THIS FILE COPY MUST BE RETURNED

//+++)

Not for publication

TO: INFORMATION SECTION
NORTHERN FOREST RESEARCH CENTRE
5320 - 122 STREET
EDMONTON, ALBERTA
T6H 3S5

THINNING ASPEN, TURTLE MOUNTAIN FOREST RESERVE

by

G. A. Steneker

FOREST RESEARCH LABORATORY
WINNIPEG, MANITOBA
INTERNAL REPORT MS-25

DEPARTMENT OF FORESTRY
APRIL, 1966

CONTENTS

THINNING ASPEN, TURTLE MOUNTAIN FOREST RESERVE

by

G. A. Steneker

INTRODUCTION

Trembling aspen (*Populus tremuloides* Michx.) is one of the most abundant commercial tree species in Manitoba and Saskatchewan. It occupies respectively about one-tenth and one-third of the productive forest land in these provinces. Although the species is abundant, it is highly susceptible to disease, so that in mature stands little can be utilised because of decay. Trembling aspen should therefore be cut before it reaches maturity (Gill 1960) and Kirby *et al* (1957) in Saskatchewan suggests a rotation age of less than 80 years. At such a rotation many trees are still too small to be utilised for veneer and lumber. Aware of the effect of decay on the quality and size of harvested material, the Department of Forestry has been conducting thinning experiments in trembling aspen stands since 1926, with the purposes of increasing individual tree increment so that larger material can be harvested at rotation age, and determining the effect of various stocking densities per acre upon total volume production.

In 1948 a thinning experiment was set up in the Turtle Mountain Forest Reserve in an 11-year-old aspen stand. This report presents growth results to 1965.

LOCATION AND DESCRIPTION OF STUDY AREA

The study area was located in the Turtle Mountain Forest Reserve (map reference: Sec. 31, Twp. 1, Rge. 20 W 1) which forms part of the B18[a] Mixedwood Forest Section (Rowe 1959). The Reserve consists of a series of low morainic hills ranging in height from 1900 to 2500 feet. Topography of the study area is gently rolling and aspect is north. The soils are described as grey-black and grey-wooded podzols of loam to clay loam texture. The fertile soil and a higher than average precipitation for the region produce a luxuriant vegetation. Species occurring in small amounts with aspen are black poplar (*Populus balsamifera* L.), bur oak (*Quercus macrocarpa* Michx.), elm (*Ulmus americana* L.), and green ash (*Fraxinus pennsylvanica* Marsh. var. *subintegerrina* (Vahl.) Fern).

A dense 11-year-old aspen stand, developed after a clear-cutting operation in 1936-37, was selected for study. The average number of aspen per acre was between 3- and 4000; the average diameter at breast height was two inches and average tree height about 20 feet.

METHODS

In 1948 five 1/5-acre permanent sample plots (with 30-feet surrounds) were established. One plot was thinned to a 5 x 5-foot spacing, another to a 7 x 7-foot spacing, on one plot 20-foot wide alternate strips were clearcut in a north-south direction and two plots were left as controls. On the control plots every fourth tree was systematically chosen to be tagged. On the strip-thinned plot all trees in one strip were tagged and on the two other thinned plots all trees were tagged. On all plots the height of a number of tagged trees was measured. Tagged trees were measured to the nearest one-tenth inch diameter breast height. Other trees were tallied by one-inch diameter classes. Reproduction was tallied in each plot on two permanent north-south transects of 14 milacre quadrats each, one transect being 30 feet from the east boundary and the other being 30 feet from the west boundary. On the strip-thinned plot the transects were located in the centre of each of a clear-cut strip. During remeasurements in 1953, 1960 and 1965 all trees, living and dead, were tallied by one-inch diameter classes. Tagged trees were measured to the nearest one-tenth inch and a number of height measurements were taken to construct height-diameter curves. An effort was made to remeasure for height those trees that had been measured in 1948. Where the sample per plot had been reduced substantially, due to mortality, additional trees were taken. Dead trees were blazed or cut. Reproduction was tallied on the permanent quadrats.

RESULTS TO 1965

Diameter and Height Increment

Diameter increment data are based on all tagged trees still alive in 1965. Figure 1 shows by one-inch diameter classes the increase in diameter at breast height from 1948 to 1965 for the four different treatments in 1948. The data show (1) that for all size classes the 5 x 5-foot and 7 x 7-foot spacing resulted in the highest diameter increment, (2) that the larger size classes had grown at a faster rate than the smaller ones, and (3) that diameter increment for all size classes had slowed down gradually since 1953 in all treatments, and particularly in the one- and two-inch classes where the growth rate of the trees on the spaced-thinned plots was approaching that of the trees on the control plots. As a result of thinning, the largest trees in 1965 on the spaced-thinned plots averaged up to two inches larger than the largest trees on the controls in the same year. A high diameter increment of the 3-inch trees on the strip-thinned plot was obtained because the 6 trees comprising the sample were all located along the edge of the uncut strip and as a result showed a more than average increment rate for this size class on the plot. This edge effect on diameter increment is illustrated in Figure 2. One uncut strip, containing the tagged trees, was divided into ten 2-foot wide strips. The average diameter in 1948 and 1965 of all trees living in 1965 within each of the 2-foot strips was calculated (Figure 2). The data show that average diameters in 1965 of trees on the two border strips was greater than that on the other strips, but a definite trend between diameter increment and distance from the border could not be detected in 1965. It would seem therefore that only the trees on the edge of the uncut strips received any stumulus from the strip thinning.

Height increment for each plot has been based on the height of the 20 tallest trees of those that were measured for height in 1948 and 1965. Tree heights between plots in 1948 differed little and averaged about 26 feet. Tree height in 1965 has been related to residual stocking (no. of trees per acre) after thinning in 1948 (Figure 3). For the strip-thinned plot the number of trees before thinning was used, as tree to tree distance within the uncut strips had not been changed by the thinning. The data show

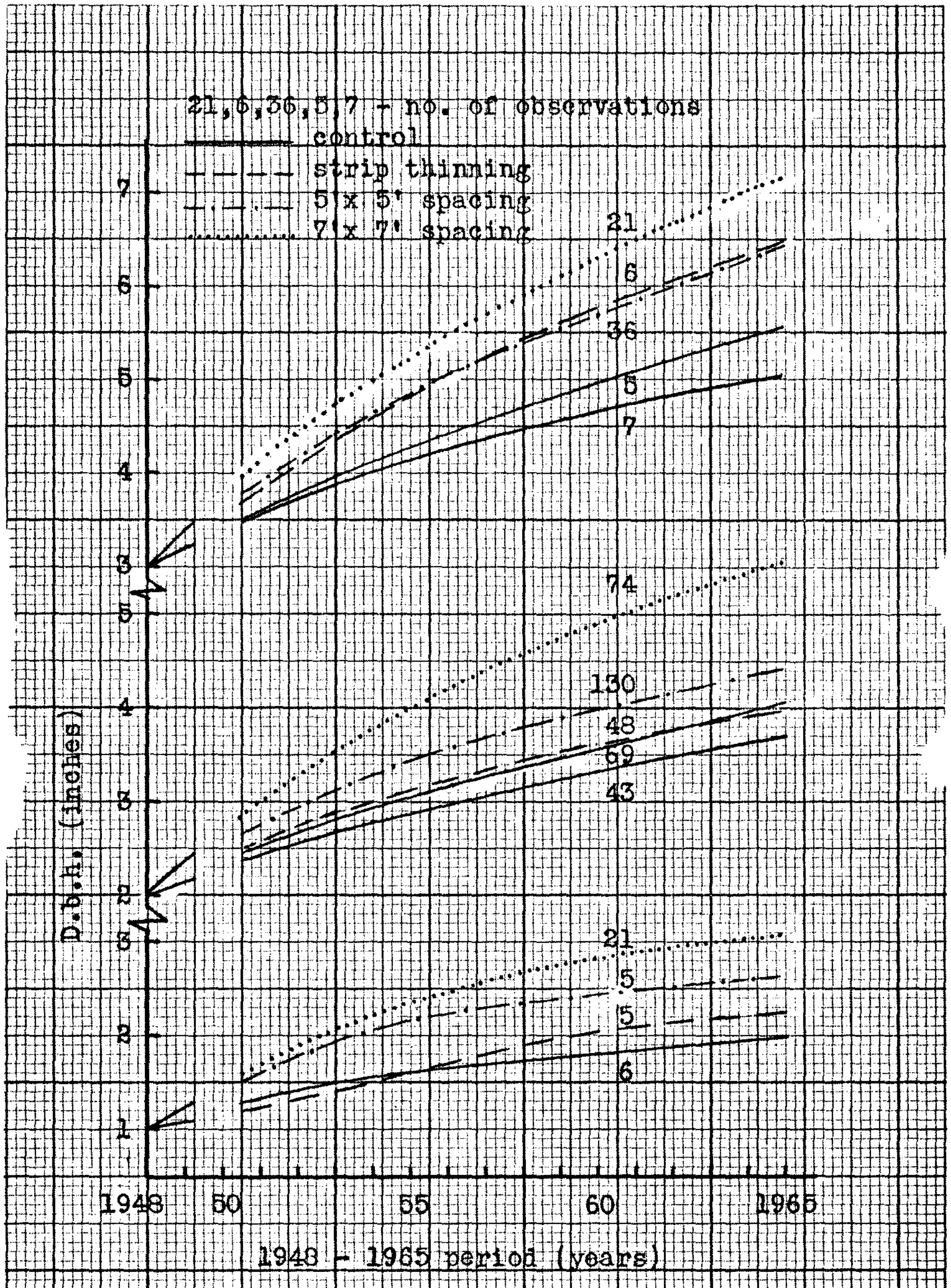

Figure 1. Increment of 1948's 1-inch, 2-inch and 3-inch trees up to 1965, by treatment in 1948.

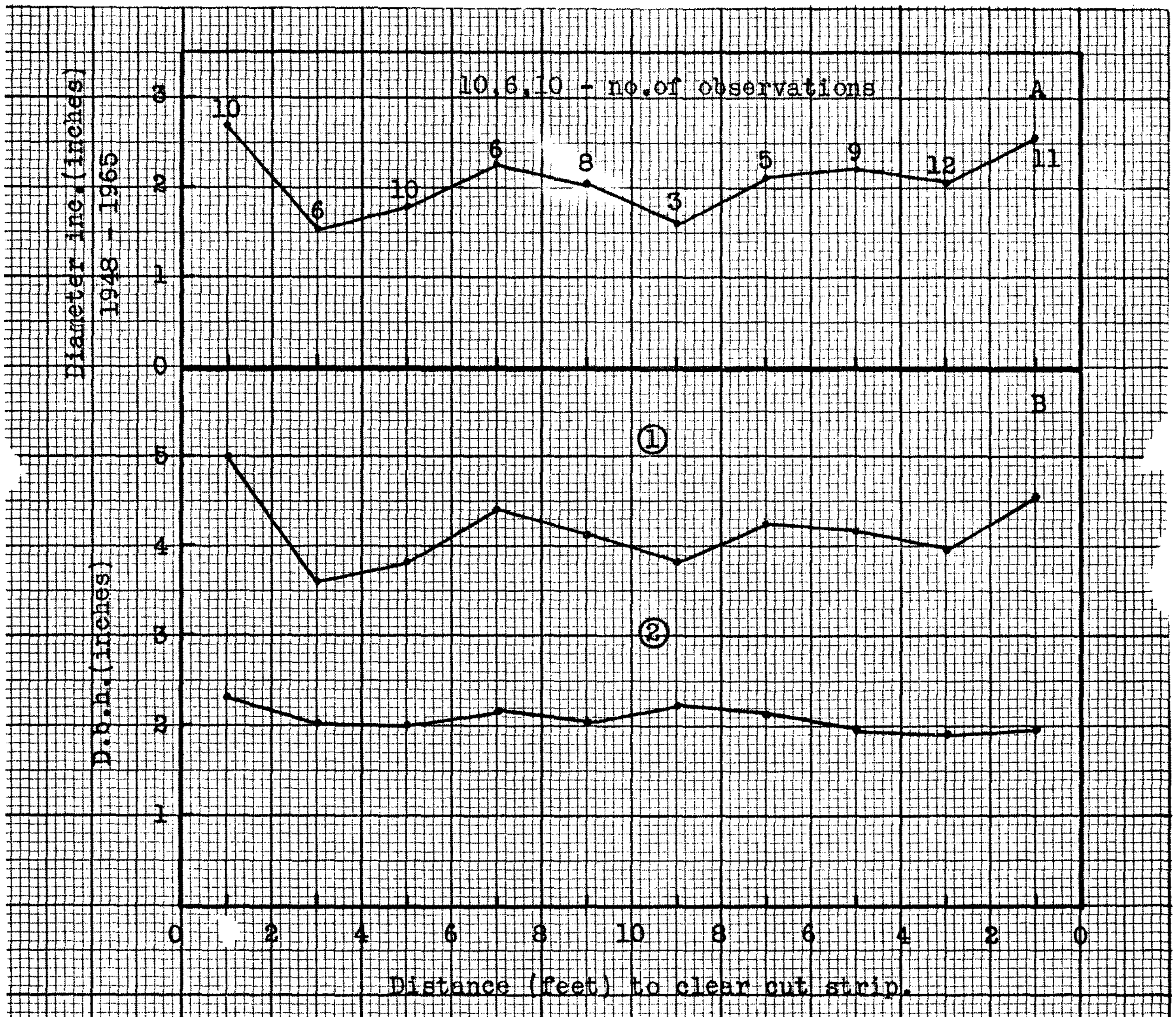

Figure 2. Average diameter in 1948 (B 2) and 1965 (B 1) of all living trees and their periodic diameter increment (A) by 2 foot wide strips in an uncut 20 foot wide strip on the strip thinned plot.

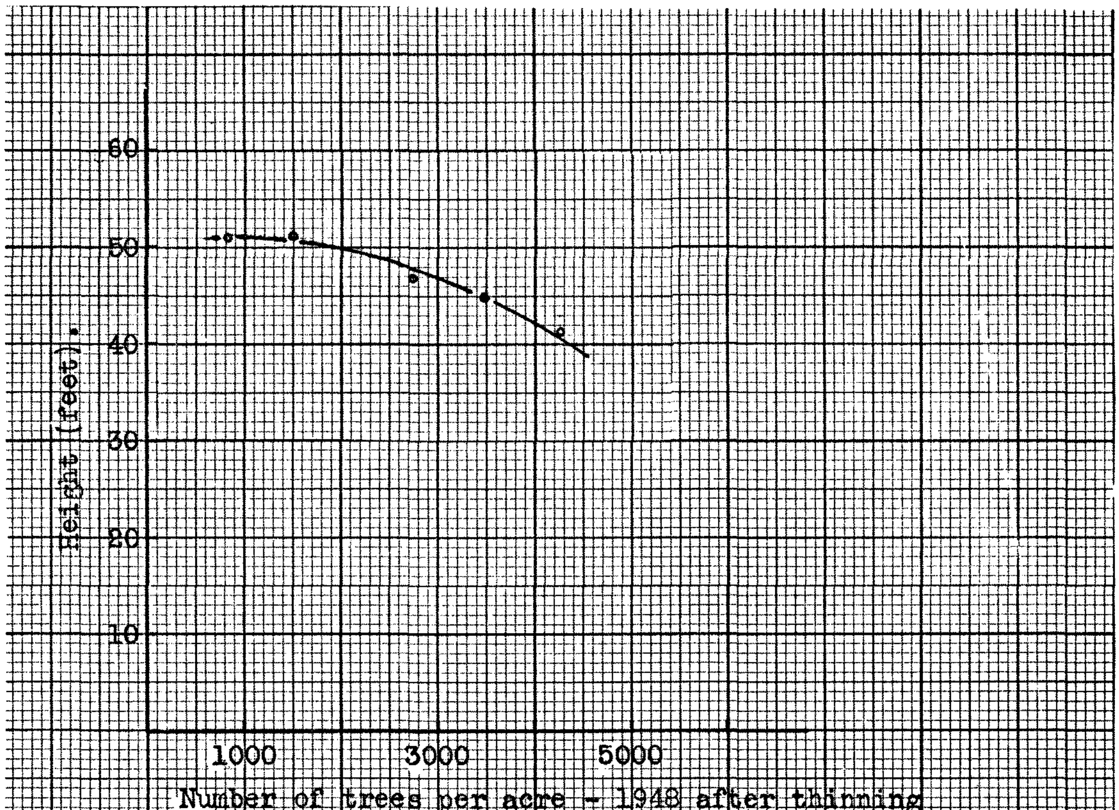

Figure 3. Number of trees per acre after thinning in 1948 per plot related to the height of the 20 biggest trees per plot in 1965 . Basis: 5 plots.

TABLE 1. STAND DATA PER ACRE

Treatment	Plot no.	No. of trees					Basal area (sq.ft.)					Total volume (cu.ft.)[1]					Merch. volume (cords)[2]					Board foot volume[3]
		1948 BT	1948 AT	1953	1960	1965	1948 BT	1948 AT	1953	1960	1965	1948 BT	1948 AT	1953	1960	1965	1948 BT	1948 AT	1953	1960	1965	1965
Control	1	2740	2740	2240	1425	980	44	44	71	88	98	655	655	1256	1877	2326	0.2	0.2	2.4	15.0	24.0	445
Control*	1	60	60	65	55	50	15	15	19	22	24	238	238	343	596	720						
Control	5	3470	3470	2930	1565	1160	70	70	99	106	123	1065	1065	1778	2274	2832	2.0	2.0	7.2	20.0	29.5	1228
Control*	5	35	35	35	35	35	5.3	5.3	5.7	7.7	7.7	95	95	120	186	188						
20' alt. strips	4	4240	2260	1905	1440	930	65	33	55	82	90	937	475	879	1612	1849	0.1	0.1	1.3	10.5	16.8	250
5' x 5'	3	3280	1470	1430	1125	855	54	32	73	107	114	800	474	1322	2328	2771	0.1	0.1	5.3	23.2	32.0	112
7' x 7'	2	3085	805	740	680	585	62	16	47	81	101	951	248	821	1798	2442	1.1	–	4.9	19.5	28.5	2266

* The control plots contain a number of elm, birch and oak. These data have been presented separately

[1] Interpolated volume tables. Canada, Department of Mines and Resources, Dom. For. Serv. Misc. Ser. no. 3. 1944

[2] Volume of peeled stem above 1-foot stump to a 3-inch top diameter inside bark. Table 17. Univ. Minn. Techn. Bull. No. 39. 1934

[3] Stump height 1-foot; log lengths 12.6 and 16.8 feet; top diameter to 6.5 inches. Table 203, Form Class Volume Tables, Canada, Dept. Mines & Resources, Dom. For. Serv., 1948.

TABLE 2. NET PERIODIC BASAL AREA AND TOTAL VOLUME INCREMENT PER ACRE
1948 - 1965

Treatment	Basal Area sq. ft.							Total Volume cu. ft.						
	Standing				Increment			Standing				Increment		
	AT 1948	1953	1960	1965	48-53	53-60	60-65	AT 1948	1953	1960	1965	48-53	53-60	60-65
Control (1)	59	90	110	122	31	20	12	893	1599	2473	3046	706	874	573
Control (5)	75	105	114	131	30	9	17	1160	1898	2460	3020	738	562	560
Strips (4)	33	55	82	90	22	27	8	475	879	1612	1849	404	733	237
5'x 5' (3)	32	73	107	114	41	34	7	474	1322	2328	2771	848	1006	443
7'x 7' (2)	16	47	81	101	31	34	20	248	821	1798	2442	573	977	644

that stocking was inversely related to height increment. However below a stocking of about 1500 trees per acre, height increment did not seem to have been affected by stand density.

Basal Area and Total Volume Increment

Stand data per acre for all plots are given in Table 1. Periodic net basal area and total volume increment between 1948 and 1965 are given in Table 2. The data show that basal area and volume increment up to 1960 were greatest on the 5 x 5-foot thinned plot and between 1960 and 1965 greatest on the 7 x 7-foot thinned plot. Apparently the density on the plot with the 7 x 7-foot spacing was insufficient between 1948 and 1960 for maximum net increment per acre. By 1960 basal area on the 5 x 5-foot thinned plot had increased to a level where further net increment was markedly reduced as a result of mortality, so that the net increment between 1960 and 1965 on the 7 x 7-foot thinned plot surpassed it. In 1948 the strip-thinned and 5 x 5-foot thinned plots had almost identical stocking. However the strip thinning was apparently detrimental to increment per acre as up to 1965, increment on this plot was about 30 per cent less than that on the 5 x 5-foot thinned plot over the same period.

Production to 1965

Total and merchantable volume production (standing volume and thinning in 1948) to 1965 is given in Table 3. To 1953 one of the control plots showed the greatest production. However, up to 1960 and 1965 the 5 x 5-foot thinned plot showed the greatest cubic foot and cordwood production (respectively 12 and 15 per cent greater than the highest control), and the 7 x 7-foot thinned plot showed the greatest board foot production (up to 85 per cent greater than the highest control). Total volume and cordwood production on the strip-thinned plot were reduced by 21 and 30 per cent respectively.

TABLE 3

VOLUME PRODUCTION PER ACRE TO 1965

Treatment	Total volume cu.ft.				Merchantable volume			
	Thinning in 1948	1953	1960	1965	1953	Cords 1960	1965	Bd. ft. 1965[1]
Control (1)	0	1599	2473	3046	2.4	15	24	445
Control (5)	0	1898	2460	3020	7.2	20	30	1228
Strips (4)	462	1341	2074	2311	1.3	10	17	250
5' x 5' (3)	426	426	2754	3197	5.3	23	32	112
7' x 7' (2)	603	603	2401	3045	4.9	20	28	2266

1 The 1960-1965 period was the first during which any substantial bd.ft. volume was produced.

Mortality

Data on mortality between 1948 and 1953 could not be obtained accurately, as dead trees on the plots in 1948 were not blazed or cut in all instances. Table 4 presents the mortality in terms of basal area and total volume for all treatments over the period 1953-1965. Mortality was lowest on the 7 x 7-foot thinned plot. Mortality on the strip-thinned and 5 x 5-foot thinned plot was comparable, but it should be remembered that only 50 per cent of the strip-thinned plot contains trees. Therefore, the 5 x 5-foot thinned plot had in effect the lower mortality of the two.

TABLE 4

MORTALITY PER ACRE 1953-1965.

Treatment	Basal area sq. ft.			Total volume sq. ft.		
	1953-1960	1960-1965	Total	1953-1960	1960-1965	Total
Control (1)	11	13	24	189	217	406
Control (5)	18	13	31	265	201	466
Strip (4)	9	13	22	159	193	352
5'x 5' (3)	10	11	21	184	201	385
7'x 7' (2)	5	4	9	96	96	192

Reproduction

Results from regeneration tallies in 1953, 1960 and 1965, based on 28 permanent milacre quadrats per plot, are given in Table 5 for the three major tree species. Comparatively little aspen regeneration in the form of suckers was left in the open strips on the strip-thinned plot in 1965. Crown vegetation, consisting of willow (<u>Salix</u> spp.), high-bush cranberry (<u>Virburnum trilobum</u> Marsh.), and cherry (<u>Prunus</u> spp.), was dense and vigorous and had apparently suppressed most sucker regeneration. Greatest amount of aspen suckers in 1965 was on the most heavily thinned plot. However, these suckers showed poor form and low vigour. On all plots the amount of bur oak regeneration had increased since 1948. Ash occurred to any extent only on the most heavily thinned plot.

TABLE 5

REPRODUCTION PER ACRE TO 1953, 1960 AND 1965

Treatment	No. of trees								
	Aspen			Bur oak			Ash		
	1953	1960	1965	1953	1960	1965	1953	1960	1965
Control (1)	35	-	464	-	35	500	-	-	143
Control (5)	-	-	821	-	142	1357	-	-	-
Strips (4)	142	1735	357	106	319	464	-	-	-
5' x 5' (3)	-	-	-	-	35	571	-	-	-
7' x 7' (2)	1381	35	1107	-	248	321	283	248	393

DISCUSSION AND RECOMMENDATIONS

To 1965 merchantable volume production on the spaced-thinned plots exceeded that on the controls, although differences were not great. Increases in total volume production, most noticable to 1960, were of little consequence by 1965. Basal area increment and consequently total volume increment on both spaced-thinned plots is declining, and increment on the 5 x 5-foot thinned plot has fallen below that on the 7 x 7-foot thinned plot. Increment on both plots is now approaching that on the controls. Both plots support a stocking in 1965 which at the particular age of the stand (28 years) is higher than that which will produce maximum periodic basal area and total volume increment. Additional thinning to maintain maximum increment will thus be needed. Data from other aspen thinning studies in Manitoba and Saskatchewan (Steneker and Jarvis 1966) have indicated that at an age of 28 years a basal area of about 60 sq. ft. is needed for subsequent maximum basal area and volume increment. It is therefore planned to thin the 5 x 5-foot thinned plot to 60 sq. ft. in the summer of 1966. The 7 x 7-foot thinned plot will be thinned to about 45 sq. ft. and one of the controls to about 90 sq. ft. This will create as complete a range as possible of stocking conditions, so that subsequent increment can be related to various stocking conditions since 1966.

The strip-thinning has been unsuccessful in increasing per acre production and individual tree growth. Although there is indication that trees along the boundary of the uncut strips received some stimulus, this has not been sufficient to overcome the effect of 50 per cent non-utilisation of the plot. Indications are that the cut and uncut strips were too wide. By 1965 crowns of the trees on the uncut borders had still not closed over the cut strips. When future strip thinnings are planned, consideration should be given to 8-10 foot wide alternate strips.

REFERENCES

GILL, C. B. 1960. The forests of Manitoba, Manitoba Dept. Mines and Natural Resources, For. Serv., Man. Div. Forest Resources Inventory Report No. 10.

KIRBY, C. L., W. S. BAILEY and J. G. GILMOUR. 1957. The growth and yield of aspen in Saskatchewan. Saskatchewan Dept. Natural Resources, For. Br., Tech. Bull. No. 3.

ROWE, J. S. 1959. Forest regions of Canada. Canada, Dept. Northern Affairs and National Resources, Forestry Branch, Bull. No. 123.

STENEKER, G. A. and J. M. Jarvis. 1966. Thinning in trembling aspen stands, Manitoba and Saskatchewan. Canada, Dept. of Forestry (in press).