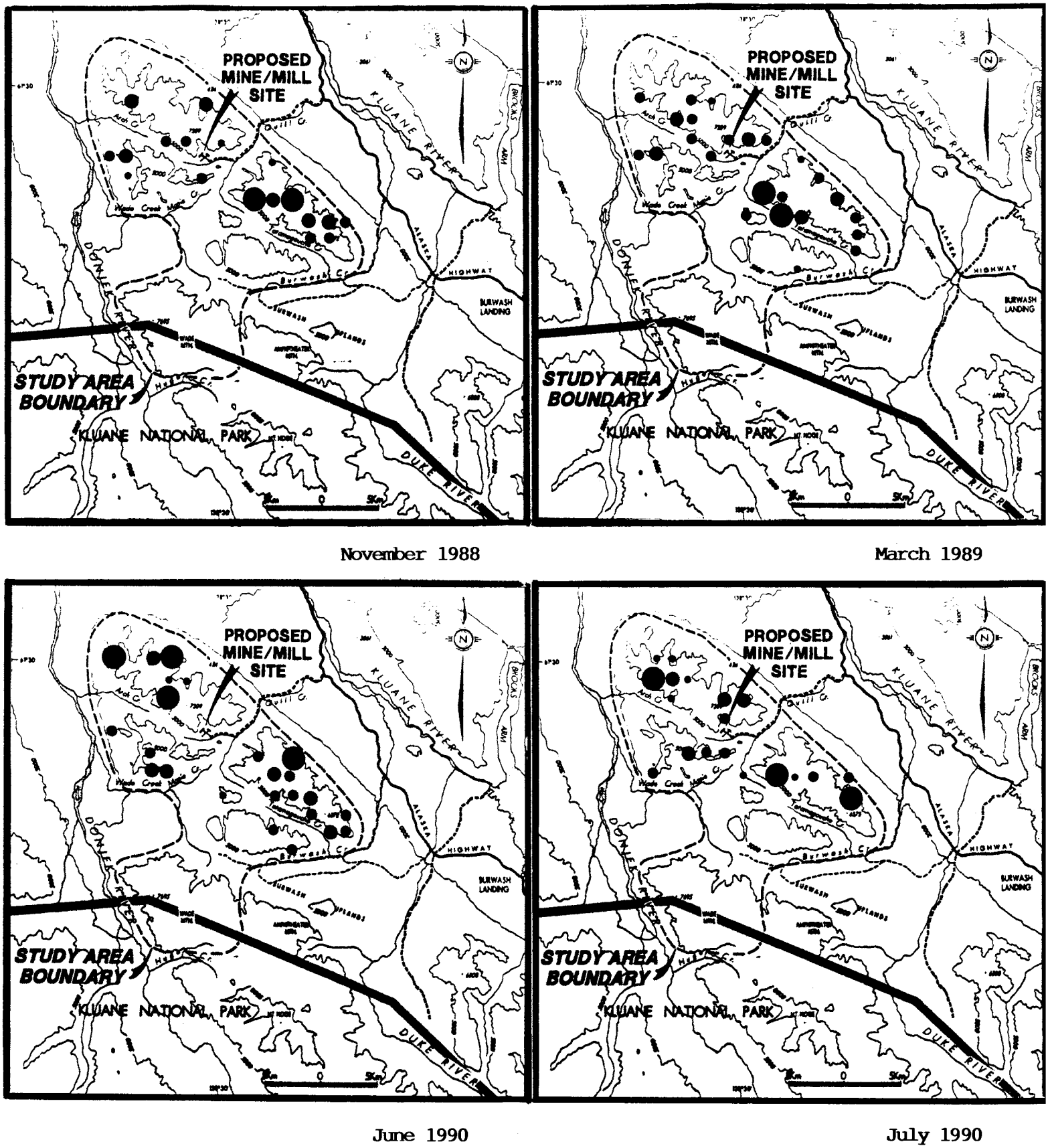


Figure 2. The distribution of observed sheep from combined systematic helicopter surveys.

- 1-10 sheep
- 11-25 sheep
- 26-50 sheep
- 51+ sheep



November 1988 March 1989

June 1990 July 1990

Figure 3. The seasonal distribution of sheep observed in the study area.

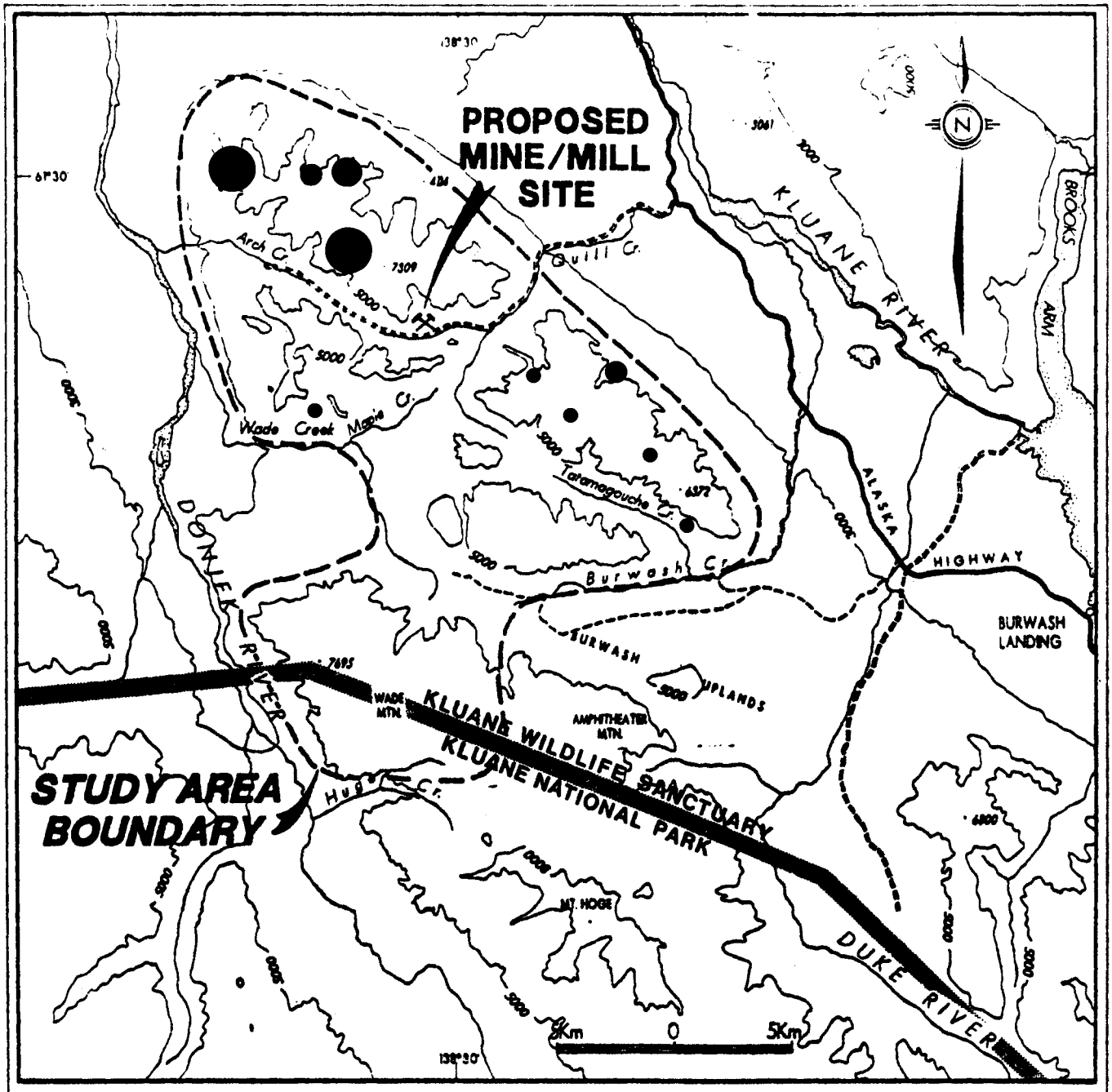


Figure 4. The distribution of nursery sheep (not including lambs) during a systematic helicopter survey in June 1989.

- 1-2 sheep
- 3-10 sheep
- 11-25 sheep
- 26+ sheep

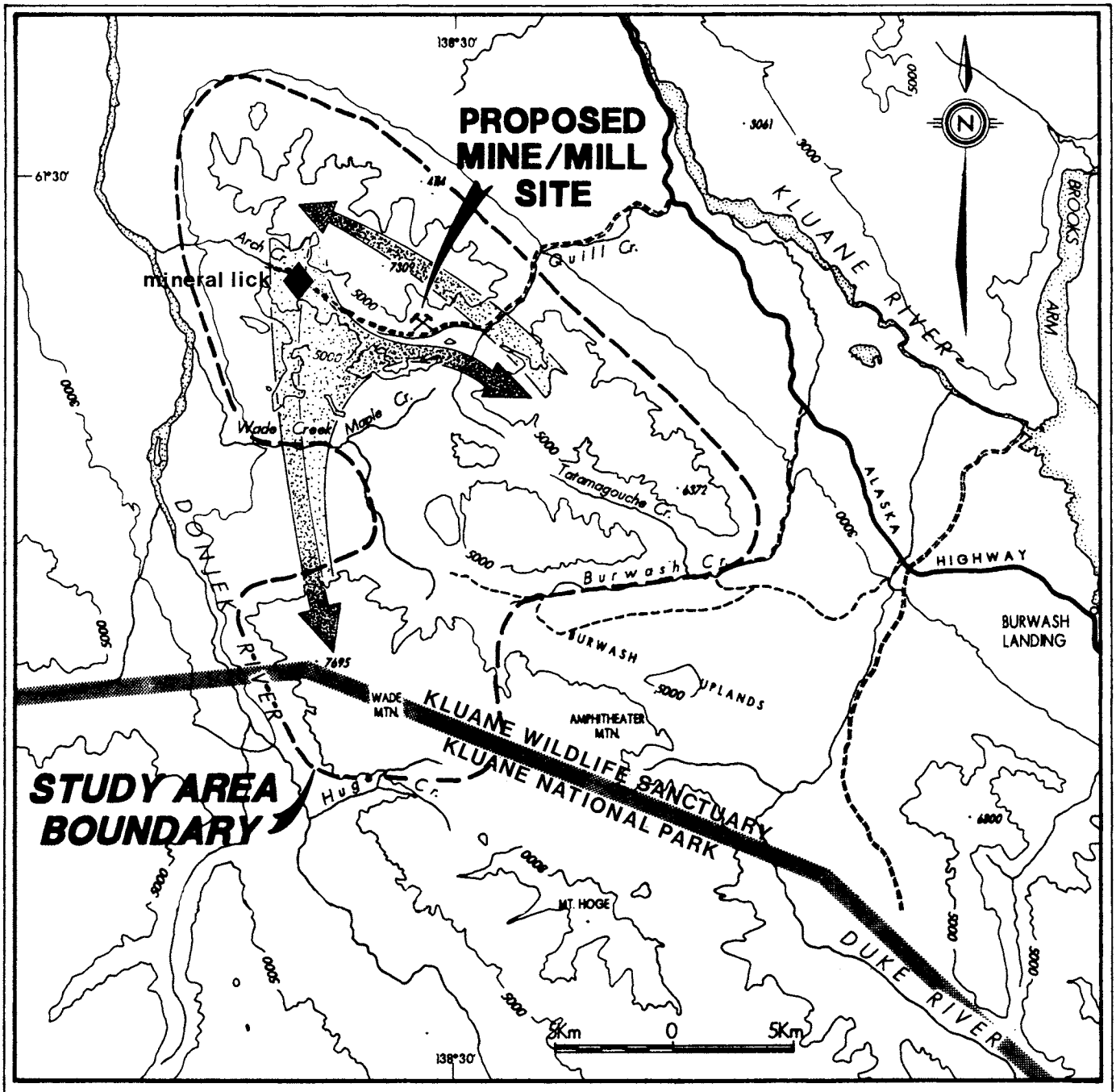


Figure 5. Location of the known mineral lick and suggested annual movement patterns of nursery sheep inhabiting the study area

Table 1. Number of sheep observed during helicopter surveys, by sex/age class and month, 1985-1990.

			SEX/AGE CLASS			
MONTH	YEAR	AREA	RAMS	NURSERY	LAMBS	TOTAL
July	1985	Study area	100	13	2	115
November	1988	Study area	84	133	47	264
March	1989	Study area	102	73	34	209
June	1989	Study area	171	122	17	310
		Study area/Wade Mountain	178	198	44	420
March	1990	Study area	112	111	31	307
July	1990	Study area	106	53	16	175
		Study area/Wade Mountain	230	187	56	483

Table 2. Mean elevational occurrence of nursery sheep and rams by season.

	NURSERY SHEEP		RAMS	
	$\bar{X}$ ELEVATION	N	$\bar{X}$ ELEVATION	N
March 1990	6011	149	5504	112
June 1989	5787	121	5251*	171
July 1990	5470	44	5390*	106
November 1988	5010	133	4965	81

* deonotes statistical similarity (June 1989 and July 1990).