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FERTILIZATION OF JACK PINE AND UPLAND BLACK SPRUCE IN SASKATCHEWAN

Demonstration MS 030

by L. D. Nairn

**FOREST RESEARCH LABORATORY
WINNIPEG, MANITOBA
INTERNAL REPORT MS-113**

**CANADIAN FORESTRY SERVICE
DEPARTMENT OF FISHERIES AND FORESTRY
APRIL, 1970**

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The forest fertilization trials in this report are being carried out by the Department of Fisheries and Forestry in cooperation with the Saskatchewan Pulp Company, the Prince Albert Pulp Company, and the Saskatchewan Department of Natural Resources, as demonstrations of the possibilities of increasing merchantable yields of jack pine and black spruce by the application of fertilizers.

ACKNOWLEDGEMENTS

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INTRODUCTION

In 1957, forest fertilization studies were initiated in Sweden by the Swedish Cellulose Company who have since demonstrated that fertilization of coniferous stands is an economical and practical method of producing additional merchantable wood per rotation (Hagner, S. et al. 1966).

In 1968 the Canadian Forestry Service in cooperation with the Manitoba Department of Mines and Natural Resources set out two forest fertilization demonstration areas in upland black spruce sites in northern Manitoba (Nairn 1970). In 1969, with the cooperation of the Saskatchewan Pulp Company, the Prince Albert Pulp Company and the Saskatchewan Department of Natural Resources, two similar demonstration areas were set out within the timber lease limits of the Prince Albert Pulp Company (Figure 1). One area, near Candle Lake, was set out in jack pine-black spruce stand and the other, near Little Bear Lake, was set out in a predominately black spruce stand. Both stands are overstocked and stagnated with large numbers of trees just below merchantable size. Fertilizers will be applied to these areas in the spring of 1970.

The Saskatchewan demonstration areas were originally laid out to be comparable (with respect to treatments and fertilizer types) with the demonstrations established in Manitoba. However, in 1969 an Inter-Provincial Forest Fertilization Technical Committee was set up in Canada to initiate a cooperative forest fertilization project. The participants of this committee are the Provincial Governments of Nova Scotia, New Brunswick, Quebec, Ontario and Manitoba as well as advisors from the Pulp Institute of Canada, the Federal Department of Fisheries and Forestry and eastern Canadian universities. The objectives of the committee is to

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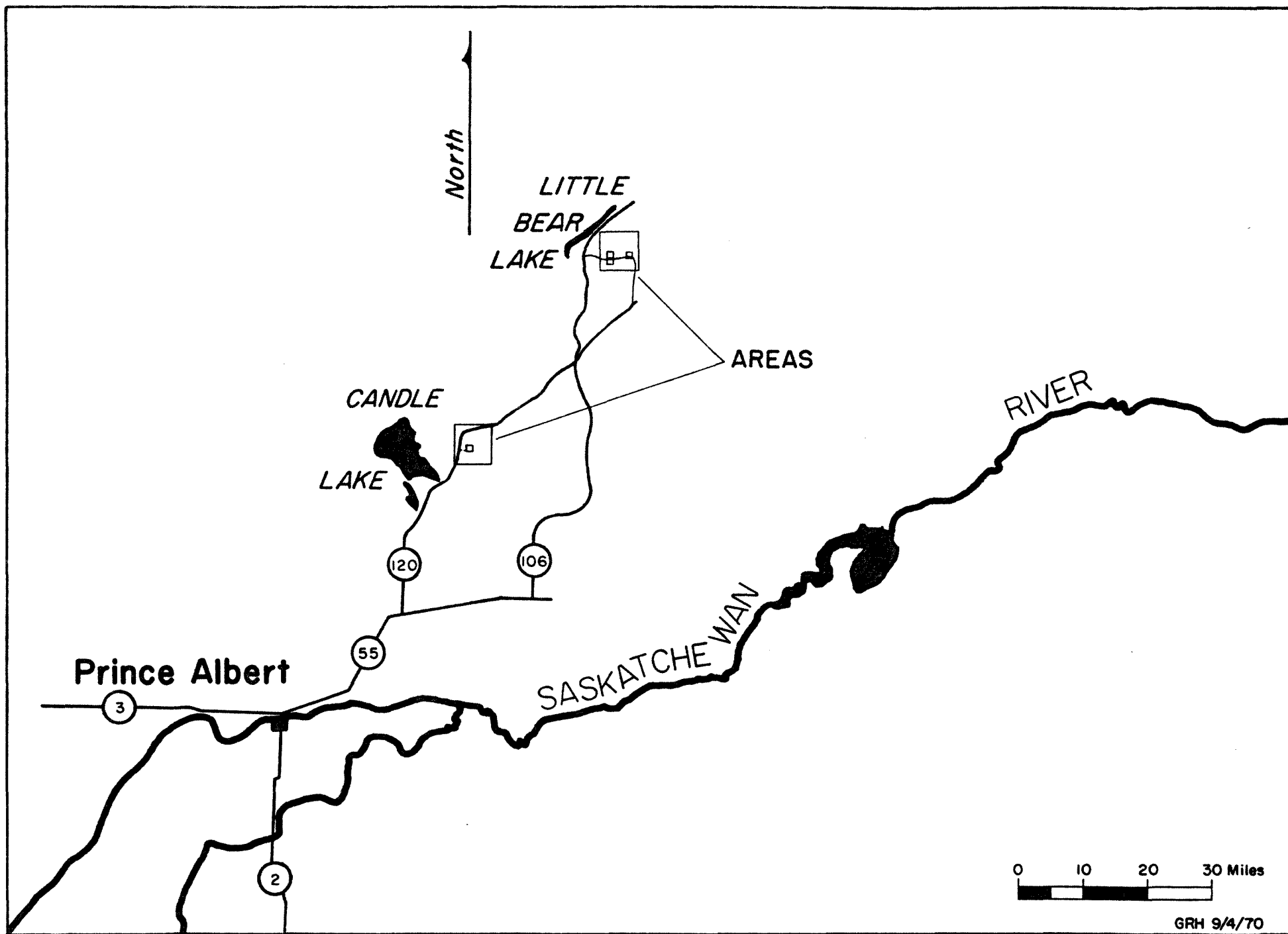


Fig.1 Fertilizer Demonstration Areas, Saskatchewan

standardize plot establishment procedures, site description, diameter and growth measurements and fertilizer treatments. It has recently been decided to modify the Saskatchewan demonstration areas to conform to the standards of the Inter-Provincial Forest Fertilization Technical Committee and also to compliment the work as much as possible already established in northern Manitoba. This will involve setting out additional plots in both areas, and remeasuring the trees in all plots prior to application of fertilizer in 1970.

CANDLE LAKE DEMONSTRATION AREA

Description of area

The Candle Lake demonstration area is located in Section 16, Tp. 56, Rge. 21 W 2nd, 1.5 miles east of mile 31.9 (1 mile south of the White Swan Lake road junction) on highway #106 (Figure 2). The area is adjacent to a recent cutover, and represents a typical marginal unmerchantable stand left intact following pulp cutting in the area. The soil is moderately well drained grey wooded developed on lacustrine clay. Soil analysis was carried out to a depth of 24 inches. The analysis indicated the top six inches of soil to be silty sand in texture with a pH of 4.4 and contained no nitrate nitrogen, 47 pounds per acre available phosphorus, and 182 pounds per acre of exchangeable K_2O .

This stand is heavily stocked, with 2,200 stems per acre and contains in terms of basal area 54 per cent jack pine, 45 per cent black spruce and one per cent trembling aspen. The distribution of stems per acre and basal area per acre by diameter classes and species is shown in Table 1. This stand originated from fire, and is 80-90 years old with the average height of the dominant jack pine and black spruce being 45 feet and 43 feet respectively. The understory consists of scattered alder and ground vegetation is a carpet of shallow moss. The terrain is fairly level, sloping gently to the north.

The annual radial increment for jack pine has been notably suppressed during the past 14 years (Figure 3). This is probably due to overstocking and competition from black spruce. Marked suppression in radial increment of black spruce has occurred during the past seven years (Figure 4). Analysis of current year's jack pine needles taken in the upper portions of the crowns show 0.54 per cent nitrogen, 0.13 per cent phosphorus and 0.53 per cent potassium.

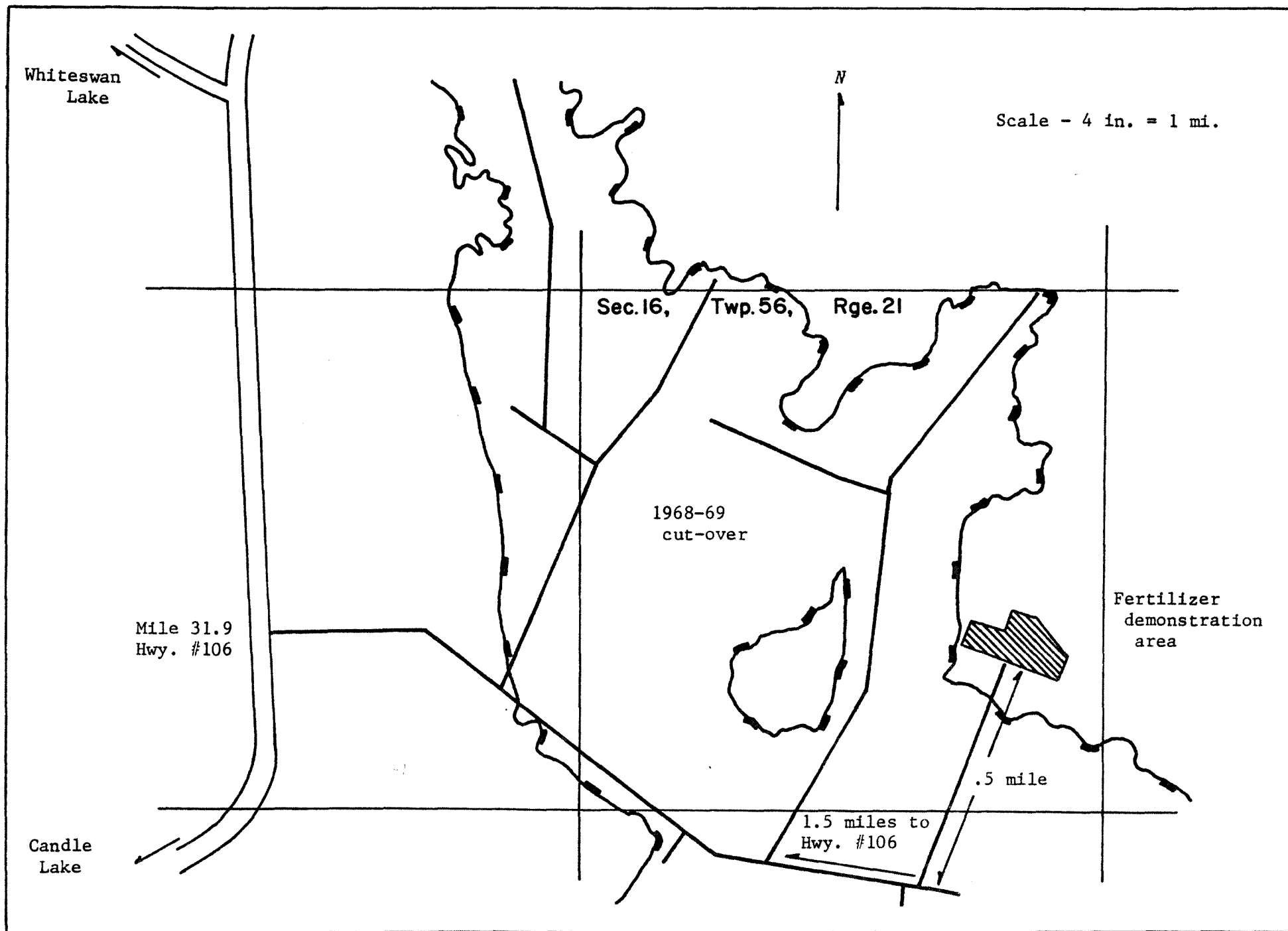


Figure 2. Location of Fertilizer Demonstration Area in Candle Lake Area, Saskatchewan
Section 16, Tp. 56, Rge. 21 W 2nd.

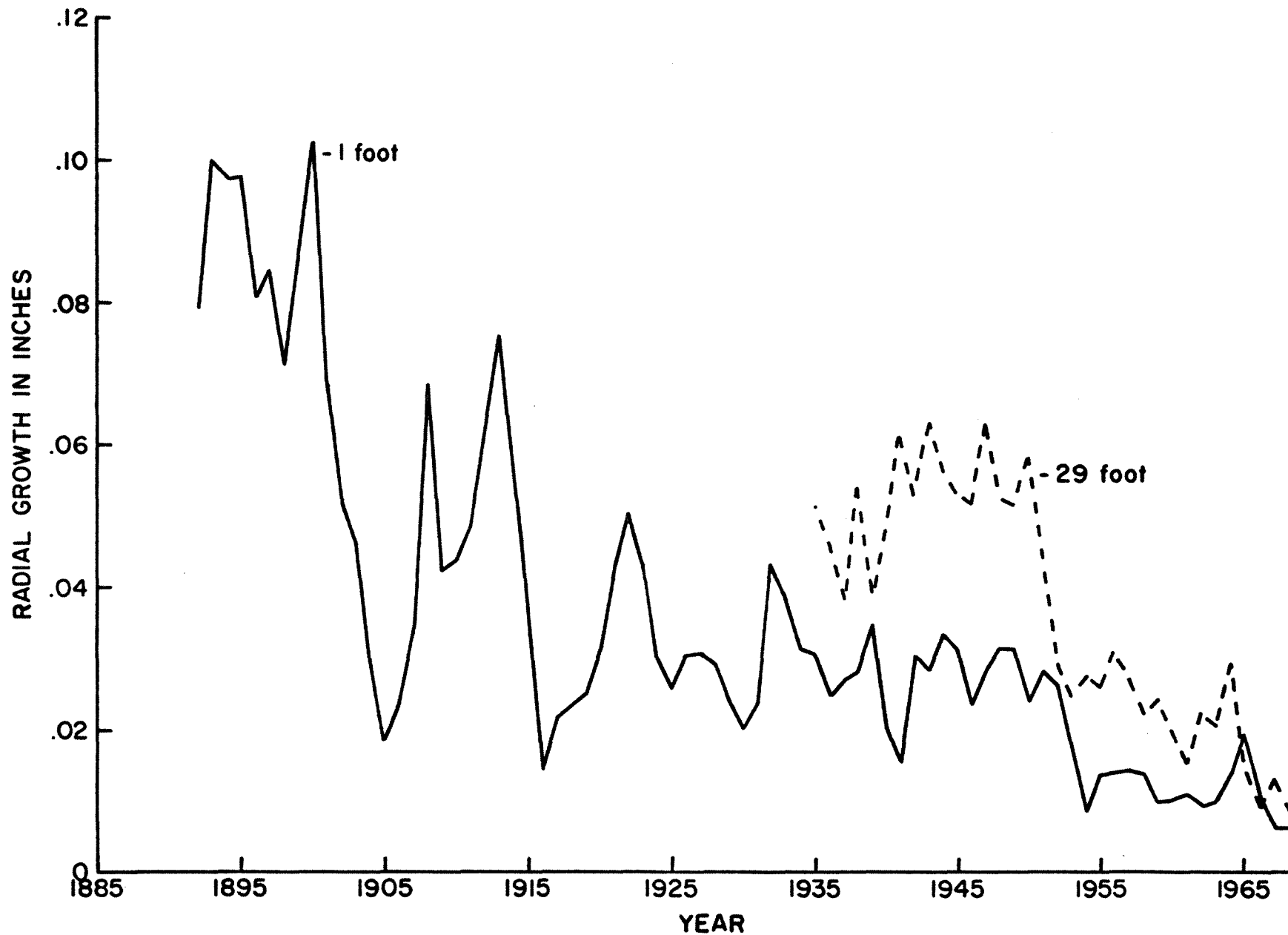


Figure 3. Radial growth of a jack pine tree 5.2 inches d.b.h. and 46 feet in height from the Candle Lake demonstration area. Radial growth is shown for the 1-foot and 29-foot levels.

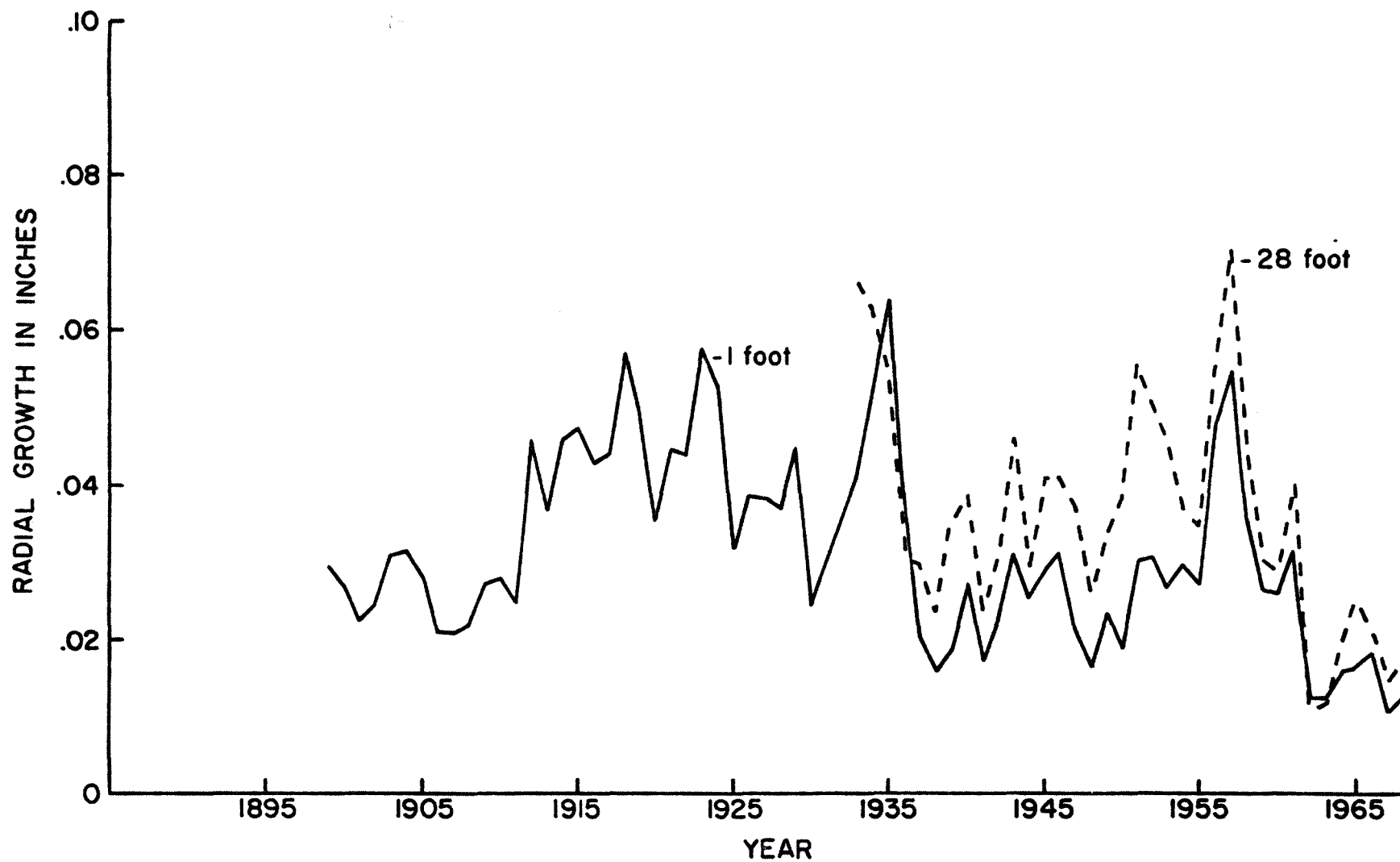


Figure 4. Radial growth of a black spruce tree 3.7 inches d.b.h. and 42 feet in height from the Candle Lake demonstration area. Radial growth is shown for the 1-foot and 28-foot levels.

Methods

In 1969 the area layout consisted of 24 plots in a randomized complete block design with four replicates. However, in 1970 this layout will be modified and increased to 32 plots in a randomized complete block design with four replications. Each block will contain eight plots with each of the eight treatments randomized within the block.

Each plot consists of (1) an inner study plot, 40 ft. x 40 ft., (2) an area 80 ft. x 80 ft. to be fertilized within and surrounding the study plot, and (3) a ten-foot buffer zone between plots and blocks to prevent contamination between treatments of adjacent plots. This layout provides for a 20-foot extension of the fertilized area around the study trees and a minimum buffer distance of 30 feet between the study trees of one plot and the treatment area of adjacent plots.

The plots are set out using a right angle prism, with a maximum acceptable closing distance of three inches being adhered to on the 40 ft. x 40 ft. study plots. The corners of the study plots are permanently marked with aluminum stakes. All dead trees within the study plots are either felled or blazed. In 1969 all living trees within the study plots 0.6 inches or larger were measured to the nearest 0.1 inch d.b.h. by diameter tape. The location of each measurement was initially marked with a paint crayon and subsequently painted. The number of trees and basal area by species for each of the 24 plots established in 1969 is shown in Table 2. Height measurements were taken on three representative trees on each plot.

Treatments

The following eight fertilization treatments will be applied in the spring of 1970 to eight plots in each of the four blocks:

*TREATMENT (element value)
lbs./acre

1. 100 N
2. 150 N
3. 150 N + 44 P
4. 200 N
5. 200 N + 100 P
6. 200 N + 100 K
7. 200 N + 100 P + 100 K
8. CONTROL - Unfertilized

* NOTE: N = nitrogen using urea (46-0-0)
P = phosphorus using triple super-phosphate (0-46-0)
K = potassium using potassium chloride (0-0-60)

All fertilizer will be applied using a "Cyclone" seeder and employing the same methods as used in Manitoba (Nairn 1970).

LITTLE BEAR LAKE DEMONSTRATION AREA

Description of area

The Little Bear Lake demonstration is located in two areas, one in section 8 and the other in section 14 Tp. 61, Rge. 17 W 2nd, approximately 2.2 miles and 5.1 miles east of Saskatchewan Pulp Company Camp #6 along the connecting road between highway #106 and highway #120 (Figure 5). The area is an upland moraine with a grey wooded soil development. The humus layer is fairly thin and soil analysis of the top six inches have indicated a silty sand to sandy loam texture with a pH of 4.1, 0.2 pounds per acre nitrate nitrogen, 8 pounds per acre available phosphorus, and 119 pounds per acre exchangeable K_2O .

The stand was heavily stocked with 2,052 stems per acre, and contained in terms of basal area, 98 per cent black spruce and two per cent jack pine. The distribution of stems per acre, and basal area per acre by diameter classes and species, is shown in Table 3. The stand is of fire origin and is 80-100 years old; the average height of the dominant black spruce is 45 feet. The understory vegetation is scattered alder over the ground cover of moss. The terrain is fairly level, sloping gently to the south.

Annual radial increment has been declining slowly over the past nine years (Figure 6). Nutrient analysis of black spruce needles from the upper crown shows 0.46 per cent nitrogen, 0.13 per cent phosphorus and 0.52 per cent potassium.

Methods

In 1969, the test area layout consisted of 24 plots in a randomized complete block design containing four replications. The western area contained one block of six plots and the eastern area contained three blocks of six plots each. This layout will be modified in 1970 so that each block will be increased to eight plots with eight treatments randomized within the block.

The individual plot size and buffer areas are the same as for the Candle Lake area. The number of trees and basal area by species for each of the 24 plots established in 1969 is shown in Table 4. Height measurements were taken on three representative trees on each plot.

Treatments

Fertilization treatments are to be identical to those carried out in the Candle Lake area and will be applied in the spring of 1970.

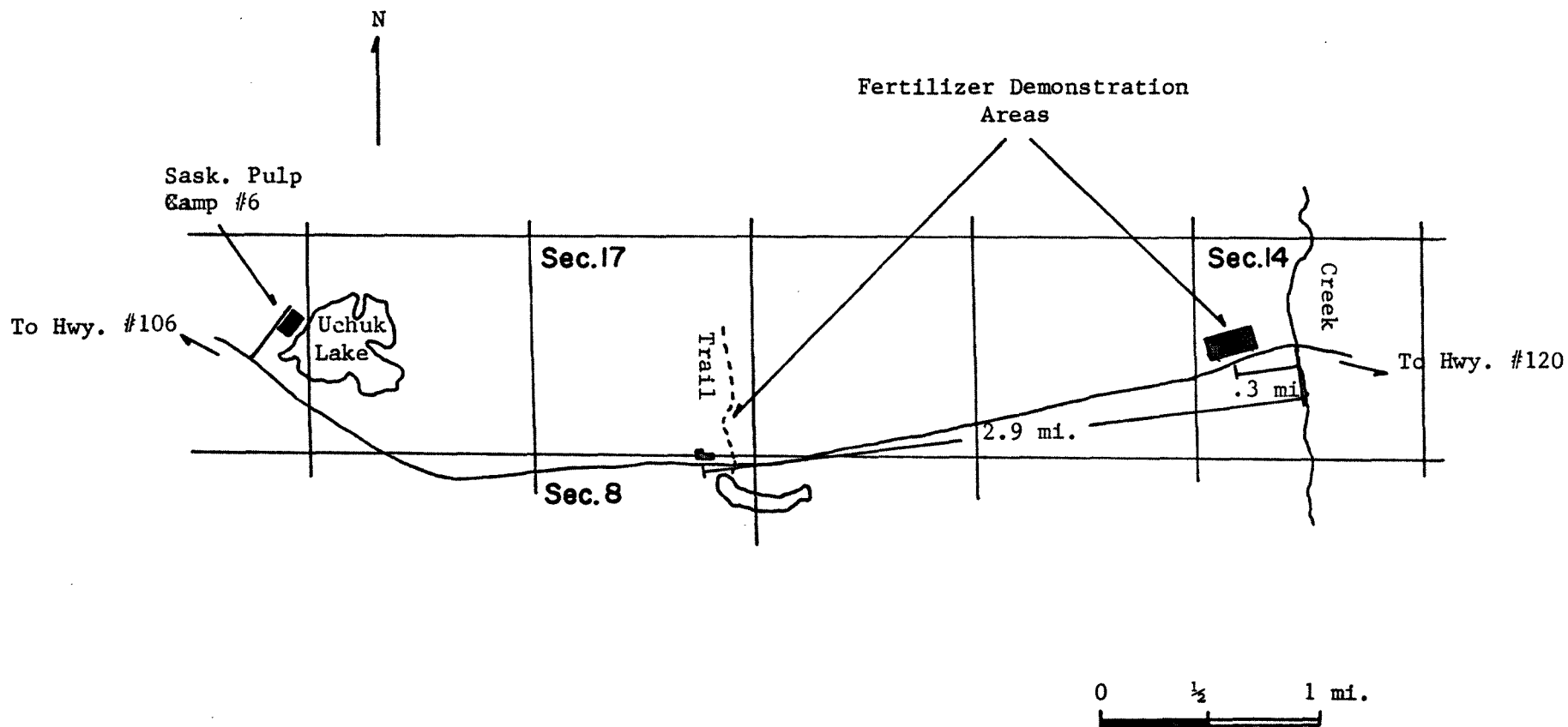


Figure 5. Location of Fertilizer Demonstration Areas in Little Bear Lake Area, Sask.,
Sections 8 & 14, Tp. 61 Rge. 17 W 2nd.

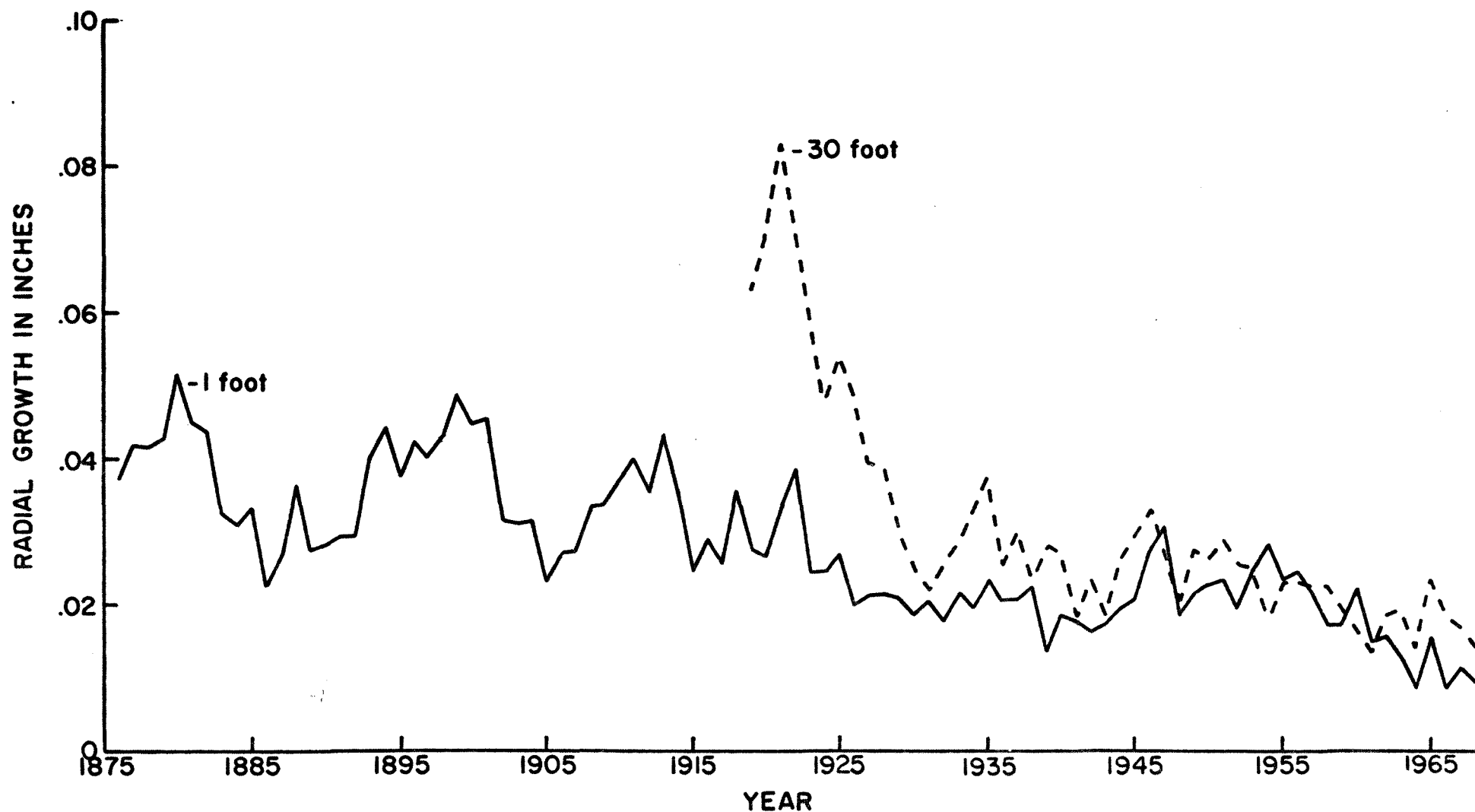


Figure 6. Radial growth of a black spruce tree 6.1 inches d.b.h. and 46 feet in height from the Little Bear Lake demonstration area. Radial growth is shown for the 1-foot and 30-foot levels.

FUTURE WORK

In the spring of 1970, both the Candle Lake and Little Bear Lake demonstration areas will be modified to include all recommended standards of the Inter-provincial Forest Fertilization Technical Committee. Essential work necessary is as follows:

- (I) Increase all blocks from six plots to eight for a total of eight additional plots in each of the two areas.
- (II) Tag all trees in each of the 64 study plots.
- (III) Remeasure all study plot trees to the nearest 0.01 inch.
- (IV) Fertilize plots.

Core samples will be taken following two and four growing seasons since fertilization and preliminary reports will be prepared on radial growth reaction.

All plots will be remeasured following five growing seasons since application of fertilizer.

Final assessment of growth will be made when radial growth has returned to pre-fertilization levels.

All plots will be checked annually for tree mortality. Foliage analysis will be carried out annually for N, P, and K for each treatment in both locations.

REFERENCES

- Hagner, S. et al. 1966. Timber production by forest fertilization. Sveriges Scogsvforb Tidskr. 64(2): 103-171.
- Nairn, L.D. 1970. Fertilization of upland black spruce in northern Manitoba. Canada, Department of Fisheries and Forestry, Can. For. Serv., Winnipeg, Man., Int. Rep. MS-110, 17 p.

TABLE 1

DISTRIBUTION OF STEMS PER ACRE AND BASAL AREA PER ACRE BY DIAMETER

CLASSES AND SPECIES IN THE CANDLE LAKE DEMONSTRATION AREA,

AUGUST 5, 1969

Species Diam. class d.b.h.	Black Spruce		Jack Pine		Aspen	
	Stems per acre	B.A. per acre (sq.ft.)	Stems per acre	B.A. per acre (sq.ft.)	Stems per acre	B.A. per acre (sq.ft.)
1" (.6"-1.5")	245	1.674	5	0.040	-	-
2"	259	6.190	96	2.709	-	-
3"	256	12.955	368	17.955	9	0.491
4"	168	14.629	421	35.455	7	0.625
5"	49	6.555	225	29.792	3	0.534
6"	10	1.984	62	11.972	1	0.238
7"	1	0.270	6	1.492	-	-
TOTALS	988	44.257	1,183	99.415	20	1.888

GRAND TOTAL ALL SPECIES

Stems per acre = 2,191

Basal area per acre = 145.560 sq. ft.

TABLE 2
NUMBER OF TREES AND BASAL AREA FOR EACH PLOT IN THE CANDLE LAKE
DEMONSTRATION AREA ESTABLISHED IN 1969

Plot No.	Black Spruce (per plot)		Jack Pine (per plot)		Aspen (per plot)		Totals Per Plot	
	No. trees	B.A.	No. trees	B.A.	No. trees	B.A.	No. trees	B.A.
1	56	2.581	40	3.757	-	-	96	6.338
2	52	1.684	42	3.055	-	-	94	4.739
3	66	2.896	45	3.706	-	-	111	6.602
4	45	2.694	31	3.654	4	0.241	80	6.589
5	37	1.385	51	4.459	-	-	88	5.844
6	28	1.274	41	3.891	1	0.106	70	5.271
7	23	1.057	44	3.947	-	-	67	5.004
8	122	6.379	3	0.415	5	0.568	130	7.362
9	58	1.221	49	3.581	-	-	107	4.802
10	58	3.569	36	2.940	1	0.075	95	6.584
11	17	0.428	55	3.934	1	0.046	73	4.408
12	31	1.511	44	3.689	-	-	75	5.200
13	21	1.104	39	3.063	-	-	60	4.167
14	13	0.432	55	2.743	-	-	68	3.175
15	14	0.599	55	5.104	-	-	69	5.703
16	28	0.449	59	3.507	-	-	87	3.956
17	23	1.698	43	3.932	-	-	66	5.630
18	12	1.017	44	3.656	5	0.586	61	5.259
19	90	3.813	31	2.682	-	-	121	6.495
20	27	1.548	38	4.234	-	-	65	5.782
21	17	0.429	47	4.348	-	-	64	4.777
22	13	0.227	59	4.416	-	-	72	4.643
23	7	0.363	45	4.284	-	-	52	4.647
24	13	0.656	46	4.609	1	0.043	60	5.308

TABLE 3

DISTRIBUTION OF STEMS PER ACRE AND BASAL AREA PER ACRE BY DIAMETER
CLASSES AND SPECIES IN THE LITTLE BEAR LAKE DEMONSTRATION AREA,
AUGUST 10, 1969

Species Diam. class d.b.h.	Black Spruce		Jack Pine		White Birch	
	Stems per acre	B.A. per acre (sq.ft.)	Stems per acre	B.A. per acre (sq.ft.)	Stems per acre	B.A. per acre (sq.ft.)
1"(0.6"-1.5")	301	2.021	-	-	-	-
2"	344	8.271	-	-	-	-
3"	437	22.702	10	0.596	2	0.143
4"	476	41.990	8	0.655	-	-
5"	280	38.545	2	0.267	-	-
6"	127	24.747	3	0.714	-	-
7"	45	11.817	1	0.278	-	-
8"	14	4.708	-	-	-	-
9"	2	0.914	-	-	-	-
TOTALS	2,026	155.715	24	2.510	2	0.143

GRAND TOTAL ALL SPECIES

Stem per acre = 2,052

Basal area per acre = 158.368 sq. ft.

TABLE 4

NUMBER OF TREES AND BASAL AREA FOR EACH PLOT IN THE LITTLE BEAR LAKE
DEMONSTRATION AREA, ESTABLISHED IN 1969

Plot No.	Black Spruce (per plot)		Jack Pine (per plot)	No. trees	B.A.	White Birch (per plot)		Totals Per Plot	No. trees	B.A.
	No. trees	B.A.				No. trees	B.A.			
1	96	4.280	2	0.301	-	-	-	98	4.581	
2	86	5.323	-	-	-	-	-	86	5.323	
3	54	5.581	-	-	1	0.067	-	54	5.648	
4	80	6.450	1	0.092	-	-	-	81	6.542	
5	104	5.455	2	0.108	-	-	-	106	5.563	
6	115	6.185	-	-	-	-	-	115	6.185	
7	70	6.770	-	-	-	-	-	70	6.770	
8	93	5.220	-	-	-	-	-	93	5.220	
9	77	6.147	1	0.052	-	-	-	78	6.199	
10	64	5.204	1	0.245	-	-	-	65	5.449	
11	128	5.942	1	0.071	-	-	-	129	6.013	
12	84	5.572	-	-	-	-	-	84	5.572	
13	30	6.056	-	-	1	0.059	-	31	6.115	
14	76	5.674	1	0.056	-	-	-	77	5.730	
15	74	6.357	-	-	-	-	-	74	6.357	
16	77	6.383	1	0.056	-	-	-	78	6.439	
17	89	6.815	-	-	-	-	-	89	6.815	
18	74	4.533	-	-	-	-	-	74	4.533	
19	69	7.682	-	-	-	-	-	69	7.682	
20	56	5.700	1	0.183	-	-	-	57	5.883	
21	54	7.601	-	-	-	-	-	54	7.601	
22	48	3.631	5	0.511	-	-	-	53	4.142	
23	46	4.101	2	0.167	-	-	-	48	4.268	
24	42	4.604	4	0.369	-	-	-	46	4.973	