forest management note

Note No. 16 Northern Forest Research Centre Edmonton, Alberta

HEAVY THINNING ACCELERATES GROWTH OF 77-YEAR-OLD LODGEPOLE PINE

The effect of stand density on the yield of natural lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Engelm.) has been well documented (Johnstone 1976). Smithers (1961) warned that when stand density exceeds about 5000 stems per hectare at 90 years of age, there likely will not be a reasonable merchantable yield. Recent studies at the Northern Forest Research Centre (Bella and De Franceschi 1977; Johnstone 1981a, b) have dealt with releasing overly dense, young pine stands. Current timber supply problems, however, have resulted in an interest in thinning older, low-merchantability pine stands as a possible means of reducing age-class imbalances in the growing stock.

During the late 1930s and early 1940s, a series of thinning trials was established at the Kananaskis Forest Experiment Station in southwestern Alberta. The study reported here was conducted in a 77-year-old, fire-origin stand of lodgepole pine located at an elevation of about 1370 m in the SA.1 Section of the Subalpine Forest Region (Rowe 1972). The soil in the study area was a degraded brown-wooded soil developed on fine-texture deltaic and alluvial fan deposits with a moderately high lime content. Lodgepole pine made up more than 85% of the volume of the stand, and there were some white spruce (*Picea glauca* (Moench) Voss. var. *albertiana* (S. Brown) Sarg.) and aspen (*Populus tremuloides* (Michx.)) in the understory. At thinning, the maximum height of the pine was about 17 m.

The stand was thinned for fuel wood in 1941 in what Quaite (1950) described as a combination of heavy thinning from above and below. This thinning removed about 70% of the total volume, reduced the stand density from 7200 to 1710 trees per hectare (of which 1554 were pine), and increased the average stand diameter from 9.1 to 10.2 cm (10.7 cm for the pine). In 1949, four 0.08-ha permanent sample plots were established in the thinned stand and two 0.04-ha permanent sample plots were located in the control area. All the trees in each plot were tagged, and the diameter at breast height outside bark (dbhob) was measured and recorded. Height and diameter increments during the preceding 8-year period were ascertained by stem analyses and increment borings of sample trees in the area immediately adjacent to the plots. The plots were remeasured in 1953 and 1963. In 1963, the 25 largest (dbhob) trees in 0.10-ha sample plots in both the thinned and unthinned stands were felled, and a stem analysis of each tree was conducted. This report presents the response of 77-year-old lodgepole pine for 21 years after treatment. After the 1963 remeasurement this study was obliterated by the relocation of Highway 40 within the Kananaskis Valley.

Thinning had a pronounced effect on the diameter growth of the pine trees during the 21 years following treatment. During this period, the mean annual diameter increment in the thinned stand was 0.213 cm/yr compared to 0.086 cm/yr in the unthinned stand, an increase of 147.7%. The 250 largest pine trees per hectare in the unthinned stand attained an average periodic annual diameter growth of 0.168 cm/yr, while those in the thinned stand grew 54.2% faster, averaging 0.259 cm/yr. Diameter growth response increased with tree size until about the 15-cm diameter class and then leveled off (Fig. 1). This suggests the need to consider tree size as well as condition when selecting potential crop trees to be retained after thinning.

Prior to thinning, the height growth in the control area slightly exceeded that in the treated area. This trend was reversed following thinning, and the periodic annual height growth of the 250 largest trees per hectare was 0.16 m/yr in the thinned stand compared to 0.13 m/yr in the unthinned stand. The lack of dramatic height-growth response is not surprising, particularly when the late age at which the stand was thinned is considered.

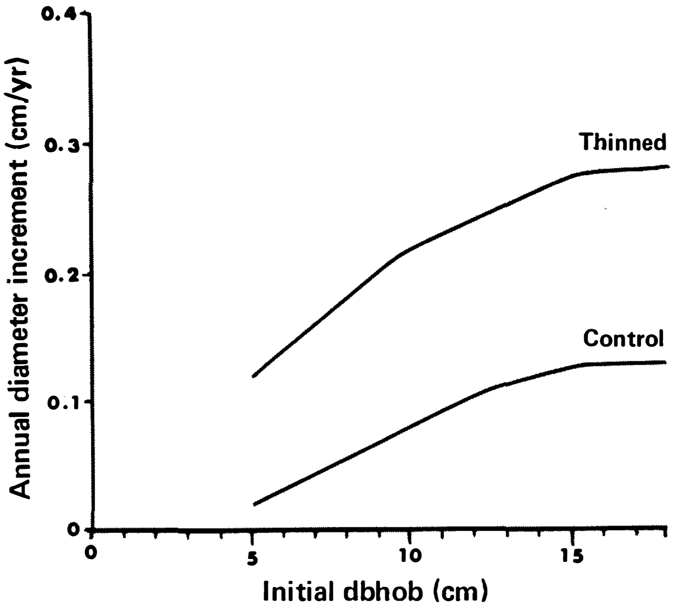

Figure 1. Relationship between periodic (1941-63) annual diameter increment and initial (1941) tree size for thinned and unthinned stands.

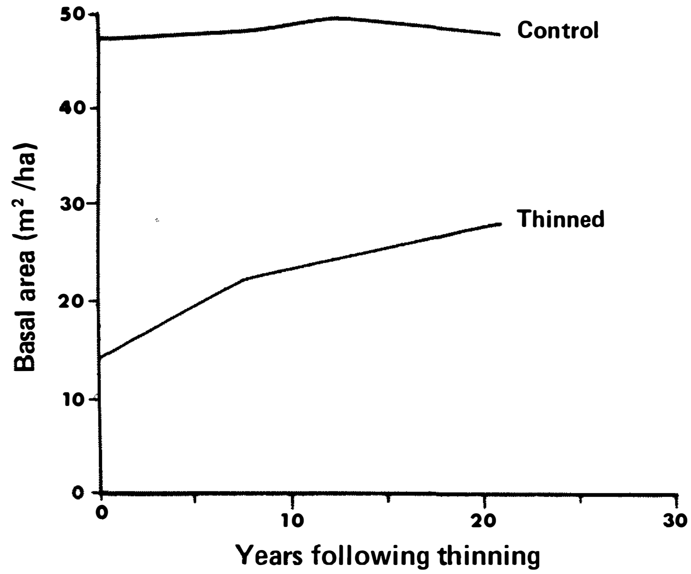

Figure 2. Relationship between basal area development and time following thinning.

Thinning greatly increased both net and gross periodic basal area increments (Table 1). Basal area in the treated stand has doubled since thinning, compared with that in the unthinned stand, where mortality was virtually balanced by increment (Fig. 2). The constancy of basal area in the unthinned stand supports Smithers' (1961) assertion that at about 60 years of age fully stocked pine stands reach a maximum basal area level, consistent with site factors, which remains fairly constant until the stand begins to break up because of overmaturity.

Thinning also had a pronounced effect on the net and gross periodic total volume increments of the stand, increasing them by 50% and 10%, respectively (Table 2). Comparing the 250 largest trees per hectare for the 21 years after thinning, the periodic annual total volume increment in the thinned stand averaged 0.008 m^3/yr (range 0.006 to 0.013 m^3/yr) and in the control stand averaged 0.005 m^3/yr (range 0.003 to 0.010 m^3/yr).

Thinning had a striking influence on mortality in the stands (Fig. 3). During the 21 years since treatment, the number of trees in the thinned stand remained relatively constant compared to a 49.3% decline in the number of trees in the control. The basal area lost through mortality in the thinned stand was only one-tenth the amount lost in the control (Table 1). In terms of volume losses, 30% of the gross increment of the unthinned stand was lost through mortality compared to 4.8% in the thinned stand.

This study shows that thinning will stimulate the growth of older, low-merchantability lodgepole pine trees. Thinning had a pronounced effect on diameter growth (of

Table 1. Effect of thinning on net and gross periodic basal area increment

	Basal area (m^2/ha)	
	Control	Thinned
1941 before thinning	47.27	47.27
Thinnings	-	33.26
1941 after thinning	47.27	14.01
1963 all living trees	47.82	28.10
Net increment 1941-63	0.55	14.09
Net periodic annual increment	0.03	0.67
Mortality 1941-63	8.98	0.92
Gross increment 1941-63	9.53	15.01
Gross periodic annual increment	0.45	0.71

Table 2. Effect of thinning on net and gross periodic total volume increment

	Total volume (m^3/ha)	
	Control	Thinned
1941 before thinning	266.74	266.74
Thinnings	-	187.18
1941 after thinning	266.74	79.56
1963 all living trees	350.91	205.72
Net increment 1941-63	84.17	126.16
Net periodic annual increment	4.01	6.01
Mortality 1941-63	35.83	6.30
Gross increment 1941-63	120.00	132.46
Gross periodic annual increment	5.71	6.31

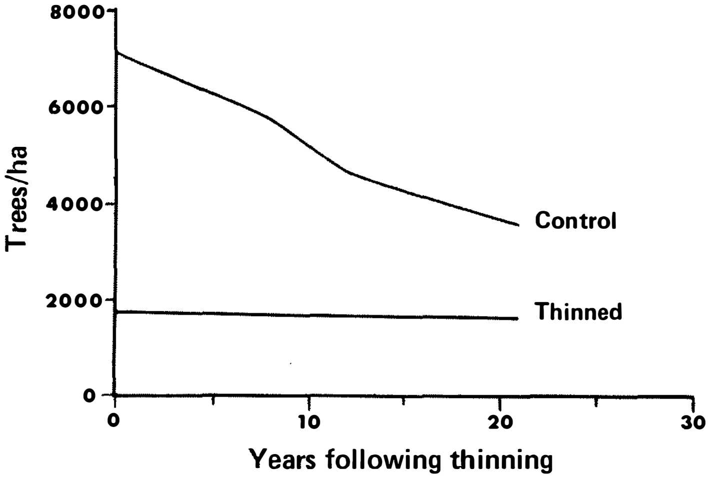

Figure 3. Relationship between stand density and time following thinning.

particular interest in a sawlog economy), increased the net periodic increment in both stand basal area and stand volume, and resulted in a substantial reduction in mortality. Thinning older stands, therefore, may be considered one alternative for relieving future timber supply problems.

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