ESTABLISHMENT REPORT ON THE MILDRED LAKE NATIVE AND CULTIVATED GRASS RECLAMATION TRIAL

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ABSTRACT

The adaptability of native and cultivated grasses to oil sands disturbances is being studied in a field trial in northestern Alberta. The native grasses originated from the mountains and foothills of the province.

The trial was established on blended materials consisting of native sand, clayey overburden and peat. Nine native grasses and eight cultivated grass varieties were seeded in June of 1981. A description of the site, a summary of experimental procedures and first-year results are included in the report.

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

The Alberta Forest Service native grass research program has in the past focused on high-elevation reclamation. A part of this research involved assessing the adaptability of grasses to drastically-disturbed coal-mined lands in alpine and subalpine environments. The native species tested in these adaptability trials originated from the foothills and mountains of Alberta.

The existing and proposed disturbances resulting from oil sands mining in the northeastern part of the province provided the incentive and opportunity to evaluate the adaptability of the same high-elevation native grasses to a different environment. Nine native species representing five genera were selected for this study.

The major objective of the present research is to evaluate and compare the performance of the native grasses under simulated oil sands reclamation conditions. To increase the scope of the study, eight cultivated grass varieties were included as treatments in the experiment.

2.0 DESCRIPTION OF THE STUDY AREA

The general location of the research site is in north-eastern Alberta, approximately 38 km north of Fort McMurray. More specifically, the site is on the A.O.S.E.R.P. Mildred Lake field camp area in NE 18-93-10-W4M (Figure 1). Elevation of the site is 314 m ASL.

The general area is characterized by short cool summers and long cold winters. Total annual average precipitation is 43 cm with 28 cm occurring as rainfall (Longley and Janz 1978). The growing season is approximately 95 days from May through August (Chu and Fedkenheuer 1980).

Vegetation types in the immediate area consist of plant communities dominated by jack pine (*Pinus banksiana*) and to a lesser extent trembling aspen (*Populus tremuloides*). Common understory species include bearberry (*Arctostaphylos uva-ursi*), blueberry (*Vaccinium myrtilloides*), bog cranberry (*V. vitis-idaea*), rice grass (*Oryzopsis pungens*), *Cladonia* sp. and club mosses (*Lycopodium* sp.) (Lesko 1974).

ALBERTA OIL SANDS EXPERIMENTAL RESEARCH PROGRAM STUDY AREA

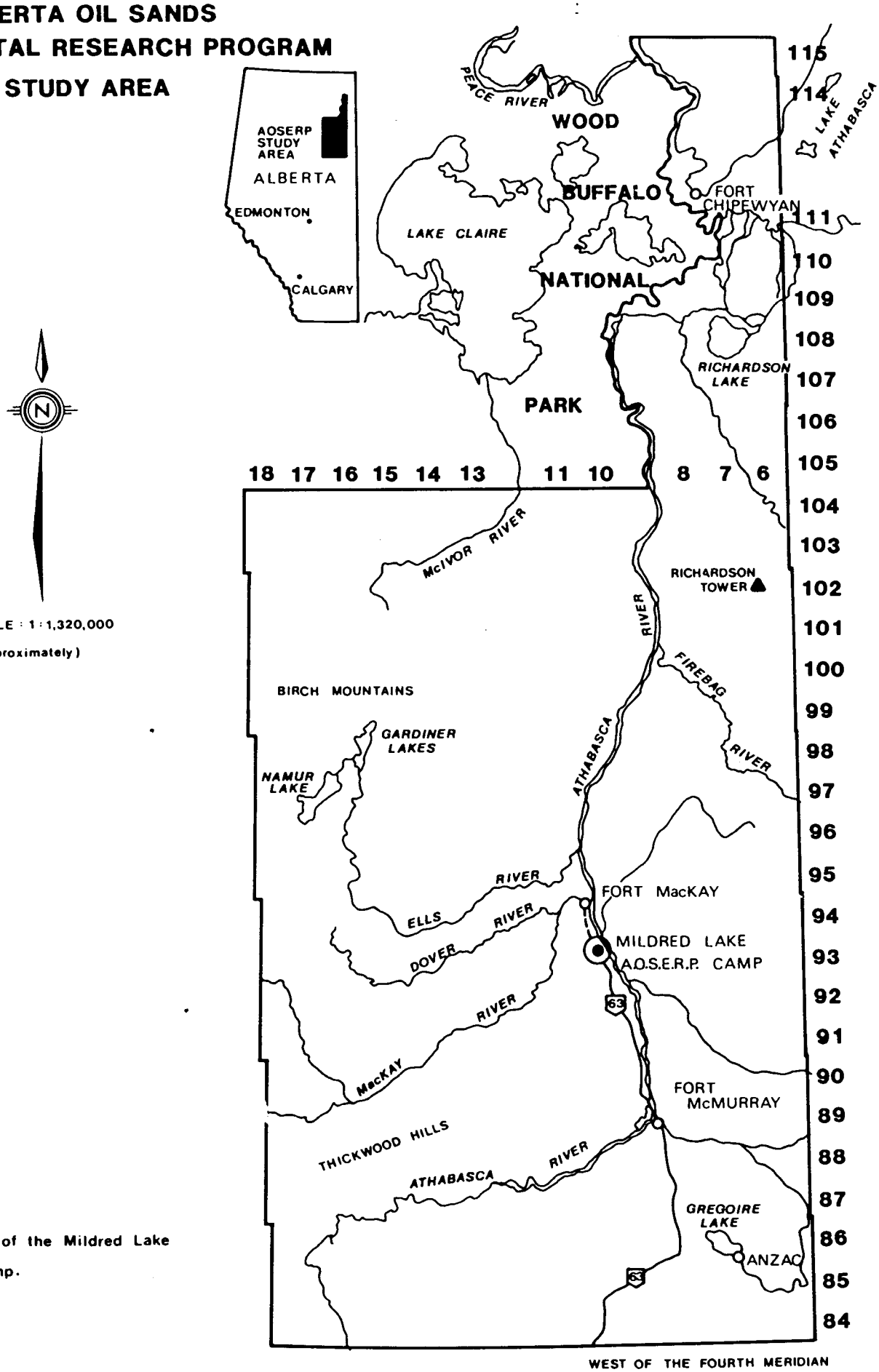

Figure 1 : Location of the Mildred Lake field camp.

3.0 MATERIALS AND METHODS

3.1 SITE PREPARATION

The research site, prepared and fenced in 1979, simulates a reclamation situation on tailings sand. The upper soil horizons on the site were stripped to expose the predominately sand C horizon. Clayey overburden and peat were then imported to the site and successively applied in 15 cm layers over the sand. The final steps involved tillage operations to blend these materials together with a 15 cm layer of sand.

3.2 EXPERIMENTAL TREATMENTS, DESIGN AND ESTABLISHMENT

Nine native grass species and eight cultivated grass varieties were selected for the experiment. The native grasses were originally collected and propagated as part of a research program conducted by the Department of Genetics, University of Alberta. The native grasses and the original seed sources are given in Table 1. The cultivated grass varieties are listed in Table 2.

The field trials were established on June 25, 1981, on the south end of the research site (Appendix 1 and Figure 2). All plots measure 2 m X 2 m with a 1-m buffer between plots and replicates. Three replicates were established, each consisting of 17 treatments arranged in a completely randomized design (see Appendix 2).

Table 1: Native grasses used in the experiment.

Scientific Name	Common Name	University of Alberta I.D. Number(s)[1]	Site(s) of Original Seed Collection[2]
1. *Agropyron trachycaulum*	slender wheatgrass	Multiline: B-2-2; B-2-8; B-2-11; B-2-13; C-1-10; E-1-1; E-1-3; E-1-5; E-2-10; E-2-20; K-2-18; #108	Grassy Mountain, Mountain Park, Waterton Flats, Barnaby Ridge, Smoky River
2. *Agropyron dasystachyum*	northern wheatgrass	Multiline: K-2-6; K-2-11; K-4-11; K-4-17; K-4-21; K-5-12; K-6-1	Sheep River, Ya Ha Tinda, Kootenay Plains, Mount Stearn
3. *Agropyron subsecundum*	bearded wheatgrass	Multiline: E-6-8; E-6-9; E-6-10; E-6-18; E-6-21; E-6-22; E-7-13; E-8-1; E-8-17; E-8-18	Greenock Mountain, Athabasca Ranch, Rock Lake, Smoky River
4. *Deschampsia caespitosa*	tufted hair grass	Multiline: Beartooth Hwy. Montana; Parkers Ridge	Beartooth Hwy. Montana, Parkers Ridge
5. *Festuca saximontana*	alpine sheep fescue	Multiline: B-8-9, 10, 16, 25; C-4-23,24,25; J-8-6,8,22	Coal Valley, Mountain Park, Pyramid Lake
6. *Koeleria cristata*	June grass	Multiline: L-1-12, 18, 24, 25; L-2-1, 6, 12, 24; L-3-6, 7; L-7-11; #123; #126	Southern Alberta, Sheep River, Cat Creek, Athabasca Ranch, Mount Stearn, Grotto Mountain
7. *Poa alpina*	alpine bluegrass	Multiline: B-3-6,15, 17, 22; C-3-10, 21, 22, 25; C-8-3,4,19; D-4-14; D-4-16, 17, 18, 19, 20; D-5-1, 20, 25	Grassy Mountain, Mountain Park, Coal Valley, Barnaby Ridge, Snow Creek, Sunshine
8. *Poa interior*	interior bluegrass	Whistler Mountain	Whistler Mountain
9. *Trisetum spicatum*	spike trisetum	Multiline: B-1-11,20; C-7-18,24,25; L-3-18	Grassy Mountain, Coal Valley, Cat Creek

[1] 1980 harvest.

[2] Primarily from the mountains or foothills of Alberta.

Table 2. Cultivated grass varieties used in the experiment.

Scientific Name	Common Name	Variety
1. *Agropyron cristatum*	crested wheatgrass	Fairway
2. *Agropyron dasystachyum*	northern wheatgrass	Elbee
3. *Agropyron riparium*	streambank wheatgrass	Sodar
4. *Agropyron trachycaulum*	slender wheatgrass	Revenue
5. *Alopecurus pratensis*	meadow foxtail	Canada No. 1
6. *Festuca rubra*	creeping red fescue	Boreal
7. *Poa compressa*	Canada bluegrass	Reubens
8. *Poa pratensis*	Kentucky bluegrass	Nugget

Figure 2: View of the Mildred Lake site immediately after trial establishment (June 25, 1981).

The grasses were seeded by simulated drilling in rows spaced 20 cm. Ten rows were established per plot resulting in 20 m of rows in each plot. The objective was to hand seed as uniformly as possible 100 seeds/m; therefore, 2 000 seeds were required per plot. The seed weight of all experimental grasses was calculated and the required weight of seed determined for each species to achieve the above seeding rate (Table 3). This seeding rate did not exclude nonviable seed.

Light-weight seeds were drilled to a depth of .5 cm while heavier seeds were seeded at a depth of 1 cm. Inorganic fertilizer (10-30-10) was broadcast at a rate of 600 kg/ha following seeding.

3.3 ASSESSMENT AND ANALYSIS OF DATA

Seedling emergence was assessed on September 23, 1981. In each plot, three 1-m linear subsamples were randomly selected from the rows and the total number of seedlings counted. This procedure was repeated in each plot by a different observer. The two totals were then averaged.

Assuming a potential of 100 seedlings/m (the seeding rate), the total theoretical plant count per plot was 300, minus and adjustment for each species based on a germination percentage. Germination tests were conducted by the Alberta Regional Seed Laboratory, Agriculture Canada.

Table 3: Seed weights of the experimental grass treatments.

Species	1 000 Seed Wt. (grams)	Seed Wt. (grams)[1] per plot
A. Native Species		
1. *Agropyron trachycaulum*	3.70	7.40
2. *Agropyron dasystachyum*	3.30	6.60
3. *Agropyron subsecundum*	3.80	7.60
4. *Deschampsia caespitosa*	0.20	0.40
5. *Festuca saximontana*	0.40	0.80
6. *Koeleria cristata*	0.28	0.56
7. *Poa alpina*	0.30	0.60
8. *Poa interior*	0.18	0.36
9. *Trisetum spicatum*	0.22	0.44
B. Cultivated Species		
10. *Agropyron cristatum*	1.50	3.00
11. *Agropyron dasystachyum*	3.20	6.40
12. *Agropyron riparium*	2.70	5.40
13. *Agropyron trachycaulum*	3.00	6.00
14. *Alopecurus pratensis*[2]	2.40	4.80
15. *Festuca rubra*	1.20	2.40
16. *Poa compressa*	0.24	0.48
17. *Poa pratensis*	0.31	0.62

[1] Weight of seed required to apply 100 seeds/m.

[2] "Prill-on" coated.

Emergence count data was expressed as a percentage of the potential number of seedlings for each species. Analysis of variance was conducted on percent emergence data (see Appendix 3). Duncan's New Multiple Range Test was used to test for significant differences among treatment means.

4.0 RESULTS

4.1 LABORATORY GERMINATION

Germination among the native species was relatively consistent (Table 4). All species, with the exception *Trisetum spicatum*, exceeded 70 percent germination. The latter species exhibited poor germination (40 percent). Among the cultivated varieties, only *Agropyron trachycaulum* 'Revenue' germinated poorly (59 percent). All other cultivated varieties exceeded 80 percent germination.

4.2 FIELD EMERGENCE

Analysis of variance indicated that differences among treatment means (species) was highly significant (see Appendix 3). The large-seeded species, specifically the *Agropyrons*, exhibited superior emergence (Table 4). Highest emergence was recorded for *Agropyron dasystachyum* 'Elbee' at 62.3 percent. With the exception of this species, no statistically significant differences occurred among treatment means of the native *Agropyron* species and the cultivated *Agropyron* varieties (Table 4).

Poorest emergence was exhibited by *Festuca saximontana*, a native species, and *Poa pratensis* 'Nugget'. The emergence for both species was 8.4 percent. Other species with poor results (less than 15 percent) included *Poa alpina*, *Poa interior*, *Trisetum spicatum* and *Alopecurus pratensis*. More native species than cultivated species exhibited poor emergence.

Table 4: Summary of first-year results.

Species	No. Seeds/ Sample[1]	Germination Rate	Potential No. Seedlings	Actual No. Seedlings[2]	Emergence Percentage[3]
Native Species					
1. *Agropyron trachycaulum*	300	97%	291	144.2	49.6ab
2. *Agropyron dasystachyum*	300	93%	279	127.3	45.6bc
3. *Agropyron subsecundum*	300	87%	261	111.3	42.6bc
4. *Deschampsia caespitosa*	300	73%	219	43.8	20.0ef
5. *Festuca saximontana*	300	92%	276	23.2	8.4f
6. *Koeleria cristata*	300	78%	234	53.2	22.7def
7. *Poa alpina*	300	79%	237	30.3	12.8f
8. *Poa interior*	300	74%	222	22.7	10.2f
9. *Trisetum spicatum*	300	40%	120	17.2	14.3f
Cultivated Species					
10. *Agropyron cristatum*	300	90%	270	109.0	40.4bc
11. *Agropyron dasystachyum*	300	88%	264	164.5	62.3a
12. *Agropyron riparium*	300	91%	273	134.0	49.1ab
13. *Agropyron trachycaulum*	300	59%	177	63.3	35.8bcd
14. *Alopecurus pratensis*	300	91%	273	29.5	10.8f
15. *Festuca rubra*	300	96%	288	60.3	20.9def
16. *Poa compressa*	300	87%	261	85.0	32.6cde
17. *Poa pratensis*	300	81%	243	20.3	8.4f

[1] A sample is the total of three 1-m subsamples taken in each plot.

[2] Mean of three replicates.

[3] Mean values (of three replicates) followed by the same letter within a column are not significantly different at the 5% level based on Duncan's New Multiple Range Test.

The superior performance of the larger-seeded *Agropyrons*, including the native species, is consistent with other research findings. Sadasivaiah and Weijer (1981) speculated that seed size was an important factor in the establishment of grasses at high elevations. The native *Agropyrons* in Sadasivaiah and Weijers' studies were superior to both small-seeded native and small-seeded cultivated grass species. Tomm and Russell (1981) also noted that the *Agropyrons* tended to out-perform other species in terms of plant cover after the first two growing seasons.

5.0 CONCLUSIONS

Laboratory germination of both the native species and the cultivated varieties tended to be uniformly good. The exceptions were *Trisetum spicatum* and *Agropyron trachycaulum* 'Revenue'.

The larger-seeded *Agropyron* species exhibited the most successful emergence in the field. The best result was obtained from *Agropyron dasystachyum* 'Elbee'. The poorest performances were recorded for *Festuca saximontana* and *Poa pratensis* 'Nugget'. Seed size appears to be an important factor in determining emergence success in an oil-sands reclamation environment.

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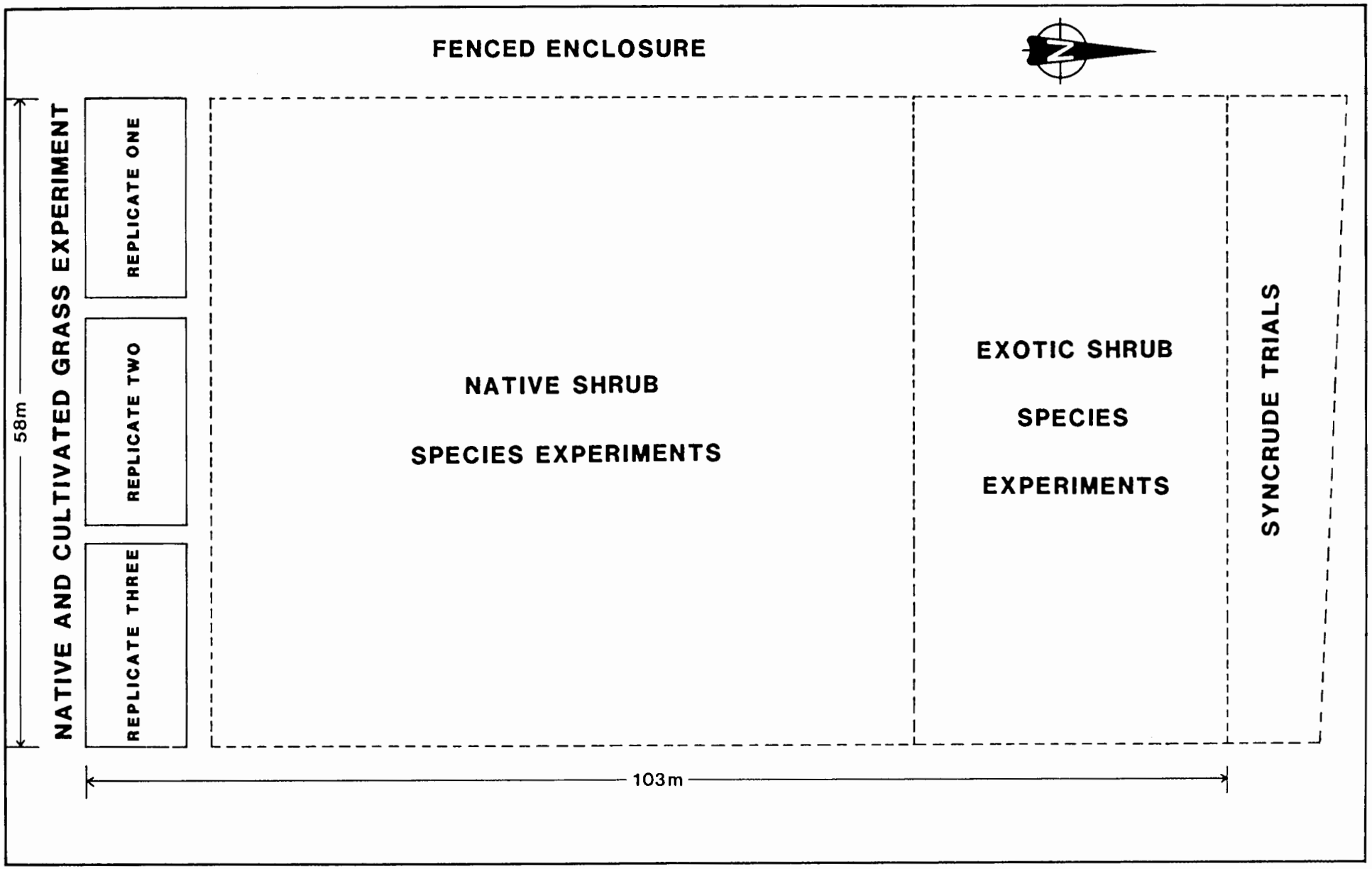
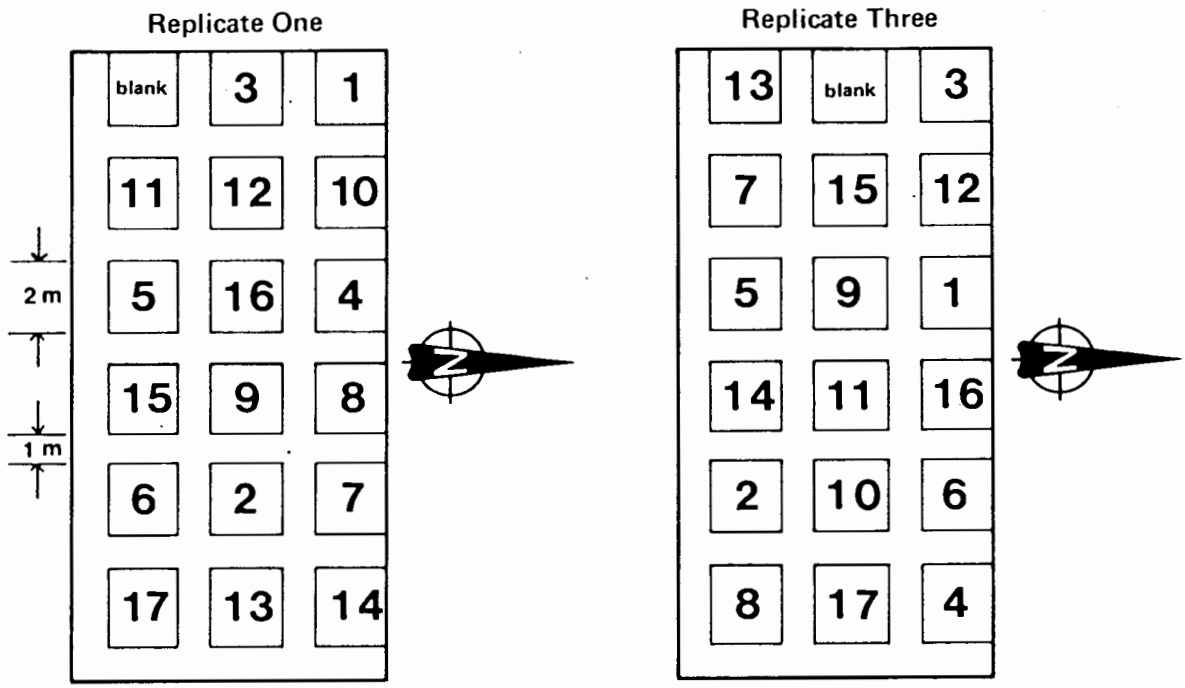
APPENDIX 1 : OVERVIEW OF THE MILDRED LAKE RESEARCH SITE



APPENDIX 2 : FIELD LAYOUT OF THE MILDRED LAKE NATIVE AND CULTIVATED GRASS TRIAL



KEY TO TREATMENTS

NATIVE SPECIES

1. *Agropyron trachycaulum*
2. *Agropyron dasystachyum*
3. *Agropyron subsecundum*
4. *Deschampsia caespitosa*
5. *Festuca saximontana*
6. *Koeleria cristata*
7. *Poa alpina*
8. *Poa interior*
9. *Trisetum spicatum*

CULTIVATED SPECIES

10. *Agropyron cristatum*	"Fairway"
11. *Agropyron dasystachyum*	"Elbee"
12. *Agropyron riparium*	"Sodar"
13. *Agropyron trachycaulum*	"Revenue"
14. *Alopecurus pratensis*	Canada No. 1
15. *Festuca rubra*	"Boreal"
16. *Poa compressa*	"Reubens"
17. *Poa pratensis*	"Nugget"

APPENDIX 3: Analysis of variance of percent emergence data.

Source of Variation	DF	SS	MS	F
Main Effects	18			
Replicates	2	1 450.51	725.26	10.57**
Species	16	14 352.12	897.01	13.57**
Error	32	2 196.09	68.63	
TOTAL	50	17 998.73		

** Significant at P=.01