DALL'S SHEEP MONITORING

IN THE CENTRAL MACKENZIE MOUNTAINS:

1990/1991

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ABSTRACT

We studied Dall's sheep (*Ovis dalli dalli*) at three study areas in the Mackenzie Mountains in 1990 and 1991. Two areas, designated as 4G and 6H, are mountain blocks of 236 and 196 km^2 respectively and were intensively studied by Simmons and co-workers in the late 1960's and early 1970's. In 1990, we examined size and age/sex composition of the sheep population on each block as well as plant biomass inside and outside a 10 x 20 foot wire exclosure erected in 1972. Methodological difficulties prevented us from studying plant composition along transects defined in 1972 on block 6H. In 1991, we conducted another census of block 6H and attempted to classify sheep. We also visited a new block (70 km^2) located along the headwaters of Sheep Lick Creek.

We found fewer sheep on mountain blocks 4G and 6H in 1990, and again on 6H in 1991, than reported in the early 1970's, but concluded that the discrepancy was most likely a result of our unfamiliarity with the study area. Production of lambs in both areas in 1990 was approximately that expected if populations were stable. Poor weather in 1991 limited our ability to classify a satisfactory sample of sheep on 6H. Only a marginal sample was obtained on the Sheep Lick Creek block despite fair weather. This sample contained a preponderance of rams.

We found much higher dry matter biomass of shrubs both inside and outside the exclosure at 6H in 1990 than reported in the 1970's but the differences were not statistically significant because of the large spatial heterogeneity of the shrubs. Forbs significantly declined both inside and outside the exclosure but the biomass were very small and, in absolute terms, the differences are insignificant. Grass declined in biomass outside the exclosure but again the differences are minor and possibly a result of patchy distributions.

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INTRODUCTION

In the late 1960's and early 1970's, intensive research was undertaken on Dall's sheep (*Ovis dalli dalli*) in the central Mackenzie Mountains by the Canadian Wildlife Service. The results of this work were summarized in a series of reports (Stelfox 1975, Simmons 1982, Simmons et al. 1984) documenting population size and composition, and range composition. In summer 1990, we returned to two of the study areas to determine whether there have been any changes in the Dall's sheep populations or their ranges in the nearly 20 years since the original studies were completed. In summer 1991, we returned to one of the original sites plus a new one known to be sheep summer range.

There were four distinct aspects to this study; population census, age/sex classification, forage availability, and forage composition. These components are treated separately in this report.

Objectives

Census-- Simmons et al. (1984) counted Dall's sheep in the early 1970's on two separate mountain blocks (4G and 6H), located along the Keele River in the central Mackenzie Mountains (Fig. 1). One purpose of the present study was to conduct an aerial census of these same two mountain blocks and compare current number and distribution of sheep with results obtained two decades ago.

Classification-- Simmons et al. (1984) recommended monitoring mid-summer lambing success and yearling recruitment of Dall's sheep in the Mackenzie Mountains as measures of population viability. We therefore conducted ground classification of Dall's sheep on mountain blocks 4G and 6H in 1990 in order to gain experience with these techniques and to compare present age/compositions with data reported by Simmons et al. (1984) for the same mountain blocks. In 1991, block 6H was censused again and sheep classification was attempted there and at the new study site located near Sheep Lick Creek.

Forage Production-- In 1990, we measured forage production both inside and outside the 10 x 20 ft wire mesh exclosure erected by Stelfox in 1972 (Stelfox 1975) to determine a) if release from grazing pressure had produced any changes in production, and b) if the grazed range outside the exclosure had undergone any change in production.

Plant Composition-- We determined plant composition both inside and outside the above exclosure to determine if a) release from grazing pressure had produced any changes in the species composition of plant community, and b) if grazed range outside the exclosure had undergone change in species composition indicative of over-grazing.

STUDY AREA

The mountain blocks studied in 1990 were originally designated as 4G and 6H by Simmons (1982) and Simmons et al. (1984). A review of literature on the areas' geomorphology, vegetation, and weather is presented in Simmons (1982). The new block visited in 1991 was recommended by the local outfitter as an area regularly frequented by ewe bands and rams. All the study areas lie west of Fort Norman in the central Mackenzie Mountains (Figure 1).

Area 6H consists of a single mountain block approximately 196 km^2 in size and located east of the confluence of the Keele and Natla Rivers. The block is sometimes referred to as Mount Stelfox. The 4G study area is 236 km^2 in size and is located between the Keele and Carcajou Rivers east of Mount Eduni. The new area was 70 km^2 in size and was located along the headwaters of Sheep Lick Creek. All study areas were entirely above treeline.

METHODS

Census - 1990

A drainage survey was used to census both mountain blocks (Hoefs 1984). Each mountain block was contoured in either a Bell 206B or 206L helicopter. The altitude flown varied depending on the location of treeline, the presence of meadows above treeline and adjacent escape terrain. Sometimes more than one pass was made across a slope at a higher or lower elevation than the initial pass. We attempted to examine all basins and small side valleys encountered during the contour, within the limitations of the helicopter and weather.

Observers sat in the left front and rear seats of the helicopter. The front observer navigated and scanned the area in front of, above, and below the helicopter. The rear observer scanned laterally and above the helicopter. The rear observer recorded all sheep sightings on data sheets and the front observer plotted their locations on 1:250,000 maps.

Census - 1991

A repeat census of block 6H was conducted using identical techniques as in 1990, although the rear seat observer was different. No census of the Sheep Lick Creek mountain block was attempted.

Classification - 1990

Four days were spent classifying sheep on mountain blocks 4G and 3 days on 6H. Camps were established near concentrations of sheep observed during the censusing of mountain blocks 4G and 6H. Day-hikes were made from the camps and surrounding slopes and valleys were scanned for sheep. Terrain and distance permitting, we approached groups of sheep as close as possible without disturbing them. Sheep were classified using spotting scopes at 30-40X magnification according to the following categories: ram (full, three-quarter, half, < half curl), ewe, yearling, or lamb. At first, we found it difficult to distinguish between ewes and young rams (i.e., 1-3 yr) and yearlings, especially from more than 1 km away. Horn size and shape were found not to be reliable criteria as they are in bighorn sheep. Observation distance, therefore, was restricted to a maximum of 1 km (preferably <500 m) and other features such as facial characteristics and presence of a penis or udder were also used as classification criteria.

Classification - 1991

Post-census classification was attempted over a four day period on block 6H but poor weather precluded movement away from base camp for much of this time. Three days were spent classifying sheep at the Sheep Lick Creek block. The technique and classification criteria were identical to that used in 1990.

Forage Production

Methods followed those outlined by Stelfox (1975). We established five 9.6 ft^2 plots inside and 5 plots outside of the exclosure by rotating a string 21 inches long from a centre stake. Plots were located immediately adjacent to those clipped in 1972 and 1975 to ensure that the exact area was not clipped twice. We clipped plots to within 1 cm of the ground with scissors. Following Stelfox's methods, *Arctostaphylos rubra*, *Empetrum nigrum*, *Vaccinium vitis-idaea*, and *Dryas* spp. were not removed. Birch (*Betula glandulosa*) was clipped to the largest twig size capable of being cut with scissors; approximately 5 mm in diameter. We separated vegetation at time of clipping into forbs, graminoids, and shrubs and placed in separate paper bags. The vegetation was air-dried in the opened paper bags for 3 weeks and weighed on a triple-beam balance. The entire sample was weighed; leaves were not separated from branches. Data are not available with which to calculate variances for the 1975 data and consequently comparisons are made only between 1972 and 1990. The level of statistical significance was set *a priori* at 5%.

Plant Composition

Stelfox (1975) established two sets of linear vegetative composition transects. The first type consisted of ten 100-foot transects marked at each end with metal angle-iron stakes. The location of these transects was indicated by Figure 3 in Stelfox (1975). Unfortunately, one cluster of transects (Range Samples 1,2,3) was indicated in the wrong location and only by comparing photographs was it discovered that they are located in the immediate location of the exclosure. The end points of only one of these transects was located. We never located the other cluster (Range Sample 4) despite 3 partial days of search. Accordingly, the 100-foot transects were not sampled.

The second transect type consisted of five 20-foot transects inside the exclosure and five 20-foot transects immediately adjacent to the exclosure (Stelfox's Figure 9). The "point-intercept method" (Shaw and Stiteler 1962 in Stelfox 1975) was used to characterize the vegetation. Unfortunately, this key and often-cited reference is not available in any public library in North America, is not retained by the U.S Forest Service who published it, and is not in the personal collections of the several range scientists we contacted. The authors are no longer living. Accordingly, we followed Stelfox's (1975) description of the method. At one foot intervals, a metal pin 2 mm in diameter (a brass welding rod) was placed vertically into the ground. A wooden pin-frame was initially used but later abandoned to hand-holding. Species touched by the pin were recorded on prepared data sheets. Both basal and foliage hits were recorded but in an unsatisfactory manner because it was unclear what Stelfox meant by a basal hit making our differentiation between basal and foliage hits unreliable. Following Stelfox, recording a basal hit excluded chance of a foliage hit but more than one species could be recorded as a foliage hit. Stelfox recorded "utilization" but did not describe how to recognize it. We therefore did not collect these data.

The validity of the composition data as a comparison with the 1972 and 1975 data is seriously compromised by our inability to re-create Stelfox's methods exactly. We therefore report no results for forage composition.

RESULTS

Census - 1990

Conditions during the two census flights were generally good, although strong winds prevented us from examining several small valleys in the middle of block 4G. Approximately 4.5 hrs of flying were required to census each mountain block.

We counted a total of 58 sheep on mountain block 4G and 84 on 6H. Mean group sizes were $3.7\pm2.1(n=15)$ on 4G and $6.5\pm4.1(n=13)$ on 6H.

These means are significantly different ($t=-2.1, P<.05$). Group sizes ranged from 1-9 on 4G and 1-14 on 6H.

On 4G, sheep were concentrated mainly along the western edge of the mountain block, primarily in rugged side valleys and draws extending eastward from the unnamed creek which was the west boundary of 4G (Fig. 1). On 6H, sheep were more abundant in the north half of the block than the south half and were frequently located on open slopes well removed from rugged escape terrain.

Age/sex classification of sheep from the helicopter was abandoned part way through the censusing of block 4G. We were not sufficiently confident in our ability to separate ewes from yearlings or ewes from very young rams (i.e. < 2 yrs.).

The locations of sheep observed during this census are on file with the Department of Renewable Resources, Norman Wells.

Census - 1991

Conditions during the census flight were good and 4 hrs. of helicopter flying was required to census 6H. We counted a total of 80 sheep on block 6H. Mean group size was 3.8 ± 2.9 ($n=21$). Groups ranged in size from 1-10. Group size did not differ significantly from group size in 1990 (t-test, $P>.05$). Sheep were concentrated in the middle and northern parts of the study area.

Classification - 1990

We classified 78 sheep on 4G and 85 on 6H. The lamb:ewe ratio was higher on 4G than 6H (0.70 vs. 0.54; no statistics). Yearlings comprised 12.5% of total sheep on 4G and 18.7% of the total classified sheep on 6H. The yearling:ewe ratios on 4G was 0.29:1 and .19:1 on 6H. We saw far more ewes per ram on 4G than on 6H (2.7 vs. .85 ewes:ram). There were also more nursery sheep (ewes, young rams, yearlings and lambs) on 4G than 6H (5.4 vs. 1.8 nursery sheep:ram).

Rams comprised 17% ($n=10$) of all sheep classified on 4G and 34% ($n = 28$) on 6H. On 4G, 6% of all classified sheep were full curls whereas they comprised 9% of sheep seen on 6H.

Average group sizes seen during classification were not significantly different between blocks 4G ($\bar{x} = 5.6$, $n=14$) and 6H ($\bar{x} = 5.3$, $n=15$) ($t=.11$, $P>.05$). Ewe groups comprised 57 and 53% of all classified groups on blocks 4G and 6H and 88% of the ewe groups on both mountain blocks contained lambs.

Classification - 1991

Due to poor weather only 26 sheep were classified on block 6H. No further analysis was attempted.

A total of 41 sheep were classified at the Sheep Lick Creek block over three days. Over half of these (59%) were rams of which 25% were full curl. Yearlings comprised only 5% of the total. The lamb:ewe ratio was low at .29. Ewe groups comprised 33% (4/12) of the total number of groups observed. Average group size was 3.5±3.1 (n=12).

Forage Production

Figures 2 and 3 present a summary of forage production for 1990 relative to 1975 and 1972. Appendix A presents the raw data.

The Newman-Keuls multiple comparison test shows no difference between 1972 and 1990 for biomass of grasses and shrubs within the exclosure. The difference between years for forbs is significant but the biomass are so low as to make the difference unimportant.

Outside the exclosure, there was no difference between 1972 and 1990 for shrubs although there was a significant decline in biomass of grasses and forbs. Again, the absolute differences in weights measured are so small that they probably reflect no practical difference. The patchiness of grass distribution (CV's of .84 and .95 for 1972 and 1990 respectively) suggest that the difference in grass biomass may have resulted from small sample size.

The change in total shrub biomass was large both inside the exclosure (37% increase) and outside it (48% increase). However, the large variance of shrub biomass ($\bar{x}$ = 85.9, SD = 89.9, n = 20) suggests (Figure 1 in Eberhart 1978) that one would need to clip approximately 60 plots in both years to determine that the observed decrease was statistically significant.

DISCUSSION

Census

The counts of Dall's sheep on mountain blocks 4G and 6H in 1990 and 6H in 1991 were lower than those reported by Simmons et al. (1984) for the early 1970's (110 and 103 respectively), the count for 6H being nearly identical between years. We are reluctant to conclude, however, that this represents a real decline in sheep numbers since that time. If an observer error of 20% in the present study is assumed (Barichello et al. 1987) the resulting estimate for 6H (102) is similar to the number reported by Simmons et al. (1984). Simmons et al. (1984) gave average values based on several successive years of observation but it is unclear whether or not observer error was factored into their results. Simmons et al. (1984) became intimately familiar with the study areas over several years thereby maximizing their censusing efficiency. In the present study, the observers were inexperienced both in their knowledge of the study areas and in aerial censusing of Dall's sheep.

Furthermore, we could easily have missed sheep, especially in block 4G, where they were concentrated on rugged terrain and where the weather prevented us from effectively examining some parts. Lastly, the more powerful 206L helicopter used for 6H enabled us to more confidently examine rugged terrain than was the case for 4H. It is important to note, however, that even with the familiarity and experience gained in 1990 on block 6H the count was nearly identical in 1991.

Classification

In 1990, both the lamb:ewe and yearling:ewe ratios on mountain blocks 4G and 6H were similar to or exceeded the four year averages 1of Simmons et al. (1984)(.60 and .27). Recruitment of yearlings on 4G (12.5%) and 6H (18.5%) are similar to the 14.8% required for a stable population size in the Mackenzie Mountains (Simmons et al. 1984).

The wide difference in the ewe:ram ratio observed between the two mountain blocks in 1990 was unlikely to be real. Other studies in Alaska and Yukon usually report ewe:ram ratios lying between the ratios on blocks 4G and 6H (e.g. Hoefs and Bayer 1983; Heimer and Watson 1986). In the case of 4G where the ewe:ram ratio was higher, the light hunting pressure (approximately 4 full curl rams per year) would not have caused a major reduction in the number of rams. Furthermore, similar hunting pressure also occurs on block 6H each year where ram numbers were atypically high. Perhaps sampling effort was not distributed widely enough within the short sampling period. This could have resulted in a bias of observed sheep.

Forage Production

Visual inspection of the plots indicated no striking differences in biomass inside and outside the exclosure except for shrubs. Clipping data suggests sizeable differences between years existed only in the greater shrub biomass outside the exclosure. This, however, is more likely a result of small sample size and the patchy distribution of the dwarf birch sampled. An adequate sample size would have been 30 plots inside and 30 plots outside the exclosure. The ratio of shrubs inside to shrubs outside was .32 in 1972 and .29 in 1990 indicating no effect from the exclosure. In summary, the exclosure data indicated that grazing pressure outside the exclosure over the past 18 years has not had a major effect on forage production. However, the sample sizes were inadequate to discriminate small changes.

SUMMARY AND RECOMMENDATIONS

Census

It appears that the number of Dall's sheep on mountain block 6H in both years were similar to those reported nearly 20 years earlier. Survey conditions during the census of 4G in 1990 rendered the results for that block impossible to assess relative to the earlier work.

The authors gained valuable experience in the aerial censusing of Dall's sheep in the Mackenzie Mountains. It was readily apparent that in mountainous terrain familiarity with an area would greatly increase the efficacy of the census. Noteworthy, however, were the nearly identical census results on block 6H between years despite an exact duplication of techniques the second year. A census of an area conducted twice, one year apart, may still not provide enough familiarity to significantly alter census efficacy for that area.

The 4.5 hrs of flying time used to census each block probably represented the absolute minimum required for censusing Dall's sheep in areas of this size (approximately 200 km) in the Mackenzie Mountains.

Classification

Dall's sheep on mountain blocks 4G and 6H showed productivity similar to that reported for sheep on these same blocks during the early 1970's. The ewe:ram ratios on the two blocks differed widely and were at variance with those reported elsewhere. Reasons for this are unclear.

The two years of sheep classification reported here demonstrate the logistic and financial constraints placed on Dall's sheep study in the Mackenzie Mountains. Classification counts conducted from a centrally based camp at high elevation, and under good weather conditions, appear only marginally able to obtain a satisfactory sample (i.e. >80 sheep) because, generally, all traversable terrain can be examined in 3-4 days. Larger sample size would require a camp movement of at least 10 km to another location on the same mountain block. If this was done with helicopter, the cost would likely mean restricting classification to one mountain block each summer.

Successful classification at one location also requires 3-4 days of good weather so that a maximum number of sheep can be observed in the shortest possible period. Given the total time available for this work each summer, and if a fixed schedule of sampling widely separate mountain blocks is adhered to, then a typical summer storm can prevent any meaningful results from a location before the move to the next location. It may be desirable to maintain a flexible schedule and work on just one or two mountain blocks each summer.

We gained valuable experience through both the census and classification work. Although the direction of Dall's sheep work in the Mackenzie Mountains has still to be determined, possible increased management efforts in the future will be enhanced by Departmental staff with experience and at least an intuitive feel for the natural history of the species. Periodic studies such as the one just described are worthwhile from this aspect alone, in addition to updating our all too small database from the Mackenzie Mountains.

Forage Production

There were no major differences noted in forage biomass. Differences between 1972 and 1975 were as great as between the 1970's and 1990 indicating no major long-term trends. There were no large differences between biomass within and outside the exclosure except in the case of shrubs which was probably the result of small sample size and great spatial heterogeneity. On the basis of these comparisons, we see no evidence for any changes in forage biomass relevant to management of Dall sheep.

It is evident that the sample sizes are too small to allow statistical examinations or fine-scale discrimination of differences. Exclosures are capable of demonstrating only major trends in biomass and are ineffective when the cover types are patchily distributed. Efforts should be made to have continuity of personnel in such monitoring to ensure that standard techniques are followed in an attempt to minimize systematic measurement biases.

Plant Composition

It would be very worthwhile to do plant composition analysis on the 10 100-foot transects set up by Stelfox (1975). If the area is visited for other reasons, some effort should be expended in attempting to find these transects. If they are found and the decision is made to examine the plots, the Shaw and Stiteler (1962) paper should be located first to confirm methods.

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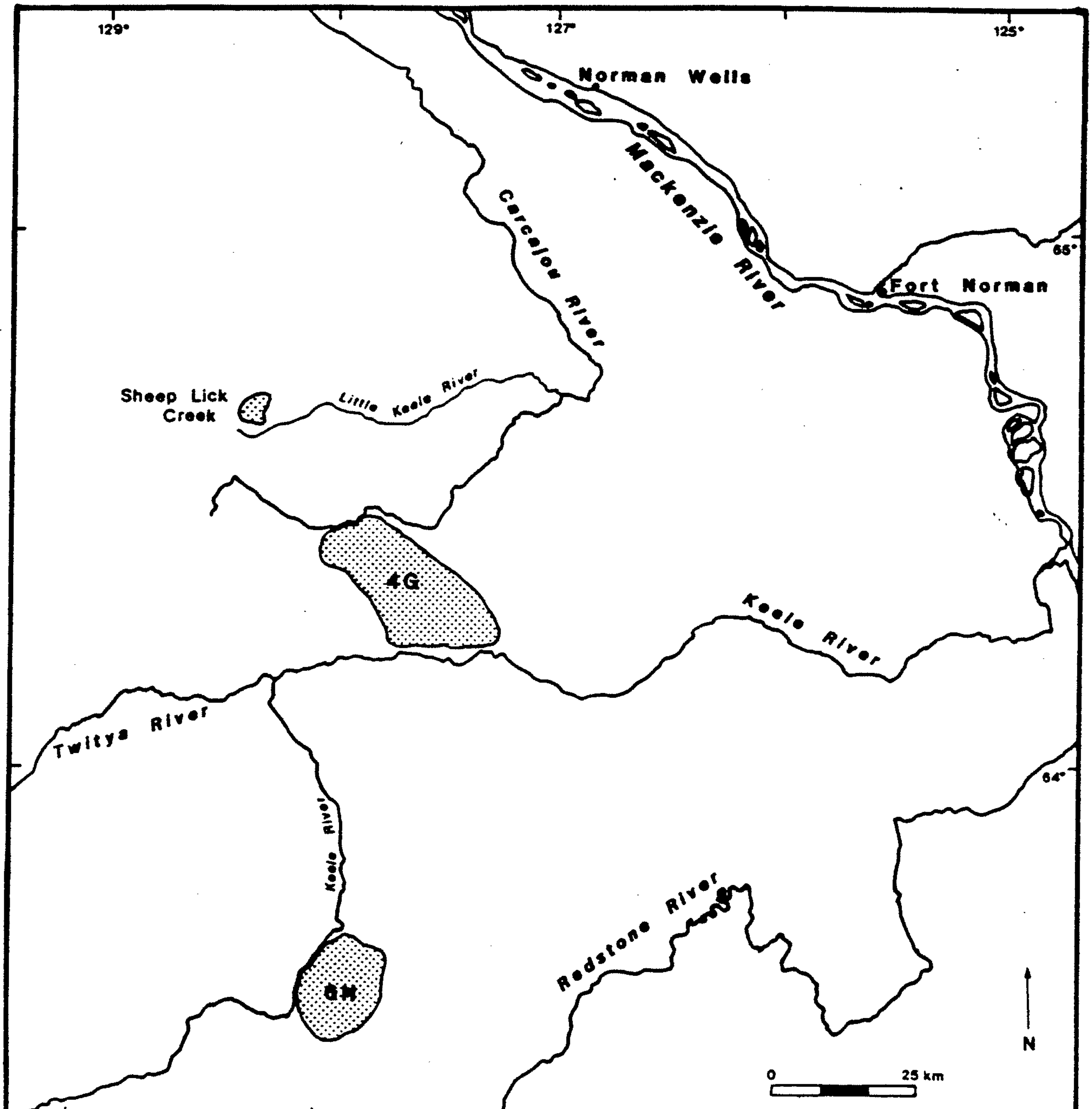

Figure 1. Map showing location of study areas 4G and 6H.

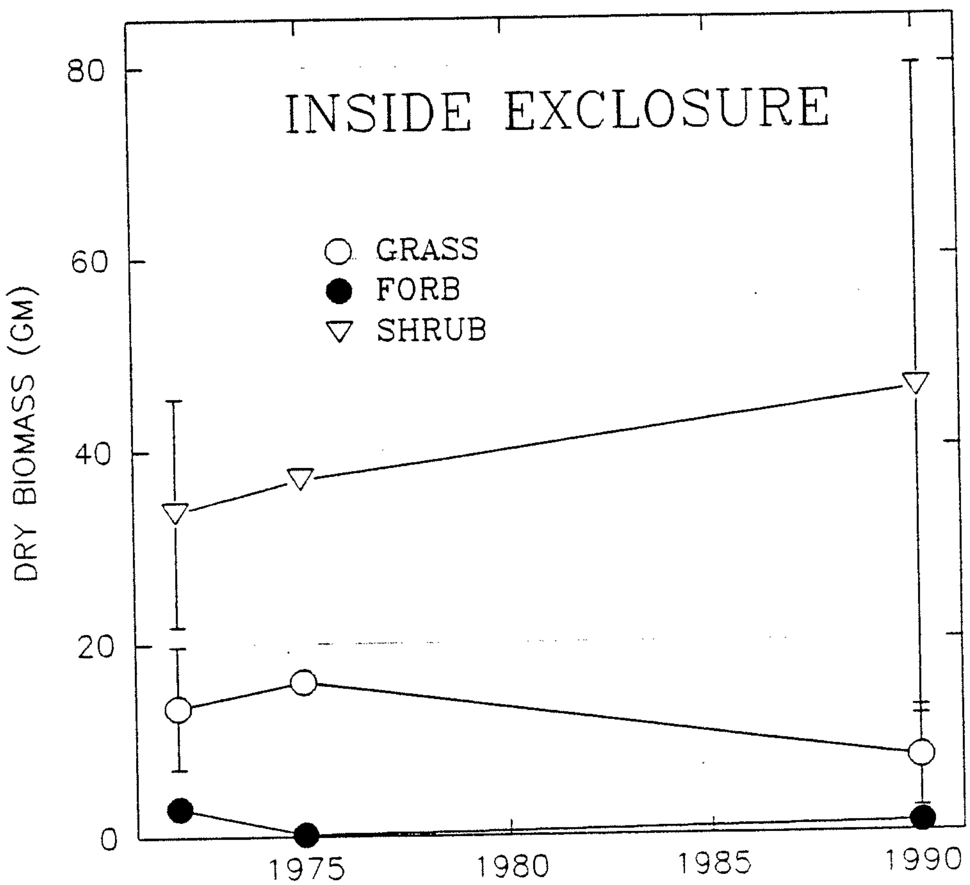

Figure 2. Mean vegetative dry biomass for grass, forbs, and shrubs inside the exclosure in the years 1972, 1975 and 1990.

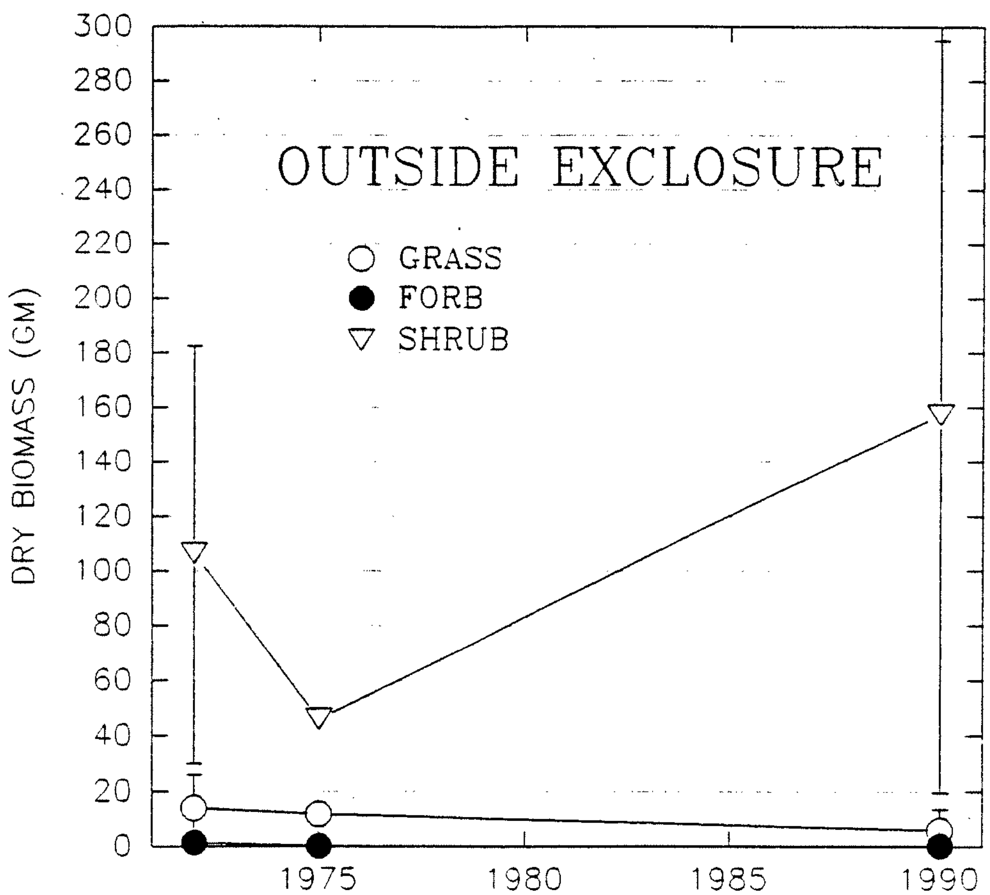

Figure 3. Mean vegetative dry biomass for grass, forbs, and shrubs outside the exclosure in the years 1972, 1975 and 1990.

APPENDIX A.

Clip plot data for inside and outside the exclosure on area 6H of the Mackenzie Mountains. The 1972 data are from Stelfox (1975).

	Grass			Forb			Shrub		
	1972	1975	1990	1972	1975	1990	1972	1975	1990
Inside									
1	6		4	3		1	20		82
2	10		4	3		1	24		1
3	13		4	2		0	34		77
4	15		13	2		2	42		29
5	23		14	5		1	48		41
Total	67	80	43	12	1	4	168	185	230
$\bar{x}$	13.4	16.0	7.8	3.0	0.2	1.0	33.6	37.0	46.0
SD	6.4	-	5.2	1.2	-	0.7	11.8	-	33.9
Outside									
1	4		14	1		1	11		3
2	6		2	1		0	43		231
3	7		1	1		0	128		226
4	24		10	2		0	165		19
5	30		3	2		0	185		308
Total	71	60	30	7	1	1	532	230	787
$\bar{x}$	14.2	12.0	6.0	1.4	0.2	0.2	106.4	46.0	157.4
SD	11.9	-	5.7	0.6	-	0.5	76.2	-	137.7

Appendix B. Schematic showing locations of clip plots relative to the exclosure.