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(Elk country)

A PRELIMINARY STUDY OF RANGE USE IN THE
VICINITY OF KIMBERLEY AIRPORT

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INTRODUCTION

The objectives of this study were twofold:

- (1) to provide baseline data which would enable future assessment of the impact of the elk winter feeding program, (started in the winter of 1973-1974), on the vegetation at Kimberley Airport.
- (2) to compare the effects of different grazing regimes (domestic and wildlife) on the vegetation near Kimberley Airport.

Eight plots were staked out around Kimberley Airport (Figure 1) to measure ungulate use and several characteristics of the vegetation. The plots were located in pairs, one pair for each area that had undergone a different amount or type of use by grazing ungulates. The four designated plot "types" were:

- 1) heavy elk use (Plots 1 and 2)
- 2) heavy cow and heavy elk use (Plots 3 and 4)
- 3) heavy cow and light elk use (Plots 5 and 6)
- 4) light elk use (Control plots 7 and 8)

The locations of the four pairs or types of plots were chosen acknowledging where the elk had been fed the previous winter. As hay for the elk had been distributed in strips alongside the eastern edge of the airstrip, the heavy elk use plots were located there. The heavy elk and heavy cow use plots were located nearby on the other side of the fence along the eastern side of the airport. Heavy cow and light elk use plots were located outside the fence on the opposite side of the airport. The light elk use or control plots were located in the area between the houses and the highway, where relatively few elk would probably have come.

All of the plots were chosen as *potential* bunchgrass sites located in a *Festuca scabrella-Pinus ponderosa* community. In other words, all plots were assumed to have once had vegetation such as that found in the control plots, or, given several years "rest" from animal grazing use, the vegetation in all of the plots would return to the characteristic bunchgrass found in the control plots. Thus the differences in vegetation of the various plot types were assumed to have resulted primarily from differences in amounts and types of past grazing pressures in each area. Support for this argument can be seen in photos taken around the airport (Figure 2), showing fence-line contrasts.

Size of each plot was 15 x 30 meters and all sampling was done within the eight plots. To assess use pellet group counts were made in each plot. To assess the

vegetation, species composition, productivity and shrub utilization were measured in each plot. Each of these measures is dealt with separately in following sections, but first it is useful to summarize the history of the area. The history of "disturbances" and of past grazing pressures are both important in understanding the vegetation that now exists at the airport.

HISTORY OF THE AIRPORT AND SURROUNDING LAND

The history of the airport and of the surrounding land can be summarized briefly as follows. In the early 1900's, the area was all a natural Ponderosa pine forest. Early logging, primarily for the railway, took place from 1900 to 1920. In 1931, the entire area was burned. The airport was built in about 1936 by Trans Canada Airlines (now Air Canada).

The rock piles all along the eastern fence of the airport consist of rocks which were cleared off by hand, with the help of wheelbarrows, during construction of the airstrip. It is probable that before construction of the airstrip the area was not completely flat and was made up of slight undulations and hills. Thus during the levelling process different soil horizons may have been differentially exposed to the surface. For example, the levelling of a slight hill would expose the "B" horizon to the surface whereas an already "flat" area would retain its "A" horizon on the surface. This would help to explain different soil compositions and correspondingly different vegetation growth in areas of relatively close proximity. It is also probable that areas alongside of the airstrip experienced similar differential disturbance. Evidence for this statement is provided by the two soil pits dug alongside the eastern edge of the airstrip. The soil pit dug in a *Poa* site differed dramatically from the soil pit dug in a nearby *Festuca scabrella* site (Figure 3).

The airstrip was maintained as a turf airstrip; in the winter large rollers were used to compact the snow for planes to land on. It was closed down in 1968-1969 and can now be used only for emergency landings. In 1973, the area was ^{recovered} taken over ^{in favour of} by the Fish and Wildlife Branch (from the Department of Transport) because it provided one of the largest intact sharptail grouse habitats in the St. Mary's Prairie - Ta Ta Creek.

In summary, while discussing the different plots located around the airport, all of the disturbance factors mentioned above should be acknowledged. Logging, fire, and nearby man-made disturbances such as the construction of the airport all had some effect on the vegetation composition of the area.

GRAZING HISTORY OF THE AIRPORT AND SURROUNDING LAND

Before discussing and comparing areas that have had different amounts of use by grazing animals, it is helpful to know something of the grazing history of each

FIGURE 3. Soil pits



3(a) Soil pit dug adjacent to Plot #1 in a *Festuca scabrella* site. Note several inches of topsoil or "A" horizon present.



3(b) Soil pit dug in an area between Plot #1 and Plot #2, in a *Poa* sp. site. Note complete absence of any topsoil or "A" horizon.

of these areas. Although pellet counts help to give some idea of what the present and recent past grazing pressure is and has been, they are not always an accurate reflection of use. Further, pellet counts cannot help in understanding long term changes in vegetation composition which may have occurred due to earlier grazing pressure. Unfortunately, the grazing history obtained for the Kimberley airport region is somewhat incomplete and, in some cases, imprecise. I can therefore offer only a rather general overview of the types and numbers of grazing animals that used the area in the past.

The four types of grazing ungulates that have or are still using the area are cows, horses, deer and elk. Grazing by cows and horses in the general area extends at least as far back as the 1800's. The airport itself was built in about 1936 and was presumably fenced off from grazing animals at about that time. The area outside of the airport was presumably subject to uncontrolled early grazing by both cows and horses. There were reported to be "hundreds of wild horses in 1948"^{1/} and the highway adjacent to the airport was not fenced off on the west side until 1966; hence livestock animals wandered at will into the vicinity of the airport from neighbouring ranges on either side of the highway. By 1966 grazing by cows and horses was "controlled" and the permit system was in effect.

Table 1 summarizes the number of grazing permittees and livestock animals in the Cherry Ta Ta Creek Range Unit from 1962 to 1974. The Cherry Ta Ta Creek Range Unit is a relatively large area, which includes the smaller Kimberley Airport region. These figures cannot therefore be applied directly to the ranges adjacent to Kimberley Airport, but they at least help to show a trend in livestock grazing in the general area over the past 12 years. As can be seen in this table, the number of animal unit months has steadily increased over the past 12 years and is now almost double the number of animal unit months in 1962 (90% increase).

Figures of the exact numbers of cows and horses using the ranges immediately adjacent to the airport were unobtainable. Two ranchers have permits which include these ranges and although a group of at least a dozen horses was often seen, the actual number of cows grazing near the airport was impossible to estimate. One of the ranchers maintained that some of his cows may never graze or come near the airport, others only occasionally, while some may use the area a great deal. It was therefore of little use to know how many cows he had out on the range. There has always been and still is, however, a tendency for cows to concentrate around the airport due to the presence of a water hole at the south end of the airport.

1/ Jack Brown

TABLE 1

BREAKDOWN OF GRAZING FROM 1962 TO 1974 IN THE
CHERRY TATA CREEK RANGE UNIT

Year	No. of permittees	No. of cattle	No. of horses	No. of A.U.M.'s
1962	6	373	36	1893
1963	6	438	44	2358
1964	6	436	46	2311
1965	5	523	44	2804
1966	6	394	30	2355
1967	5	483	14	2879
1968	5	586	19	3491
1969	5	615	11	3573
1970	5	596	12	3479
1971	5	606	34	3606
1972	5	622	32	3601
1973	5	683	35	3561
1974	5	708	27	3599

An animal unit month or A.U.M. is a feed measure. An animal unit is defined as a mature cow weighing 1000 lbs. with a nursing calf. An animal unit consists of approximately 660 lbs. of air dried forage per month. Each "cow" is one animal unit month, each horse is equal to one and one-quarter animal unit, and each sheep is equal to one-quarter animal unit.

(FROM OFFICE OF DISTRICT FORESTER, NELSON, B.C.)

Within the last decade there has also been some livestock grazing within the airport boundaries. One rancher had a grazing lease for three years which allowed him to graze cows on the airstrip in the fall of each year starting from about 1968. Recently the weakening of the fence around the airport has allowed cows to occasionally "break through" and take advantage of the grass inside for short intervals of time. Furthermore, a few horses were kept at the airport by residents of the airport houses in the summer of 1973. Thus both the heavy elk use and the control plots located within the airport boundaries had a certain amount of horse use during that summer.

The history of grazing at the airport by the other two ungulates, deer and elk, is less complete. It can probably be assumed that a certain number of elk and deer have been using this area since at least the turn of the century. Sightings of elk at the airport during the winter feeding program, which was begun in the winter of 1973-1974, are recorded in Table 2. It was estimated by a Fish and Wildlife technician^{2/} that +20 could be added to this list, making the total number of elk using the feeding station closer to 100.

Looking at the entire grazing history, then, it is apparent that the rangeland on the outside of the airport boundaries has been used fairly heavily by cows and horses in the past and at present. The rangeland inside the airport boundaries was protected from grazing animals after about 1936 but has had some occasional use by cows and horses in the last decade. Although a few horses used the inside area for one summer, it is doubtful that this was a long enough time period to have had a significant impact on the vegetation. Past use by deer and elk, inside and outside the airport boundaries, is not documented and can only be speculated on. Known heavy concentrations of elk occurred along the eastern side of the airport in the winter of 1973-1974, during the winter feeding program.

2/ Bill Warkington

Table 2. Elk sightings made on February 21st, 1974, in the vicinity of Kimberley Airport.

Sightings	Spiked bulls	Cows	Calves
Elk seen at airport	3	40	9
Elk seen among trees adjacent to airport	4*	10	1
Elk seen at Joe Son's Ranch - ½ mile away from airport	-	16	4
TOTAL	7	66	14

Total number of elk seen: 87

* Including 1 class 2 bull, 1 class 3 bull, and 1 class 4 bull.
(Class 2 = large 4 or small 5 point antlers, class 3 = large 5 or small or medium 6 point, class 4 = large 6 or 7 point).

Conditions at time of sightings:

95% high overcast
6" fresh snow (48 hours old)
Maximum snow depth: 8"-10"
Time: 3:18 p.m.

PELLET GROUP COUNTS

Pellet group counts were made in each of the eight plots during the first week of June, 1974. Groups were counted within a circular pellet-plot of 1.72 m or 5.64 ft. radius (100 sq. ft. area), as recommended by Smith, Neff and McCulloch (1969). Fifteen of these pellet-plots were placed at regular intervals inside each plot (Figure 4). To evaluate the difference between regularly and randomly located plots ten pellet-plots were placed randomly in each of Plot Nos. 3, 4, 5 and 6. Number of pellet groups occurring within each pellet-plot were tallied separately for horse, cow and elk. At least one half of the pellet group had to be inside the boundary of the pellet-plot to be counted. If the animal had been walking, leaving a trail of pellets, the centre of the trail had to occur within the plot to be counted.

Results are summarized in Table 3 and Figure 5. Inexperience with pellet counts produced one unfortunate result: no deer pellets were recorded. Later in the summer two white-tailed deer were sighted at the eastern edge of the airstrip and, in the process of clearing Plots 1, 2, 3 and 4 at the end of the summer, a considerable number of deer pellet groups were found. No deer pellet groups were found while clearing Plots 5, 6, 7 and 8.

Pellet group data from all of the plots were analyzed statistically. F and t tests were used to determine whether or not the two plots selected for each plot "type" or treatment differed significantly and were not representative of the same treatment. The F test was employed to evaluate potential differences in the variance estimate and the t test was used to evaluate potential differences between the means. Results of the F and t tests are summarized in Table 4.

Variance estimates from Plots 1 and 2 and from Plots 7 and 8 did not differ significantly according to the F test. Using the data from 15 regularly placed pellet-plots per plot significant differences in the variance estimators, s^2 , were found between cow use in Plots 3 and 4, and between elk use and between horse use in Plots 5 and 6. The paired plots 3 and 4, and 5 and 6 were reevaluated using ten randomly located samples. When randomly located samples were used no significant differences were found between animal use within each pair of plots. On the basis of t tests the only significant difference that occurred between plots of the same treatment type was between cow use in Plots 3 and 4 when data from 15 regularly spaced pellet-plots per plot were used. Using the data from ten randomly placed pellet-plots per plot revealed no significant differences.

In summary, the F tests and t tests indicate that the distribution and average level of grazer use did not differ significantly between pairs of plots in the same

FIGURE 4. DIAGRAM OF A GENERALIZED PLOT, SHOWING THE 15 REGULARLY SPACED CIRCULAR PELLET PLOTS AND THE RANDOMLY LOCATED 4 TRANSECT LINES, 5 1m^2 CLIPPING SITES AND 5 1m^2 CAGES.

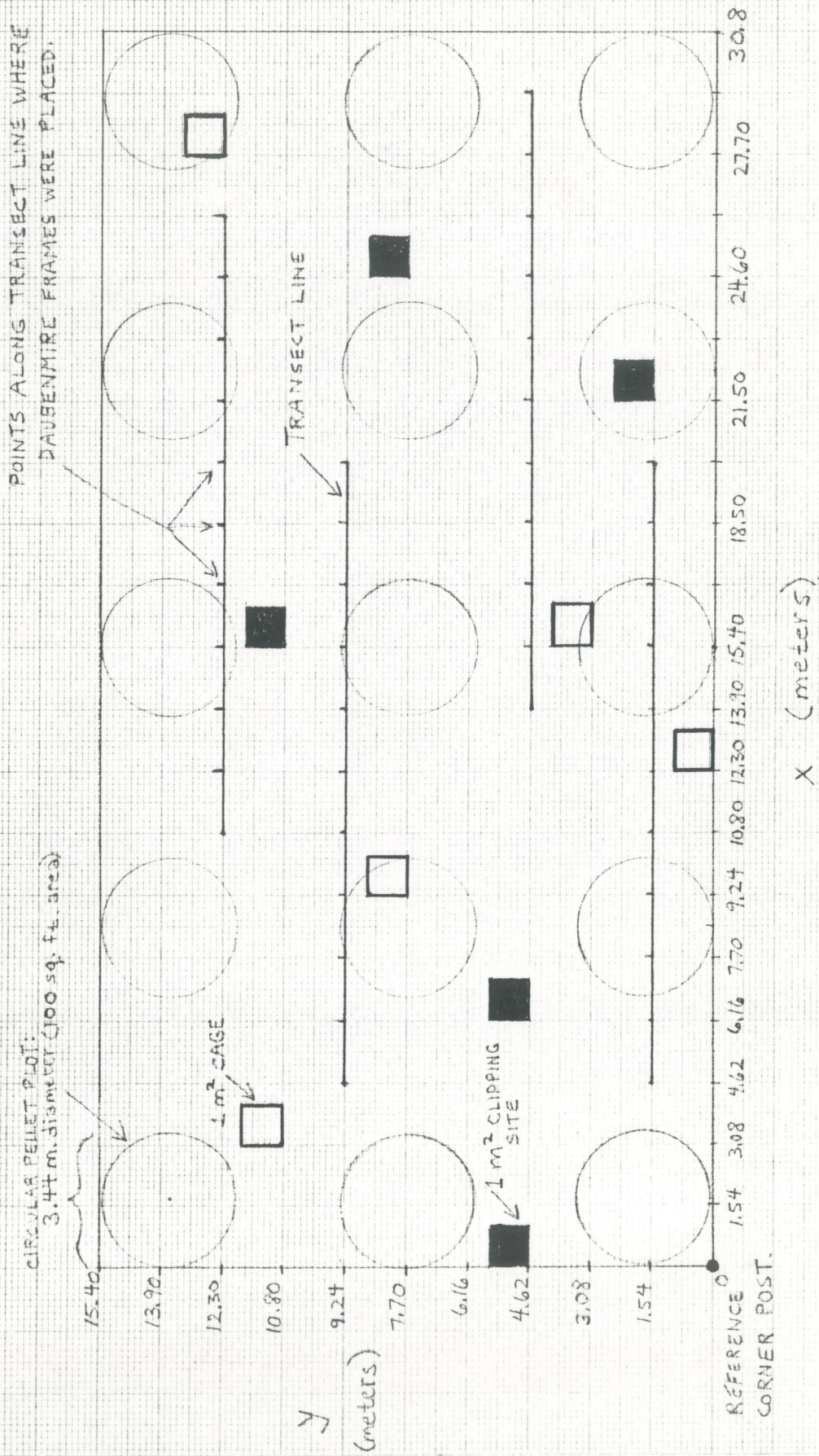


Table 3. Pellet group counts

	Plot #	Elk	Cow	Horse
Total pellet groups from 15 regularly placed pellet-plots in each plot	1	36	2	7
	2	49	0	11
	3	7	16	1
	4	9	6	6
	5	1	14	5
	6	3	22	6
	7	8	0	8
	8	5	0	7
Total pellet groups from 10 randomly placed pellet-plots in each plot	3	4	6	1
	4	5	4	4
	5	0	13	1
	6	0	11	4

1 Pellet-plot = 100 sq. ft. area (5.64 ft. or 1.72 m radius)

Table 4. Results of F and t tests

F values

	Plot #	Elk	Cow	Horse	D.F. (n-1)
Based on 15 regularly placed pellet-plots in each plot	1 & 2	1.87	-	.85	14
	3 & 4	1.38	4.65*	-	14
	5 & 6	2.94*	.37	2.58*	14
	7 & 8	1.45	-	1.68	14
Based on 10 randomly placed pellet-plots in each plot	3 & 4	.80	1.81	.74	9
	5 & 6	-	.88	.74	9

14 D.F. - Reject if $F > 2.13$
 9 D.F. - Reject if $F > 3.18$

$\alpha = 0.5$

* - Significant difference at the 95% confidence level

t values

	Plot #	Elk	Cow	Horse	D.F. (n-1)
Based on 15 regularly placed pellet-plots in each plot	1 & 2	1.78	-	1.18	28
	3 & 4	.52	2.09*	-	28
	5 & 6	.62	1.46	.28	28
	7 & 8	.80	-	.22	28
Based on 10 randomly placed pellet-plots in each plot	3 & 4	.30	.71	1.36	18
	5 & 6	-	.53	1.36	18

28 D.F. - Reject if $t > 2.05$
 18 D.F. - Reject if $t > 2.10$

$\alpha = 0.5$

* - Significant difference at the 95% confidence level

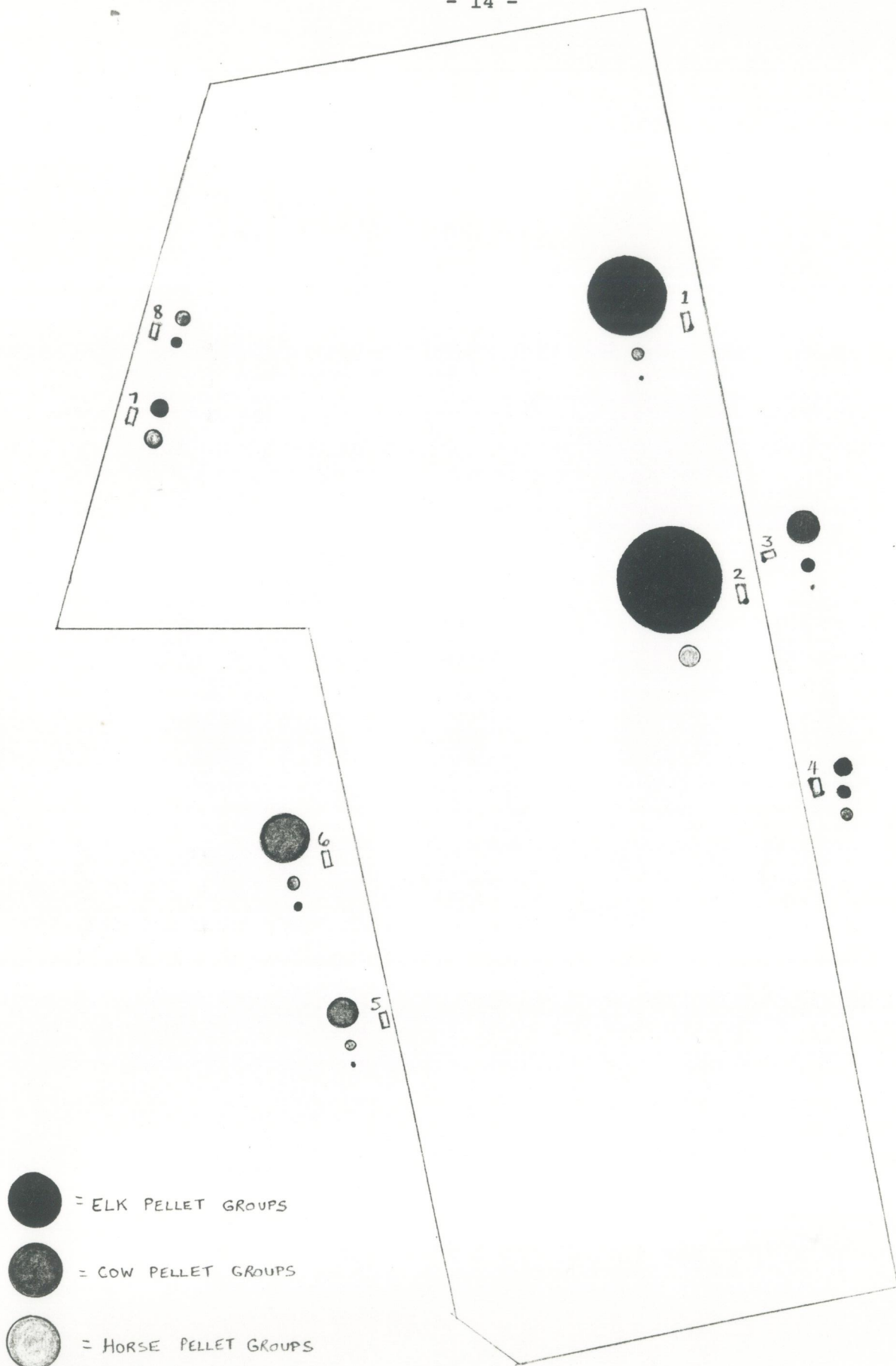


FIGURE 5. COMPARISON OF PELLET GROUP NUMBERS PER MACROPLOT
(BASED ON 15 REGULARLY SPACED PELLET-PLOTS WITHIN EACH MACROPLOT)

treatment type. Both members of each pair apparently sample the same use patterns. It is interesting that randomly located pellet-groups provide distinctly different variance estimates than do regularly located plots. Table 5 summarizes average animal use over the four plot types. It should be noted that pellet counts provide no more than an index of use. The use is integrated over the entire time during which the pellet-plot was exposed and does not reveal the pattern of use through time. Similarly it is probably misleading to compare fecal matter of such different size as elk and horse. The fecal matter of horse and cow probably takes longer to disintegrate and disappear than does that of elk. The measures summarized in Table 5 reveal only these broad integrated patterns and reveal the general grazing regime.

Further statistical analyses have been performed on the pellet group data. These include tests of positive and negative association between ungulate species, and comparisons of pellet distribution with well known distributions such as Poisson and negative binomial. Because of the small sample size results are potentially misleading and are not included in this report. Anyone interested may obtain the analyses from the author.

MEASURES OF VEGETATION

The pellet group counts discussed above were employed to assess ungulate use of the different treatment types. The vegetation was also measured to assess impact of the different grazing regimes. Three broad measures were employed: species composition (Daubenmire frames), herb biomass at maximum standing crop (clipping), and shrub utilization (diameter at point of browsing). These measures are discussed separately.

Species composition

To estimate the species composition of each plot, the canopy-coverage method, devised by Daubenmire (1959), was employed. This method and its advantages are described by D. Demarchi (1971), adapted from Daubenmire (1968). For those unfamiliar with the approach Demarchi's discussion is presented in Appendix I. The general layout of each macroplot is illustrated in Figure 4.

Using a random numbers table to obtain the x and y coordinates of each transect line starting point, four 15 meter transect lines were randomly placed in each plot. Locations of transect lines in the eight plots are illustrated in Appendix II. The Daubenmire frame (20 x 50 cm or 0.1 m²) was placed at regular intervals of 1.5 m along each transect line. Thus, estimates were obtained from 10 Daubenmire frames

Table 5. Average number of "pellet" groups per 100 sq. ft. by treatment type.

Treatment	"Pellet" groups		
	Elk	Cow	Horse
Heavy elk use ^{1/} (Plots 1 & 2)	2.84	.07	.60
Heavy cow and heavy elk use ^{2/} (Plots 3 & 4)	.45	.50	.25
Heavy cow and light elk use ^{2/} (Plots 5 & 6)	0	1.20	.25
Light elk and light cow use; ^{1/} control (Plots 7 & 8)	.43	0	.50

1/ n = 30 regularly located pellet-plots

2/ n = 20 randomly located pellet-plots

per transect line or 40 Daubenmire frames per plot. Canopy coverage estimates for each species were made in the manner described in Appendix I. These data were collected during the first two weeks of July, 1974.

The averaged percent canopy coverage for each species in each plot is given in Table 6. The significance of the differences between the percent canopy coverages of each species in the different plots cannot be commented on before statistical analyses of these data are completed. However, the relative percent canopy coverage of three of the most important components of the plots can be seen in Figure 6. As is shown in this Figure, the species *Festuca scabrella*, believed to be the major climax graminoid in the general area, has a high canopy coverage percent in Plots 1, 2, 7 and 8 whereas it has a relatively very low canopy coverage percent in Plots 3, 4, 5 and 6. *Festuca scabrella* is thus much better represented in areas of light cattle grazing even when elk winter use is heavy. *Antennaria rosea*, usually an indicator of overgrazing, is practically non-existent in Plots 1, 2, 7 and 8 whereas it covers a substantial area in Plots 3, 4, 5 and 6. Bare ground, another indicator of overgrazing, is either completely lacking or else composes an extremely small area in Plots 1, 2, 7 and 8. In Plots 3 and 4 a substantial area is bare ground and in Plots 5 and 6 one quarter of the area is bare ground.

Thus, although other species have not been discussed, these three components clearly illustrate the effects of different types and amounts of grazing pressure in the different areas. All of the plots in heavy cow use areas have only a small percent of their area covered by *Festuca scabrella* (probably the climax graminoid), and have a considerable percent of their area composed of bare ground or *Antennaria rosea*, indicators of overgrazing. All of the plots protected from cow use, including the two plots that had heavy elk use the previous winter, had a large percent of their area covered by *Festuca scabrella* and an almost negligible percent of their area composed of overgrazing indicators.

Standing crop measures

To sample the productivity of the different areas around the airport, five 1.0 m² plots were located randomly (using a random numbers table) within each plot. In areas of heavy use (Plots 3, 4, 5 and 6) an additional five 1.0 m² exclosures or cages were located randomly within each plot. The exclosures were put out at the start of the third week of May, 1974, shortly after the cows had been released onto the range. The purpose of setting out these exclosures was to enable comparison of 1.0 m² plots that had received only past (prior to 1974) grazing use by cows with 1.0 m² plots that had received both past and present (1974) grazing use by cows.

TABLE 6

-18-

COMPLETE LIST OF SPECIES AND % CANOPY COVERAGE IN PLOTS 1 - 8
(Inc = incidental Spp, in plot but not recorded in Data)

SPECIES	PLOT #							
	1	2	3	4	5	6	7	8
<u>GRASSES</u>								
Agropyron trachycaulum		.1	5.7	.9	1.1	2.6	.1	.9
Bromus inermis	Inc	.3						
Bromus tectorum			1.0			Inc		Inc
Calamagrostis rubescens	8.4	4.7	2.3	7.5	.1	.2	.6	.2
Festuca idahoensis			Inc			Inc		Inc
Festuca scabrella	83.1	65.8	2.0	8.0	10.1	11.8	64.5	65.1
Koeleria cristata		.2	9.1	14.5	5.7	7.7	1.3	1.5
Poa compressa	2.2	6.7	.1	3.6	8.5	3.3	7.7	5.2
Stipa occidentalis					11.5	.7		
Stipa richardsonii		.8	9.7	25.2	.6	12.0	18.0	17.8
<u>FORBS</u>								
Achillea millefolium	.1	.9	6.4	2.9	2.3	9.9	1.0	1.1
Agoseris elata	.5		9.9	6.8		1.4	1.6	
Allium cernuum		Inc						
Alyssum alyssoides					.5			
Ancinikia retrosa	.1			.1		.1		
Anemone patens		.8	1.0	3.0	1.9	2.3	2.7	2.5
Antennaria rosea	1.0	2.8	18.0	8.7	7.2	4.7	.9	.8
Apocynum androsaemifolium	.1							
Arabis holboellii				.1	.6	.2		Inc
Aster campestris		1.5		.7			1.0	
Aster spp. (small purple)	.8		.1		3.1		1.0	
Astragalus miser	1.0	4.0	8.5	4.4			.4	1.7
Calochortus elegans	.7	.3		.1			.1	.1
Campanula rotundifolia	.4						.1	.5
Castilleja spp. (yellow)	.1	1.3		.1			Inc	1.3
Chrysopsis villosus					.8	.4		
Cirsium spp.					.1			
Collinsia parviflora					.8	2.7		
Epilobium poleuster			.2	.1	.4	3.5		
Erigeron filifolius			1.9		2.5	3.1		
Filago arvense			Inc		Inc	Inc		

COMPLETE LIST OF SPECIES AND % CANOPY COVERAGE IN PLOTS 1 - 8

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SPECIES	PLOT #							
	1	2	3	4	5	6	7	8
<u>FORBS (cont.)</u>								
<i>Fragaria virginiana</i>		1.2	.2	.5	.1	2.3		.1
<i>Galium boreali</i>							.8	.1
<i>Geum triflorum</i>								1.4
<i>Geum</i> spp.					.8			
<i>Hedysarum sulphurescens</i>	.1	Inc	Inc	.8	.4			
<i>Heuchera</i> spp.	.2				.1			
<i>Hieracium - albertinum</i> <i>scouleri</i>						.1		.4
<i>Lappula redowskii</i>			.7		1.2	1.0		
<i>Lithospermum ruderale</i>			1.8	.5	.1			
<i>Lupinus sericeus</i>		24.4			11.4	4.5	38.3	30.5
<i>Medicago lupulina</i>				.2	.1	2.8	6.2	2.7
<i>Medilotus alba</i> <i>officinalis</i>							Inc	
<i>Orthocarpus tenuifolius</i>						.2		
<i>Penstemon confertus</i>	5.7	7.4	6.2	7.6	3.0	2.5	10.9	9.5
<i>Plantago Purshia</i>						1.0		
<i>Sagina apetala</i> <i>accidentalis</i>			9.3	.7	4.5	7.0	.4	.2
<i>Sisymbrium altissimum</i>								
<i>Sisymbrium incisum</i> (=Descurainia pinnata)			.5		2.1	.7	.1	
<i>Solidago spathulata</i>			Inc	.6	.1	.5	.1	.5
<i>Taraxacum officinale</i>	.5	2.0	9.1	3.0	6.0	10.5	3.7	3.6
<i>Tragopogon dubius</i> <i>pratensis</i>		.5				Inc		2.8
<i>Viola</i> spp.				.4				.9
<u>SEDGES</u>								
<i>Carex carthomodes</i>		.8	Inc	2.7	.4			
<u>SHRUBS</u>								
<i>Amelanchier alnifolia</i>	.7	3.5	3.1	3.8	Inc	1.8		
<i>Arctostaphylos uva-ursi</i>	16.5	14.0	22.9	16.9	2.3	6.4	6.5	10.8
<i>Rosa woodsii</i>			.2	.1	2.6		.5	Inc
<i>Sheperdia canadensis</i>	Inc	6.1	3.1	2.5		Inc		
<i>Spiraea betulifolia</i>	Inc							

COMPLETE LIST OF SPECIES AND % CANOPY COVERAGE IN PLOTS 1 - 8

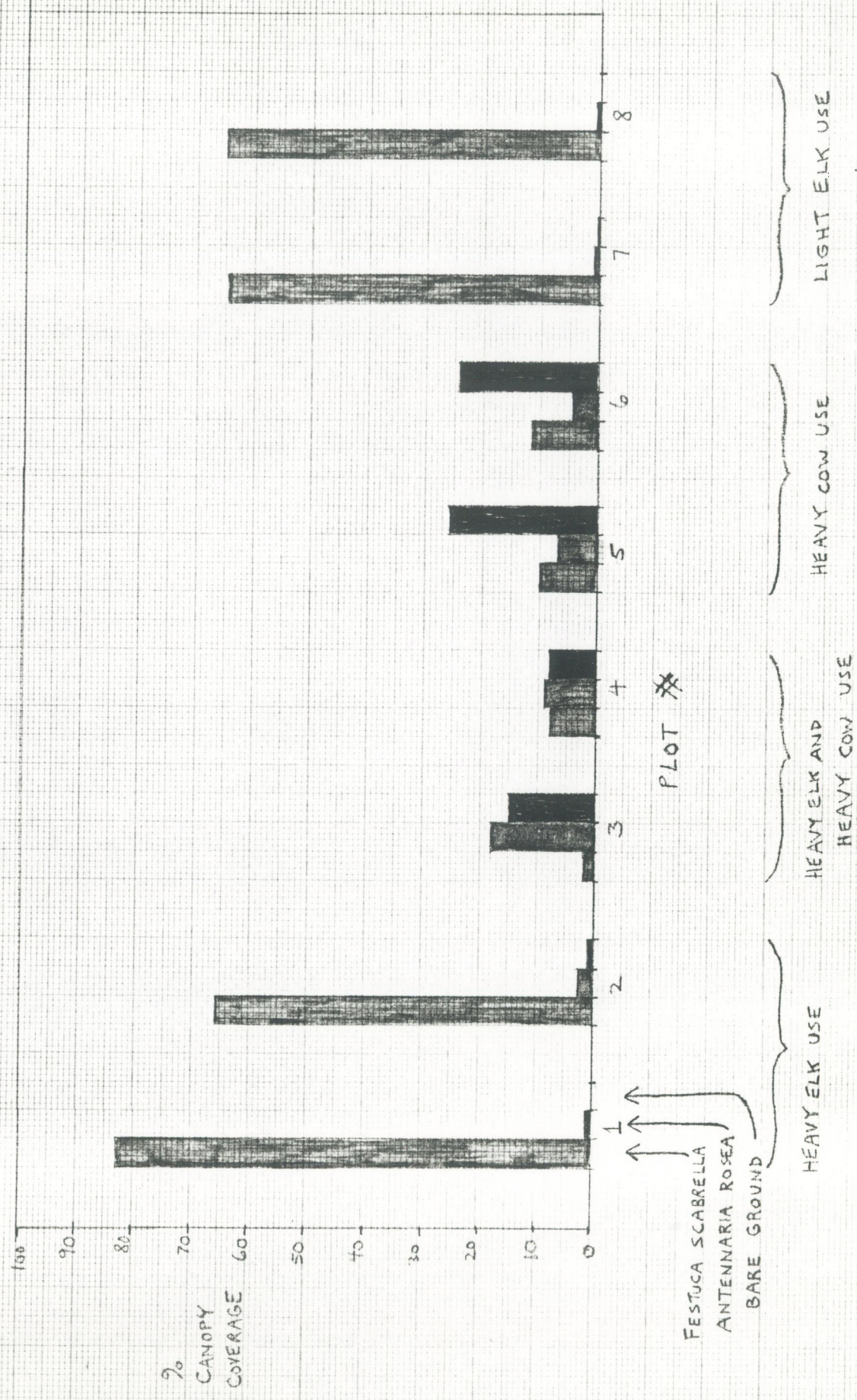
-20-

<u>SPECIES</u>	<u>PLOT #</u>							
	1	2	3	4	5	6	7	8
<u>TREES</u>								
Pinus contorta				.4				
Pinus ponderosa			Inc	Inc		.1	Inc	
Populus tremuloides		.1		Inc		Inc	2.5	Inc
Pseudotsuga menziesii	4.6							
<u>Non-productive</u>								
bare ground		1.1	13.9	8.3	25.8	24.4	.1	
lichen	3.5	1.0	7.3	8.3	.1	6.1	.2	.3
litter	95.7	83.3	23.4	75.6	30.7	31.7	95.0	96.3
moss			1.6	2.0	.8	5.9	.2	.1
pellets	3.2	2.0	2.1	1.3	1.9	4.3		.1
rocks	.4				.7	1.2		
Sticks of wood	.4				.7	.4		

FIGURE 6

GRAPH SHOWING % CANOPY COVERAGE OF

FESTUCA SCABRELLA, ANTENNARIA ROSEA AND BARE GROUND IN EACH PLOT



Three 1.0 m² exclosures were also placed randomly in Plot 7 in the third week of June, 1974, with the objective of measuring the effect exclosures had on plant growth and possibly obtaining some estimate of a correction factor. Locations of the 1.0 m² plots and exclosures in the eight plots are illustrated in Appendix II.

All grasses, sedges and forbs occurring inside the 1.0 m² microplots were clipped during the third week of August, 1974, when the vegetation was believed to have attained maximum standing crop. The plants were clipped as close as possible to ground level. No prostrate shrubs (e.g. *Arctostaphylos uva-ursi*) were clipped. Clippings for each microplot were stored in paper bags and were later put in a drying oven at 50°C for 24 hours and were then weighed. The average microplot weight for each macroplot is given in Table 7. The data show that Plots 1, 2, 7 and 8 were much more productive, each producing over 100 g/m² (892 lbs/acre) than were Plots 3, 4, 5 and 6, each of which produced less than 50 g/m² (446 lbs/acre). We can compare these figures with the productivity of other nearby areas. The biomass measures from three open seral sites on Premier Ridge averaged 71.7 g/m² (638 lbs/acre), of which grasses formed the largest component (Kemper, 1967). The potential productivity of these areas (under a better grazing regime) was estimated to be about 150 g/m² (1334 lbs/acre).

Biomass measures inside the exclosures were consistently greater than productivity in exposed microplots in the four macroplots with heavy cow use. Some of this difference, however, may be due to a possible "greenhouse effect" of the cages. Differences in plant growth inside and outside of exclosures can be seen in Figure 7. The high productivity inside the three exclosures in Plot 7, a control plot, indicates that the cages did create conditions more favourable to plant growth.

Figure 8 shows the relationship between species diversity and productivity in each plot. Plots with high species diversity have low productivity, while most plots with lower species diversity have high productivity. This is to be expected as Plots 1, 2, 7 and 8 were dominated by almost pure stands of *Festuca scabrella*, and were thus fairly productive. Plots 3, 4, 5 and 6, under heavy cow grazing, had no major dominant species. Many annuals absent from the control plots had come in to colonize the bare ground. Thus, as productivity declines and bare ground is exposed, "weed" species colonize these sites and increase the diversity.

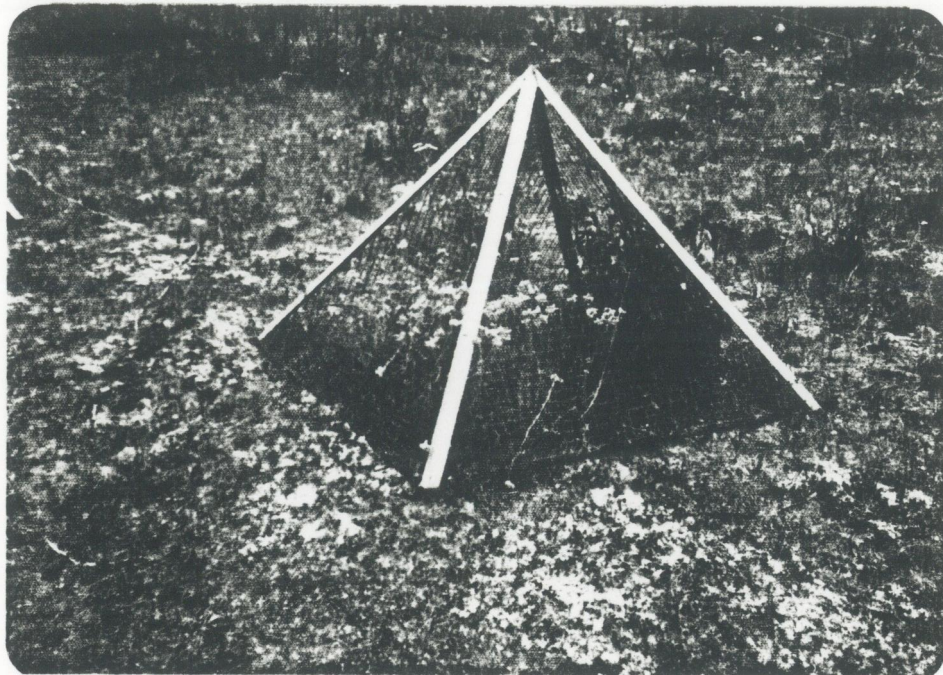
Shrub utilization

To determine the amount and effect of browsing on shrubs, randomly selected shrubs were measured in each plot. A maximum of ten shrubs of the major shrub species present in each plot was measured; a maximum of five shrubs of each second-

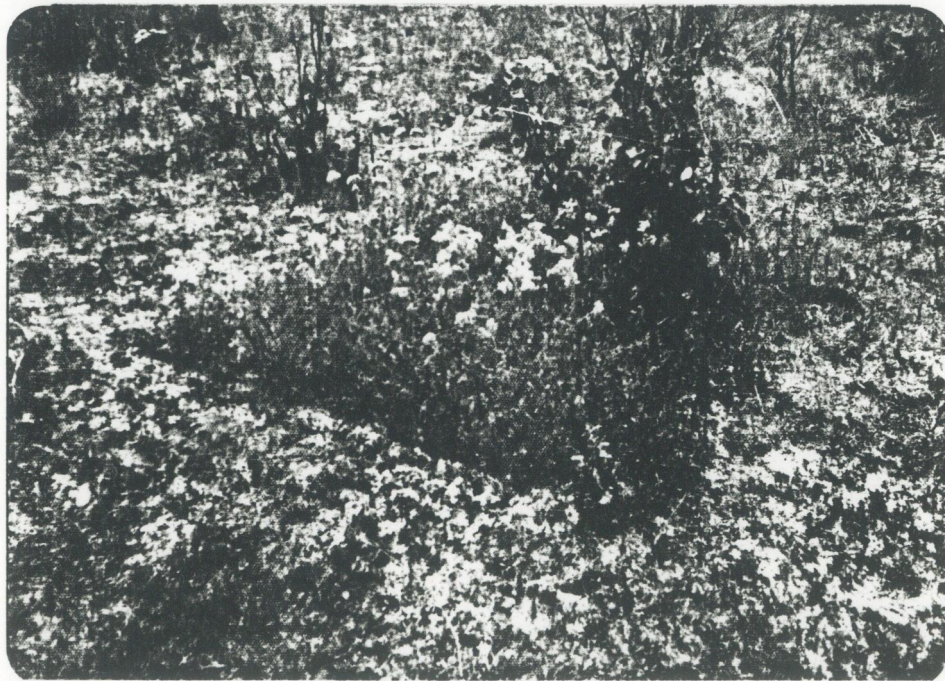
Table 7. Weights of m² clippings (n=5)

PLOT #	EXPOSED		EXCLOSURES		EXCL. - EXP. (g/m ²)	EXCL. - EXP. EXPOSED x 100%
	$\bar{X} \pm SD$ (g/m ²)	$\bar{X}$ (lbs/acre)	$\bar{X} \pm SD$ (g/m ²)	$\bar{X}$ (lbs/acre)		
<u>Heavy Elk</u>						
1	99.6 ± 18.0	888				
2	144.6 ± 44.5	1290				
<u>Heavy Cow/Heavy Elk</u>						
3	43.3 ± 10.8	386	68.5 ± 8.6	611	25.2	58.2
4	44.7 ± 20.6	398	69.4 ± 5.3	619	24.8	55.5
<u>Heavy Cow/Light Elk</u>						
5	36.7 ± 14.8	327	80.1 ± 28.8	714	43.4	118.3
6	34.5 ± 7.6	308	95.9 ± 49.4	855	61.4	178.0
<u>Light Elk</u>						
7	143.8 ± 15.9	1283	220.6 ± 33.5	1968	76.8	53.4
8	177.6 ± 47.2	1584				

FIGURE 7. Cage Contrasts and Effects

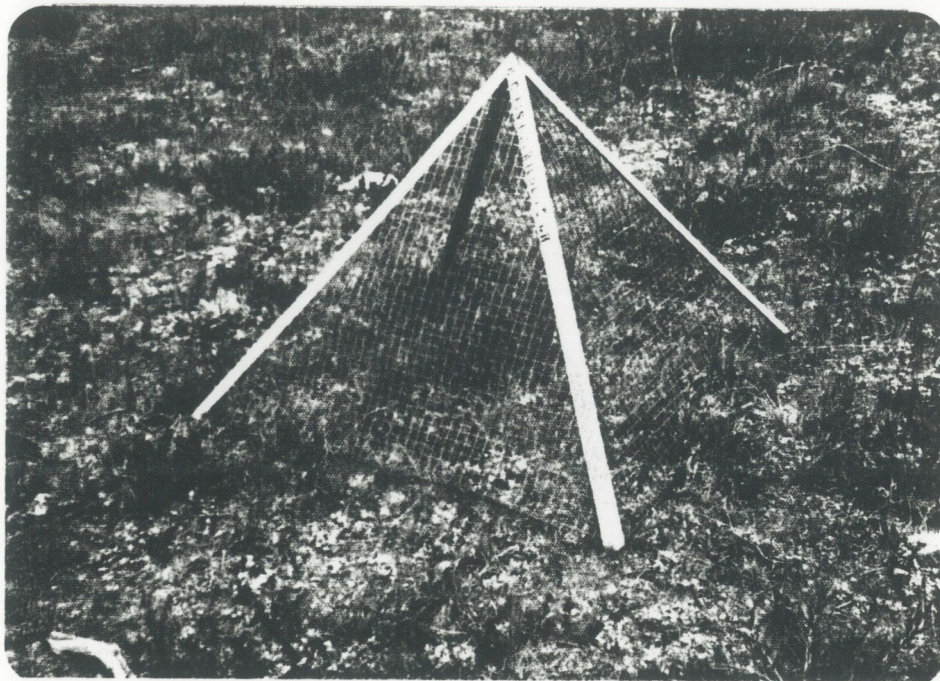


Cage in Plot 6 - extreme contrast between vegetation inside and outside of cage.



Same as above, with cage removed. Extreme contrast is probably due in part to "green house effect" of cage.

FIGURE 7 (continued). Cage Contrasts and Effects



Cage in Plot 3 - little contrast between vegetation inside and outside of cage.



Square meter area in Plot 4 where cage was. Moderate contrast between vegetation inside and outside of where cage was.

dary shrub species present in the plot was also measured. The diameter at the point of browsing (PB) was measured on five browsed twigs on a randomly selected stalk of each shrub. The diameter at the point of annual growth (PAG) was measured on five unbrowsed twigs on a randomly selected stalk of each shrub. Measurements of diameter at PB or PAG per shrub were less than five if there were less than five browsed or unbrowsed twigs present on the randomly selected stalk. Also the number of twigs browsed and number of twigs unbrowsed were counted on a randomly selected stalk of each shrub. The diameters at PB and PAG and numbers of browsed and unbrowsed twigs of shrubs in exclosures (cages) were also measured.

The data are summarized in Table 8. These data illustrate that for the shrub species *Amelanchier alnifolia* the diameters at the point of browsing are approximately equal to the diameters at the point of annual growth. In other words, twigs are being browsed at approximately the same rate as they are growing. Total grazing pressure on *Amelanchier alnifolia* shrubs was fairly heavy, as is shown by the percent of the total number of twigs that is browsed. In each plot, well over 50% of the total number of twigs had been browsed.

For *Sheperdia canadensis*, the diameters at the point of browsing are consistently higher than the diameters at the point of annual growth. This means that twigs are being browsed and removed at a faster rate than they are putting on new growth. However, the percent of browsed twigs over total number of twigs was quite small ($12.8 \pm 8.7\%$). Thus although grazing pressure on *Sheperdia canadensis* was generally quite low, the individual twigs that were utilized were browsed heavily (more growth was removed than could be added in an annual growing season).

In the shrub species *Rosa woodsii*, the diameters at the point of annual growth were consistently higher than diameters at the point of browsing. Thus twigs were growing at a faster rate than they were being browsed. It is probable that only the succulent tips were being browsed because of the presence of sharp thorns on older shrub growth and the general "prickly nature" of the shrubs. Grazing pressure was moderate on *Rosa woodsii*; approximately half of the total number of twigs were browsed ($49.4 \pm 6.5\%$).

In addition to these broad comparisons of utilization of the three shrub species, some variation in shrub utilization on the different plots is apparent. For example, browsing pressure on shrubs (percent browsed of total twigs) in Plot 6 was consistently higher than in other plots. The disparity is probably due to the heavy cow use on Plot 6 (see Table 3). Variations in shrub utilization between the other plots is not as apparent and it is difficult to make any generalizations.

Table 8. Shrub measurements

SHRUB SPECIES

PLOT

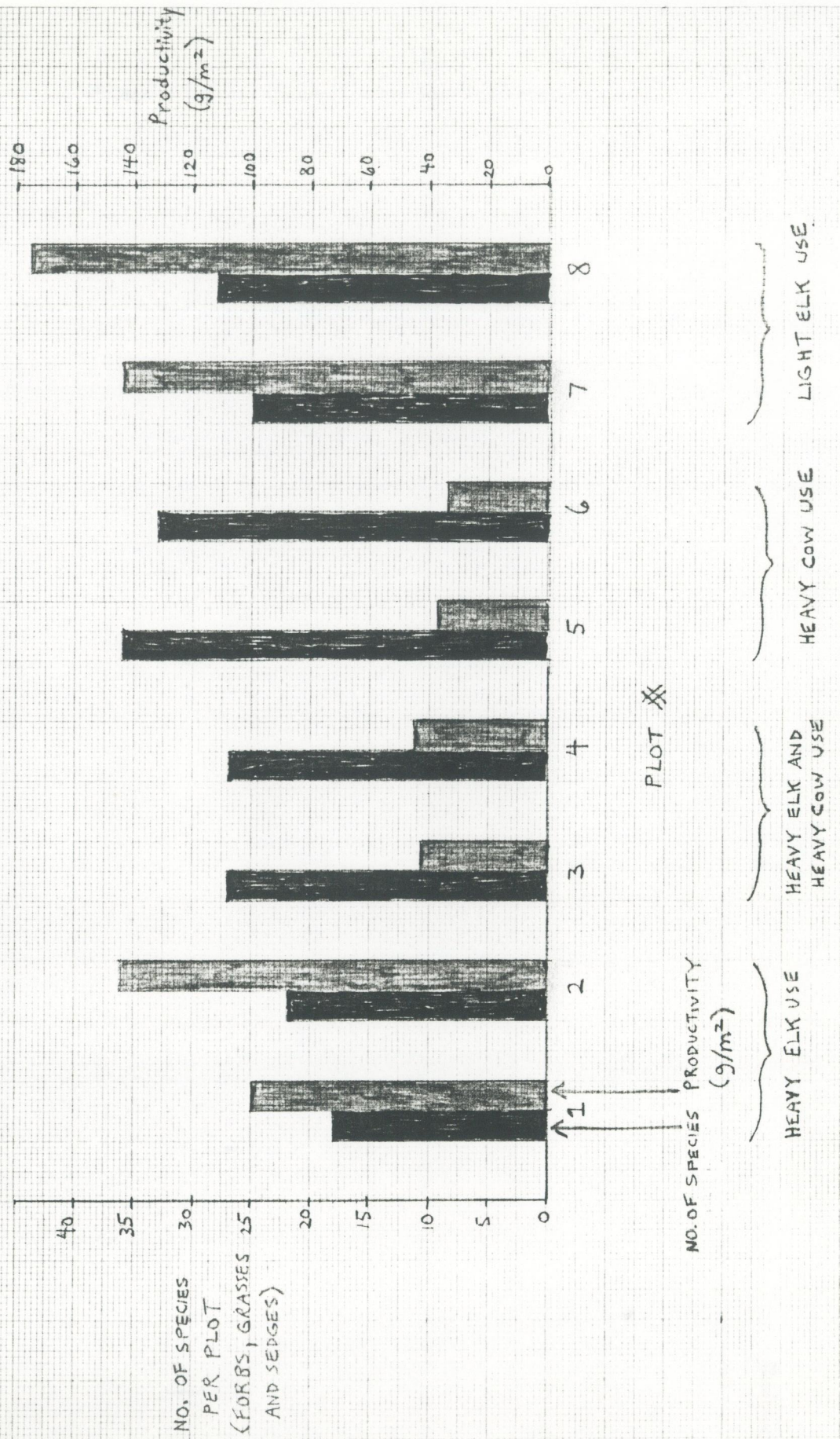
	1	2	3	4	5	6	7	8
<u>AMELANCHIER ALNIFOLIA</u> (Based on data from 10 shrubs, usually 5 measurements per shrub) Average diameter at PB (mm) Average diameter at PAG (mm) # browsed twigs/# unbrowsed twigs % browsed of total twigs	1.8 1.6 213/93 70	1.7 1.7 108/84 59	1.5 1.6 117/94 55	1.3 1.3 77/52 60	1.6 1.6 141/75 65	1.1 0.9 330/53 86		
<u>SHEPERDIA CANADENSIS</u> (Number of shrubs measured indi- cated in parentheses - see note below) Average diameter at PB (mm) Average diameter at PAG (mm) # browsed twigs/# unbrowsed twigs % browsed of total twigs	1.5 (1) ¹ 1.1 (1) 7/177 (1) 4 (1)	2.4 (1) 1.4 (3) 24/141 (3) 15 (3)	1.8 (5) 1.2 (5) 35/244 (5) 13 (5)	1.4 (3) 1.1 (5) 32/333 (5) 6 (5)		2.3 (2) 1.1 (2) 36/133 (2) 26 (2)		
<u>ROSA WOODSII</u> Average diameter at PB (mm) Average diameter at PAG (mm) # browsed twigs/# unbrowsed twigs % browsed of total twigs			1.0 (5) 1.4 (5) 98/91 (5) 52 (5)	1.2 (4) 1.6 (5) 63/101 (5) 38 (5)	1.3 (10) 1.7 (10) 169/150 (10) 53 (10)		1.1 (2) 1.3 (2) 100/84 (2) 54 (2)	1.1 (10) 1.4 (10) 101/103 (10) 50 (10)
<u>SHRUBS IN ENCLOSURES (CAGES)</u> <u>AMELANCHIER ALNIFOLIA</u> Average diameter at PB (mm) Average diameter at PAG (mm) # browsed twigs/# unbrowsed twigs % browsed of total twigs				1.3 (2) 1.5 (2) 11/12 (2) 48 (2)	1.3 (1) 1.2 (1) 7/5 (1) 58 (1)	1.6 (4) 1.3 (4) 19/31 (1) 61 (1)		

PB = Point at browsing

PAG = Point of annual growth

1 Number in parentheses = number of shrubs measured. Number of measurements of diameters at PB or at PAG was usually 5 but varied according to how many browsed and unbrowsed twigs were present on the stalk (randomly selected) of a given shrub.

FIGURE 8
GRAPH SHOWING NO. OF SPECIES (FORBS, GRASSES AND SEDGES) AND
PRODUCTIVITY (g/m^2) PER PLOT



SUMMARY AND CONCLUSIONS

The objectives at the outset of the study were as follows:

- (1) to provide baseline data which would enable future assessment of the impact of the elk winter feeding program, (started in the winter of 1973-1974), on the vegetation at Kimberley Airport.
- (2) to compare the effects of different grazing regimes (domestic and wildlife) on the vegetation near Kimberley Airport.

These objectives were largely met. The two major emphases in this study were on animal use and its effects on the vegetation. With respect to animal use, it should be emphasized that each grazing regime was assigned a heading, such as "heavy elk use", primarily on the basis of location with respect to past and present ungulate use. It is important to acknowledge the rationale because in some cases pellet counts alone did not justify the animal use terminology. For example, there were more elk pellet groups recorded in one of the control plots than in one of the "heavy elk and cow use" plots. The major findings of the four different use types are summarized below.

(1) Heavy elk use

This area is situated inside the airport fence (not accessible to cows), along the strip where hay for the elk was distributed. Pellet counts showed an average of 2.84 elk pellet groups and .07 cow pellet groups per 100 sq. ft. *Festuca scabrella*, believed to be the climax graminoid, and *Antennaria rosea* and bare ground, both indicators of overgrazing, were used to compare species composition in the different grazing regimes. In the heavy elk use area, a large (average of 66 to 83)¹ percent of the area was covered by *Festuca scabrella* while an almost negligible percent of the area was composed of *Antennaria rosea* (average of 2%) and of bare ground (average of 0.5%). Biomass weights were relatively high with an average of 122.12 g/m²; diversity was relatively low with an average of 18-22 species of forbs, grasses and sedges per plot (450 m²). It is difficult to compare shrub utilization within the four grazing regimes as different shrub species often occurred in the different plots. However, shrub utilization in the heavy elk use

1 Two averages are given because the means of the two plots in the heavy elk use area differed significantly according to the "t" test. The two means within each use type are averaged and the averaged mean is given in all cases where no significant difference occurred between the two plots of the same use type. Appendix V gives the results of "t" tests on the different measures of vegetation for all use types.

area appears similar to shrub utilization in the other grazing regimes. An average of 61% of the total *Amelanchier alnifolia* twigs were browsed, indicating fairly heavy use. An average of 9% of total *Sheperdia canadensis* twigs were browsed indicating light use.

(2) Heavy elk and cow use

This area is situated outside the airport fence (accessible to cows), adjacent to the strip where hay for the elk was distributed. Pellet counts showed an average of .45 elk pellet groups and .50 cow pellet groups per 100 sq. ft. A relatively small (average of 2 to 8) percent of the area was covered by *Festuca scabrella* while a substantial area was composed of *Antennaria rosea* (average of 9 to 18%) and bare ground (average of 11%). Biomass weights were relatively low (average of 44 g/m²) with a moderate diversity of forbs, grasses and sedges (average of 27 species per plot). The average percent browsed of total twigs was 99% for *Sheperdia canadensis*, 42% for *Rosa woodsii* and 51% for *Amelanchier alnifolia*. Thus grazing pressure on shrub species ranged from light to moderate; *Amelanchier alnifolia* was browsed more heavily than *Rosa woodsii* which in turn was browsed more heavily than *Sheperdia canadensis*. The degree of shrub utilization, although not always possible to compare with that in the other areas, appears similar to that in the other areas.

(3) Heavy cow and light elk use

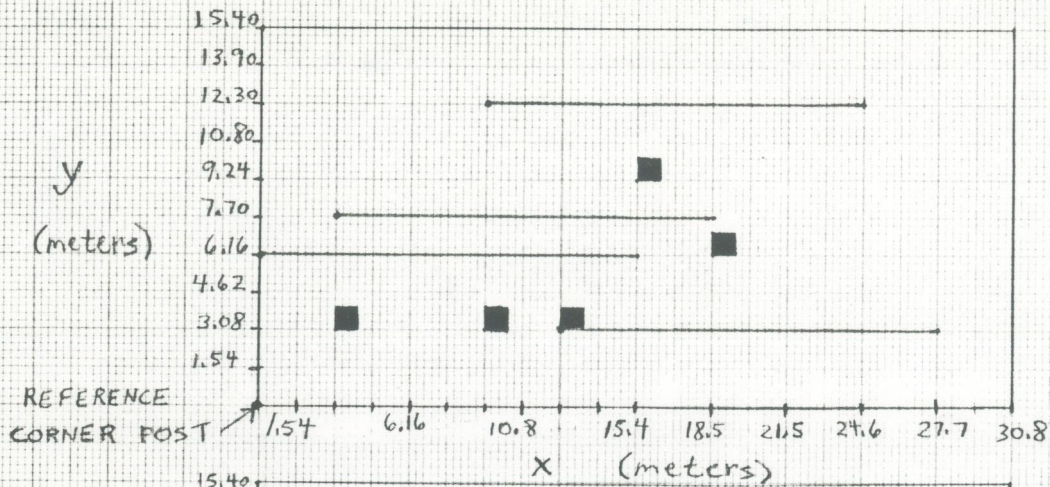
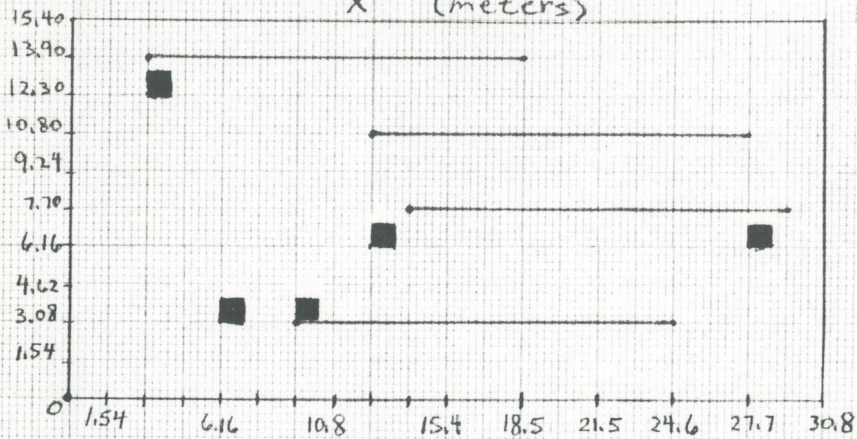
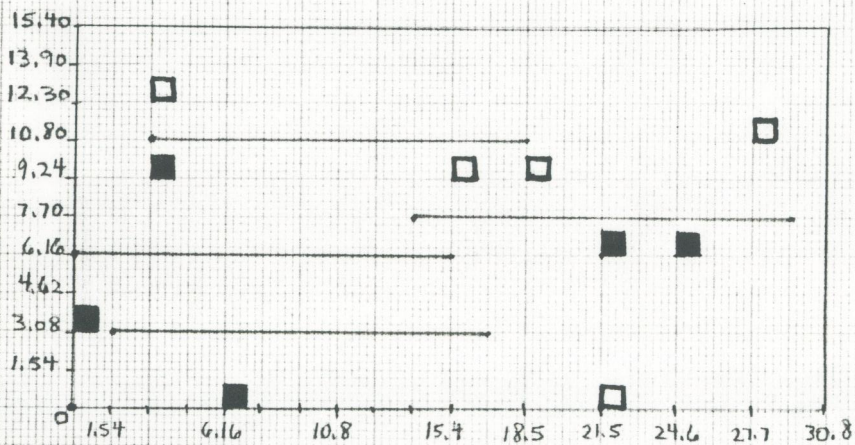
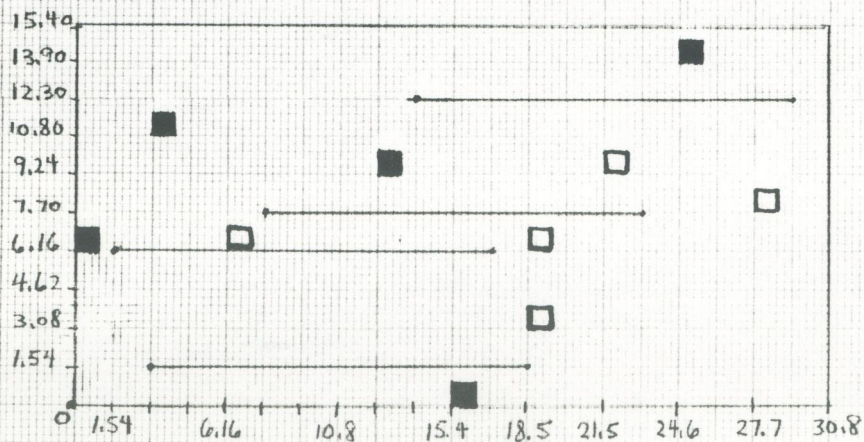
This area is situated outside the airport fence (accessible to cows) on the opposite side of the airstrip from where hay for the elk was distributed. Pellet counts showed an average of .25 elk pellet groups and 1.20 cow pellet groups per 100 sq. ft. A relatively small percent of the area was covered by *Festuca scabrella* (average of 11%); a considerable percent of the area was composed of bare ground (average of 25%) and *Antennaria rosea* (average of 6%). Biomass weights were relatively low (average of 35.59 g/m²) and diversity of forbs, grasses and sedges was relatively high (average of 33-36 species per plot). The average percent browsed of total twigs was 26% for *Sheperdia canadensis*, 53% for *Rosa woodsii* and 65 to 86% for *Amelanchier alnifolia*. The trend of browsing pressure on the different species of shrubs is similar to that in the heavy cow and elk use area. The degree of shrub utilization is slightly higher in this area than in other areas, probably because of heavier cow use (more than twice as many cow pellet groups per 100 sq. ft. as in any other grazing regime).

(4) Light elk use

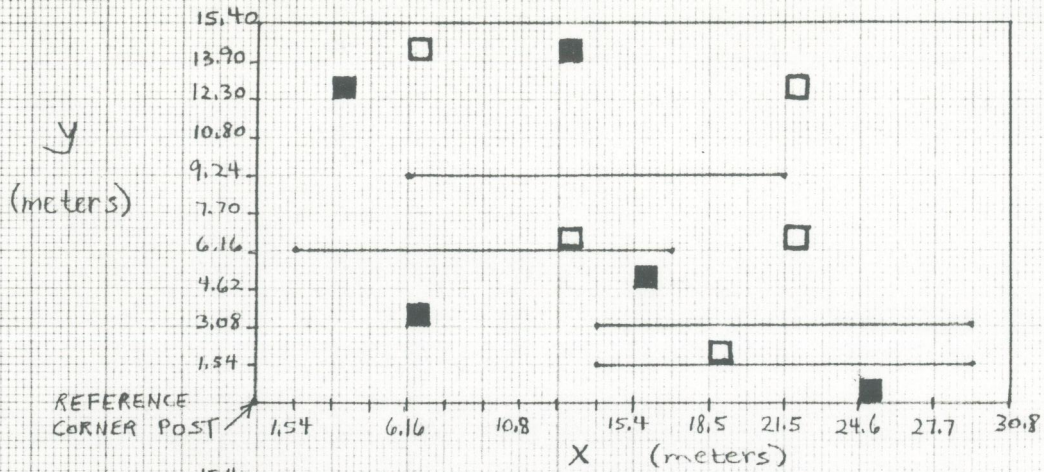
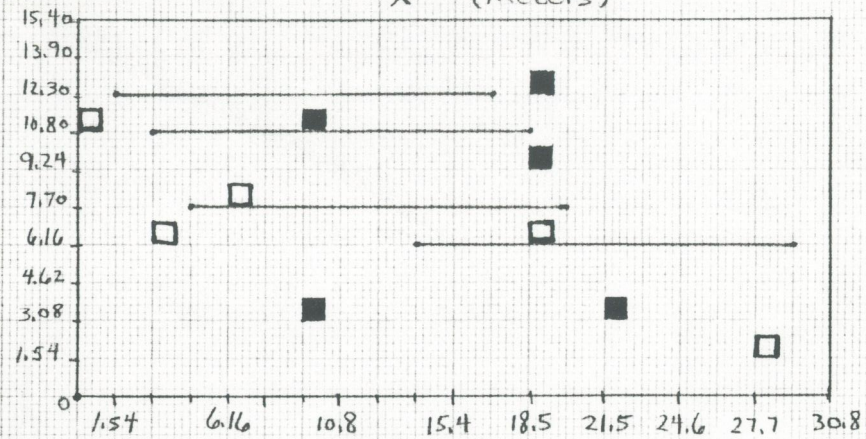
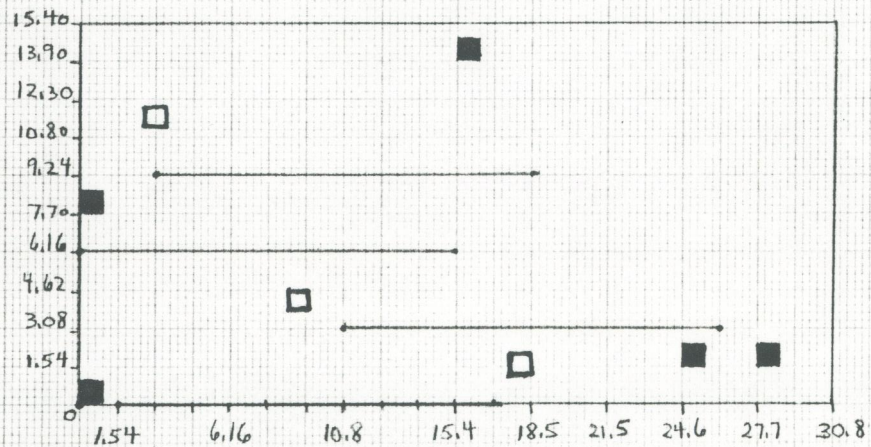
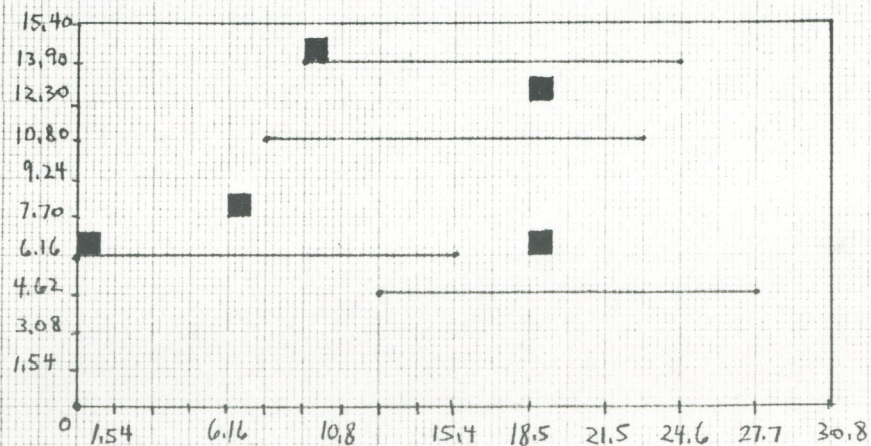
This area is situated inside the airport fence (non-accessible to cows), between the highway and row of houses. Pellet groups showed an average of .43 elk pellet groups and 0 cow pellet groups per 100 sq. ft. A relatively large percent of the area was covered by *Festuca scabrella* (average of 65%) and negligible amounts of area were covered by *Antennaria rosea* (average of 1%) or bare ground (average of 0%). This area yielded high biomass weights (average of 160.7 g/m²) with moderate diversity of forbs, grasses and sedges (25→28 species per plot). Only the *Rosa woodsii* shrub occurred in this area and an average of 51% of total twigs was browsed. Utilization of this shrub is thus similar to that in the other areas.

The light elk and the heavy elk use areas are both in much better condition, from the standpoint of species composition, diversity and productivity, than either of the areas subjected to heavy cow use. The heavy cow use ranges are badly overgrazed, providing little forage for either wildlife or domestic stock. Both the light elk and heavy elk use ranges are in good condition. It is too early, however, to assess the impact of heavy elk concentrations after only one winter of heavy elk use.

MAPS OF PLOTS 1 TO 4 SHOWING LOCATIONS OF TRANSECT LINES AND CLIPPING SITES



MAPS OF PLOTS 5 TO 8 SHOWING LOCATIONS OF TRANSECT LINES AND CLIPPING SITES



APPENDIX III. GENERAL DESCRIPTION OF PLOTS

Plot 1:

The reference corner post is the south east corner of the plot and orientation of the plot from the reference corner is 342° off north. Vegetation is primarily *Festuca scabrella* and *Arctostaphylos uva-ursi*. In the north west corner of the plot there is a large *Sheperdia* bush and in the south west corner of the plot there is a patch of small *Amelanchier* shrubs. On the west side in about the middle there is a Douglas-fir tree about 15-20' high. The number of ground squirrel holes in the plot is 8 (back and front entrances of each ground squirrel counted as separate holes). Disturbed areas in the plot include part of the south west corner (which has been graded once and has a patch of brome grass growing on it) and one small rock pile inside the north east edge of the plot.

Plot 2:

The reference corner post is the south east corner of the plot and orientation of the plot from the reference corner is 352° off north. Vegetation is primarily *Festuca scabrella*, *Lupinus* spp. and *Arctostaphylos uva-ursi*. In the centre-east side of the plot there are three large *Sheperdia* bushes, a patch of low *Amelanchier* shrubs and some small aspen (*Populus tremuloides*). In the north half of the plot are scattered *Amelanchier* shrubs. There are seven ground squirrel holes in the plot.

Plot 3:

The reference corner post is the south west corner of the plot and orientation of the plot from the reference corner is 52° off north. Vegetation is mixed; the two most dominant species are *Arctostaphylos uva-ursi* and *Antennaria rosea*. *Rosa*, *Amelanchier* and large *Sheperdia* are present in the centre of the plot with other scattered *Amelanchier* and *Sheperdia* bushes elsewhere in the plot. At the south east end of the plot there is one ponderosa pine tree (*Pinus ponderosa*) about 15' high. At the center of the south side of the plot there is one large burnt stump. At the north east end of the plot there is a very large ground squirrel mound of dirt and the number of ground squirrel holes in the plot totals 10.

Plot 4:

The reference corner post is at the south east corner of the plot and orientation of the plot from the reference corner is 358° off north. Vegetation is mixed but the most dominant species are *Stipa richardsonii*, *Koeleria cristata* and *Arctostaphylos uva-ursi*. Scattered *Amelanchier* shrubs occur throughout the plot, a large

Sheperdia-Rosa-Amelanchier patch occurs at the south west corner of the plot and a few large ^{*Sheperdia*} bushes, each one with a *Rosa* shrub growing inside it, occur in the northern half of the plot. On the west side of the plot are three small (approximately 10' high) lodgepole pines (*Pinus contorta*) and one small (about 8' high) ponderosa pine. A few small aspen are growing in the north east corner of the plot. There are six burnt stumps and two ground squirrel holes in the plot.

Plot 5:

The reference corner post is the north west corner of the plot and orientation of the plot from the reference corner is 172° off north. Vegetation is diverse. Scattered *Amelanchier* shrubs occur in the south half of the plot; scattered *Rosa* shrubs occur in the north half of the plot. There are 11 stumps and 30 ground squirrel holes in the plot.

Plot 6:

The reference corner post is the north west corner of the plot and orientation of the plot from the reference corner is 172° off north. Vegetation is diverse. There are scattered *Amelanchier* shrubs and two medium-small *Sheperdia* bushes in the plot. There is also a cluster of aspens at the south west corner of the plot. There are four ground squirrel holes in the plot.

Plot 7:

The reference corner is the north west corner of the plot and orientation of the plot from the reference corner is 202° off north. Vegetation is primarily *Festuca scabrella* and *Lupinus* spp. There is a patch of *Medicago lupulina* at the south end. The north east and south east corners contain small aspen trees; there is also one ponderosa pine tree (about 4' high) in the plot. There are no ground squirrel holes in this plot.

Plot 8:

The reference corner is the north west corner of the plot and orientation of the plot from the reference corner is 202° off north. Vegetation is primarily *Festuca scabrella* and *Lupinus* spp. There are very small scattered *Rosa* shrubs at the north end of the plot and three small aspens (less than 3' high) in the plot. There are four ground squirrel holes in the plot.

COMPARISON OF RANGE CONDITION PHOTOGRAPHS AT THE OLD KIMBERLEY AIRPORT, TA TA CREEK: 1974 AND 1995.

In 1974 Anthea Farr completed an analysis of eight plots on and adjacent to the old Kimberley airport near Ta Ta Creek, B.C. in the East Kootenay Trench. Her report including photographs of each plot with one photo of the general area and one photo of the vegetation cover at close range. Four plots were within the old airport area that is fenced and has not been grazed since the 1930's. Four other plots were located just outside the airport fence on crown range. These areas were heavily grazed in that period with season long grazing. Subsequently a portion of that range was fenced out from the range in the late 1970's or early 80's. We thus have four plots that have been ungrazed by cattle since the 1930's, two plots that have been ungrazed since 1980 (approx.) and two plots that have been grazed since the 1900's.

Cattle were grazed in the adjacent range season long up until about 1975 when ARDA money was used to divide the Ta Ta - Cheek Creek range unit into eleven pastures with each pasture being grazed from 3-6 weeks annually between May 10 and Oct. 15. For the last several years yearlings have been run in the pastures adjacent to the old airport; during some of those years when the ranch holding the grazing permit changed hands, only a few animals were grazed as the herd was built up. The pastures adjacent to the airport has been only lightly grazed during the last several years, however, the location of waterholes and the presence of preferred domestic species plants along the roads and fencelines have resulted in 70-90% utilization of the open areas adjacent to the old airport in most years. Many areas of native range in these pastures have shown almost no use over the last five years.

Elk and deer have access to the airport. In the early 1970's elk were fed hay during harsh winters on the old airport resulting in a concentration of elk in the area. Since that time elk numbers have declined substantially. A detailed elk survey carried out in the winter of 1991-92 (Simpson, 1992) indicated an elk population of slightly over 100 head in the Ta Ta -Cherry Creek Range Unit. Estimates for earlier years were 2 to 4 times that number. Summer use in the airport area is negligible; 5 whitetail deer and two elk were observed there during the summer of 1995. Winter numbers in the area are higher, perhaps 20-50 head, but it is difficult in spring to find any evidence of significant use of forage or browse in the old airport, by elk or deer.

In mid August of 1995 we attempted to locate the plots and took photographs at the same location as the photographs taken in 1974. In the case of plots 7 and 8 we found steel posts that probably indicated the corners of the plots. At plot 3, outside the fence to the east we located a stump in the photograph that allowed us to locate the plot exactly. For the other plots we had to use trees and the mountains in the distance to locate the plot; these locations are within 1-200 m of the original plot but may not be on the exact site.

Photos of the eight plots from 1974 and 1995 are included below. The major changes that are obvious are the growth of the trees over 20 years. On the plots within the old airport site (7,8, 1,2) there is little obvious change in grass vitality or species composition. Some shrubs appear to have died back. Plots 5 and 6, which were grazed heavily up to 1980's and were then fenced into the old airport, have recovered substantially. It would be very interesting to look at the species composition of these sites. Plots 3 and 4 outside the airport to the east also show significant recovery from their condition in 1974, some of the shrubs in plot 3 do not appear to have changed over 20 years.

Photographs were also taken along the east fenceline of the old airport close to plot 3. These photos were taken August 20 following 15 days of grazing in that pasture. Utilization is about 80%. This is due to the presence of attractive domestic grass species and since the adjacent road is used as a travel route by cattle. 50 m to the east (in a douglas fir forest site), utilization is 0-5%. In an open fescue-needlegrass opening just north of this site utilization is 5-10%.

In addition to the data available in Farr (1974), Fred Bunnell collected data on at least some of these sites in the 1974-1984 period. With the subsequent removal of grazing from two of the sites, these plots provide a excellent opportunity for developing long term data and a photo record of changes in grass composition on these sites over 20 years. I would suggest that the data collected by Fred Bunnell be aquired and based on that and the information in Farr 1974, that a contract to let for 1996 to redo the plots. That, with the range survey completed in 1995 by C. and K. Tannis of Eastern Slopes Rangeland Seeds Ltd. for the range division will provide good tools for monitoring range condition in this area in the long term.

Literature Cited

- Farr, A. 1974. A Preliminary study of range use in the vicinity of the Kimberley Airport. B.C. Fish and Wildlife Branch, Cranbrook office. 21p.
- Simpson, K. 1992. Elk Inventory in the East Kootenay Trench 1992. Prepared for the Min. of Environment, Wildlife Branch, Cranbrook, B.C. 58pp.

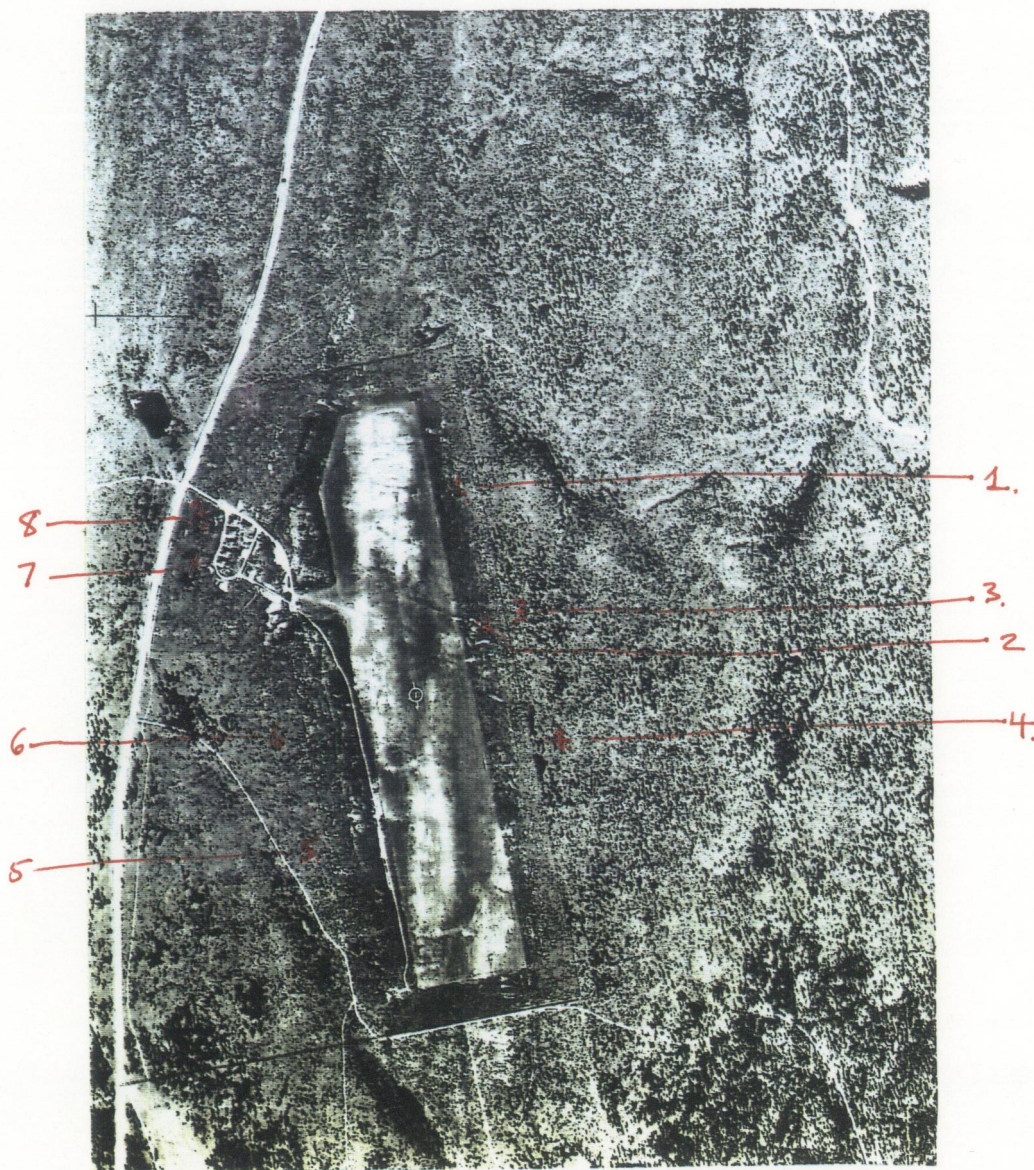
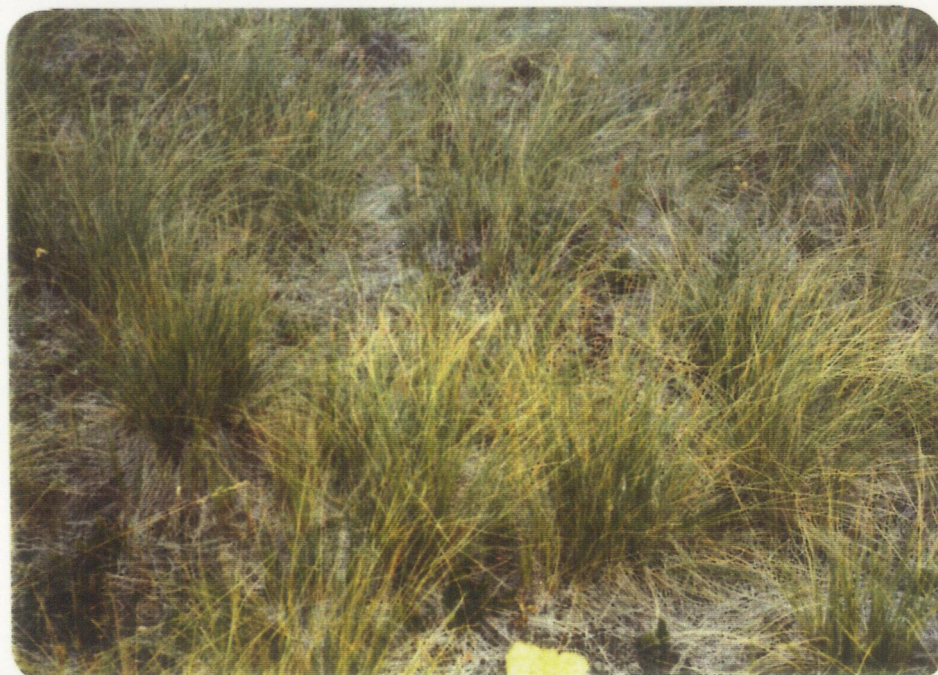


FIGURE 1. Location of plots at Kimberley Airport

(Dot beside number marks exact location
of plot)

PLOT #1



Direction of Photo
7
Notes

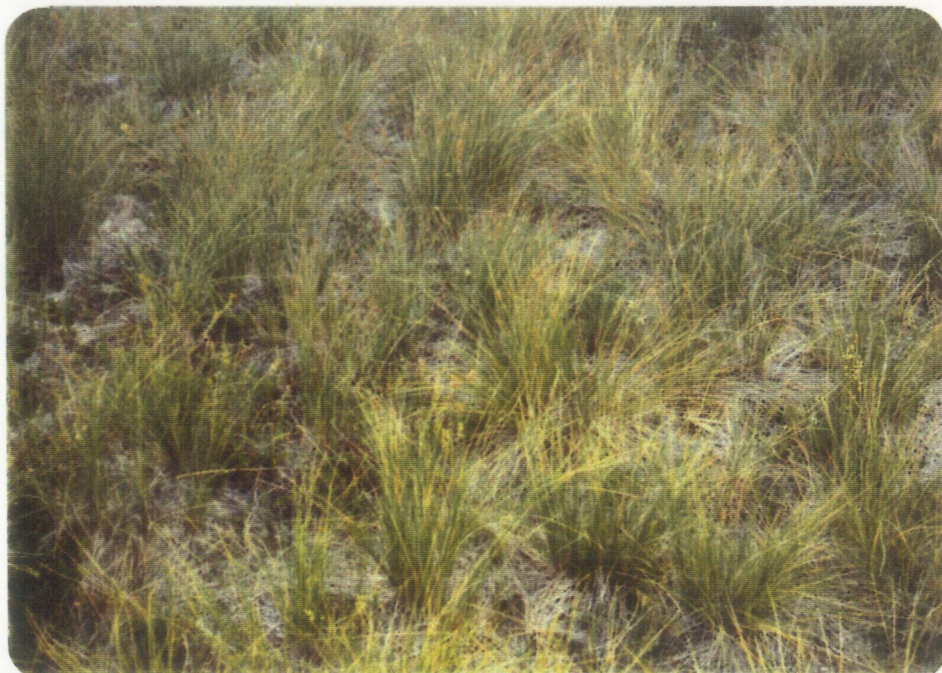
Plot # 1. August 1995.



Ungrazed fescue grassland on the east edge of the airport. (Location of 1995 photo is not exact).



PLOT #2



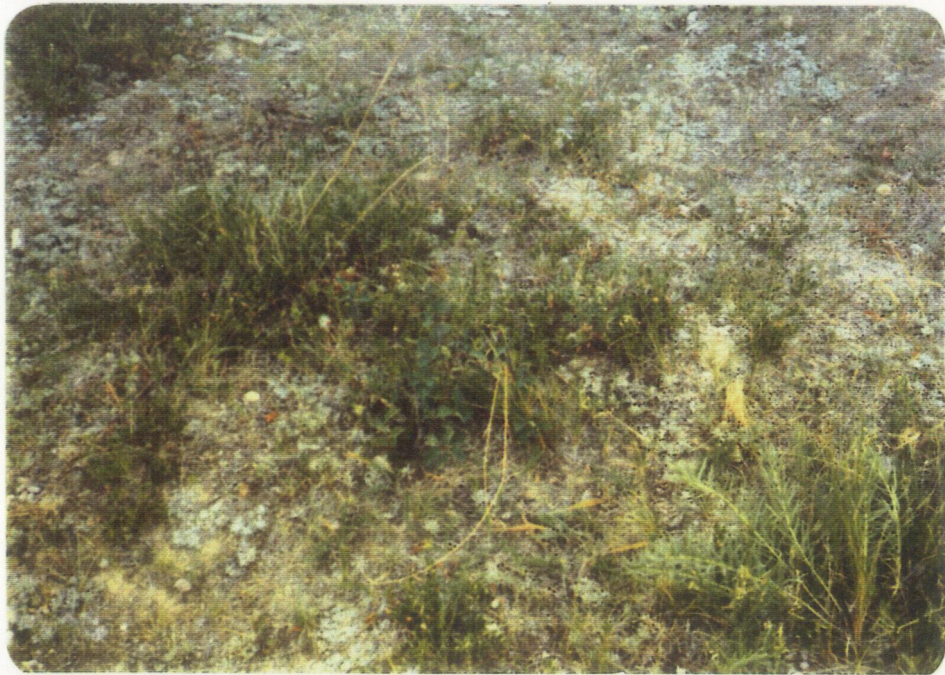
Plot # 2. August 1995.



Ungrazed fescue grassland on the east edge of the airport. (Location of 1995 photo is not exact).



PLOT #3



Plot # 3. August 1995.



Grazed grassland on the east edge of the airport. (We assume the location is exact, based on the presence of the stump. ~~Location of 1995 photo is not exact.~~)



PLOT #4



Plot # 4. August 1995.



Grazed grassland on the east edge of the airport. (Location of 1995 photo is not exact).



PLOT #5

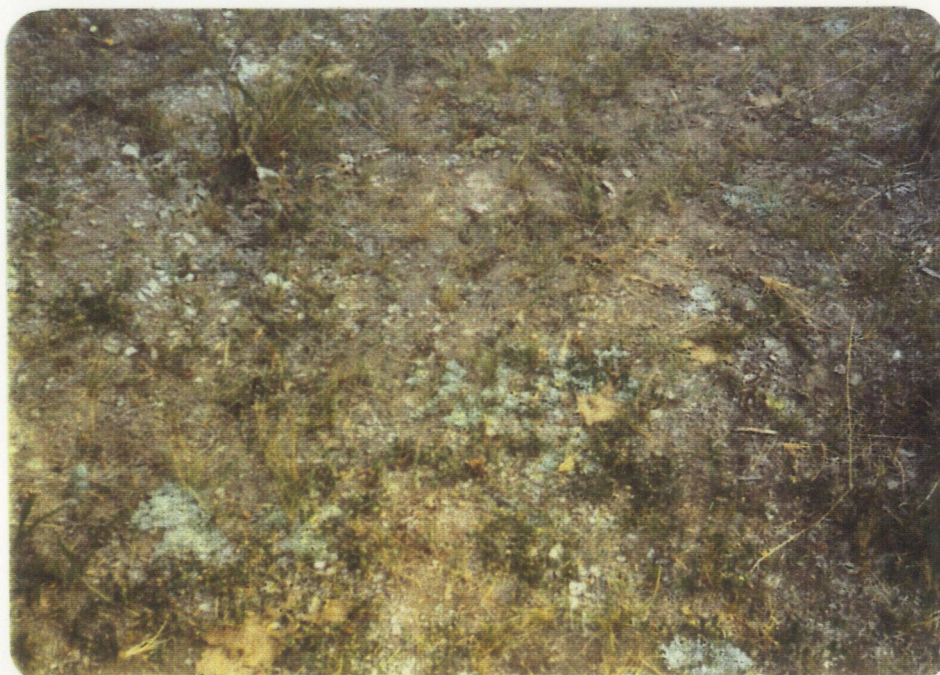
Plot # 5. August 1995.



Ungrazed grassland in the south-west corner of the airport. (Location of 1995 photo is not exact). This site was grazed until the early 1980's and was then fenced into the old airport.



PLOT #6



Plot # 6. August 1995.



Ungrazed grassland in the south-west corner of the airport. (Location of 1995 photo is not exact). This site was grazed until the early 1980's and was then fenced into the old airport.



PLOT #7



Plot # 7. August 1995.



Ungrazed grassland on the west edge of the airport adjacent to the Kimberley-Ta Ta Creek highway and east of the old building sites. (A silver angle iron rod was found that should be the north-east corner of the plot). This site has not been grazed by cattle since the 1930's.



PLOT #8



Plot # 8. August 1995.



Ungrazed grassland on the west edge of the airport adjacent to the Kimberley-Ta Ta Creek highway and east of the old building sites. (A silver angle iron rod was found that should be the north-east corner of the plot). This site has not been grazed by cattle since the 1930's.



FIGURE 2. Fence-line contrasts



2(a) Taken from inside Plot #3, looking towards airport



2(b) Taken from near Plot #6, looking south. It was assumed that all plots were potential *Festuca scabrella* sites, like that on the left side of the fence, and grazing pressure was responsible for the difference in vegetation seen to the right of the fence.

Fence-line Contrasts: 1995



Taken near plot # 3, looking north.

Taken near plot # 6, looking south.
The subtle vegetation change down
the center of the photograph indicates
the location of the old fence.

The aspen stand in the 1974 photo-
graph has disappeared completely.

