REPRODUCTION AND RESIDUAL STAND DEVELOPMENT FOLLOWING CUTTING IN RED PINE-JACK PINE STANDS IN MANITOBA

Project MS-179

by

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INTRODUCTION[1]

Red pine (Pinus resinosa Ait.) occurs in scattered stands in southeastern Manitoba. Occasional pure stands may be found but it is usually associated with jack pine (Pinus banksiana Lamb). In southeastern Manitoba, red pine usually has better form, is larger in diameter at maturity, and produces a better quality of lumber than jack pine. Thus it is desirable that red pine be favoured in forest management.

In 1954 an experiment was begun in a 50- to 70-year-old red pine/jack pine stand to study some of the factors effecting regeneration and advance growth on clear-cut and on partially cut areas and to determine the effect of release of red pine upon the growth and mortality of the residual trees.

DESCRIPTION OF EXPERIMENTAL AREAS

Two stands, located in the Sandilands Forest Reserve, were selected for the experiment. The area is within the Rainy River Section (L. 12) of the Great Lakes - St. Lawrence Forest Region (Rowe 1959). The stands were composed of varying proportions of red and jack pine and in

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[1]For further details on this project the reader is referred to the publication prepared in 1963 by J. H. Cayford.

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addition scattered trembling aspen (Populus tremuloides Michx.), white birch (Betula papyrifera Marsh.), and white spruce (Picea glauca (Moench) Voss) were present. In 1954 the red pine averaged 64 years in age and the jack pine 60. Site indices at age 50 years were 55 for red pine and 56 for jack pine (Gevorkiantz 1956, 1957).

The experimental area is located between 1,100 and 1,150 feet above sea level and is one of the beaches of post-glacial Lake Agassiz. The topography is flat with the exception of one small area which has a slight westerly slope. Soils are mainly fine - to medium - sand and loamy - sand podzols, well-drained and nearly stone free. Calcareous gray-wooded soils occur on a small portion of the area. These have developed on coarse sand and gravel overlying till.

Throughout the stands herbaceous vegetation is dense, and grasses and bracken are abundant. Shrub density is variable, ranging from very light to dense, mainly depending upon overstory density.

In general the stands were relatively free from serious insect or disease attack. However much jack pine advance growth had been browsed by deer (odocoileus virginianus borealis) causing deformaties and loss of increment.

Fire scars from the years 1905, 1920, and 1930 are common.

EXPERIMENTAL METHODS

Establishment

In each stand two 5-acre cutting units (5 chains by 10 chains) were established. Each cutting unit was divided into three segments; a central partial cut area three chains by 10 chains and a clear cut strip one chain by 10 chains on either side. On the partial cut areas all jack pine and malformed red pine larger than 3.5 inches d.b.h. were removed.

Advance Growth and Regeneration

During the summer of 1964, 320 permanent one-milacre quadrats were examined for advance growth and regeneration. In each cutting unit there were four permanent transects each of which consisted of 20 one-milacre quadrats. On each quadrat the height of the tallest red pine and jack pine regeneration was recorded; a total count was made on every tenth quadrat. Advance growth on each quadrat was recorded as living or dead.

In addition to the permanent transects 4000 temporary milacre quadrats were established on the four cutting units as follows: Each cutting unit was divided into 50 one-chain by one-chain square blocks. Two randomly located transects, each containing 10 one-milacre quadrats, were established on each block. Quadrats were recorded as stocked or not stocked. No differentiation was made between regeneration and advance growth. A total tally was made on every tenth quadrat. Heights were recorded of all red pine and jack pine less than 4.5 feet tall; diameters were taken of trees over 4.5 feet in height and less than 3.6 inches in diameter.

Growth Plots

In the centre of each partial cut area a transect of 10 permanent plots, each one chain by one chain, was established in late June of 1955. All living trees 0.6 inches d.b.h. and over on each plot were tagged, their locations mapped, and their diameter and height measured. The plots were remeasured in late September of 1960 and again during September of 1965.

REPRODUCTION IN 1964

Stocking by Cutting Unit

Stocking to advance growth and regeneration on the four cutting units as based on the permanent transects ranged from 41 to 54 per cent (Table 1). On cutting units 1 to 3 there was more red pine than jack pine stocking, this was reversed on cutting unit 4. Density ranged from 200 to 1,662 stems per acre. Regeneration makes up 67 per cent of the seedlings.

Stocking on the four cutting units as based on the temporary transects was 36 per cent and individual cutting units ranged from 23 to 54 per cent (Table 2). Density for the four cutting units averaged 858 stems per acre and individual areas ranged from 510 to 1,230 per acre. The total number of stems per acre was about equally divided between red pine and jack pine.

Stocking by Residual Stand

Red pine stocking was best between a residual basal area of 50 and 60 square feet per acre (Figure 1). However, stocking was not seriously effected by basal areas as high as 120 square feet per acre. Jack pine stocking was best between a residual basal area of 20 and 30 square feet per acre. Stocking of jack pine declined rapidly with increasing basal area.

Average stocking to either red pine or jack pine on the four cutting units was less than 40 per cent which is the minimum desirable stocking (Candy 1951).

TABLE 1

PER CENT STOCKING AND NUMBER PER ACRE, 1964 - PERMANENT TRANSECTS

Cutting Unit	Per Cent Stocking [1]								
	Advance growth			Regeneration			Advance growth and regeneration		
	jP	rP	jP or rP	jP	rP	jP or rP	jP	rP	jP or rP
1	1.2	6.2	7.5	20.0	28.8	40.0	21.2	31.2	42.5
2	2.5	10.0	12.5	17.5	22.5	33.8	20.0	30.0	41.2
3	25.0	23.8	40.0	3.8	18.8	21.2	28.8	37.5	53.8
4	12.5	8.8	20.0	21.2	13.8	28.8	31.2	22.5	45.0
Average	10.3	12.2	20.0	15.6	20.9	30.9	25.3	30.3	45.6
	Number Per Acre								
	Advance growth [1]			Regeneration [2]			Advance growth and regeneration		
	jP	rP	jP and rP	jP	rP	jP and rP	jP	rp	jP and rP
1	12	62	75	125	0	125	137	62	200
2	25	138	162	250	1250	1500	275	1388	1662
3	688	325	1012	0	375	375	688	700	1387
4	162	88	250	750	250	1000	912	338	1250
Average	222	153	375	281	469	750	503	622	1125

[1] Based on 80 milacre quadrats per cutting unit.
[2] Based on 8 milacre quadrats per cutting unit.

TABLE 2

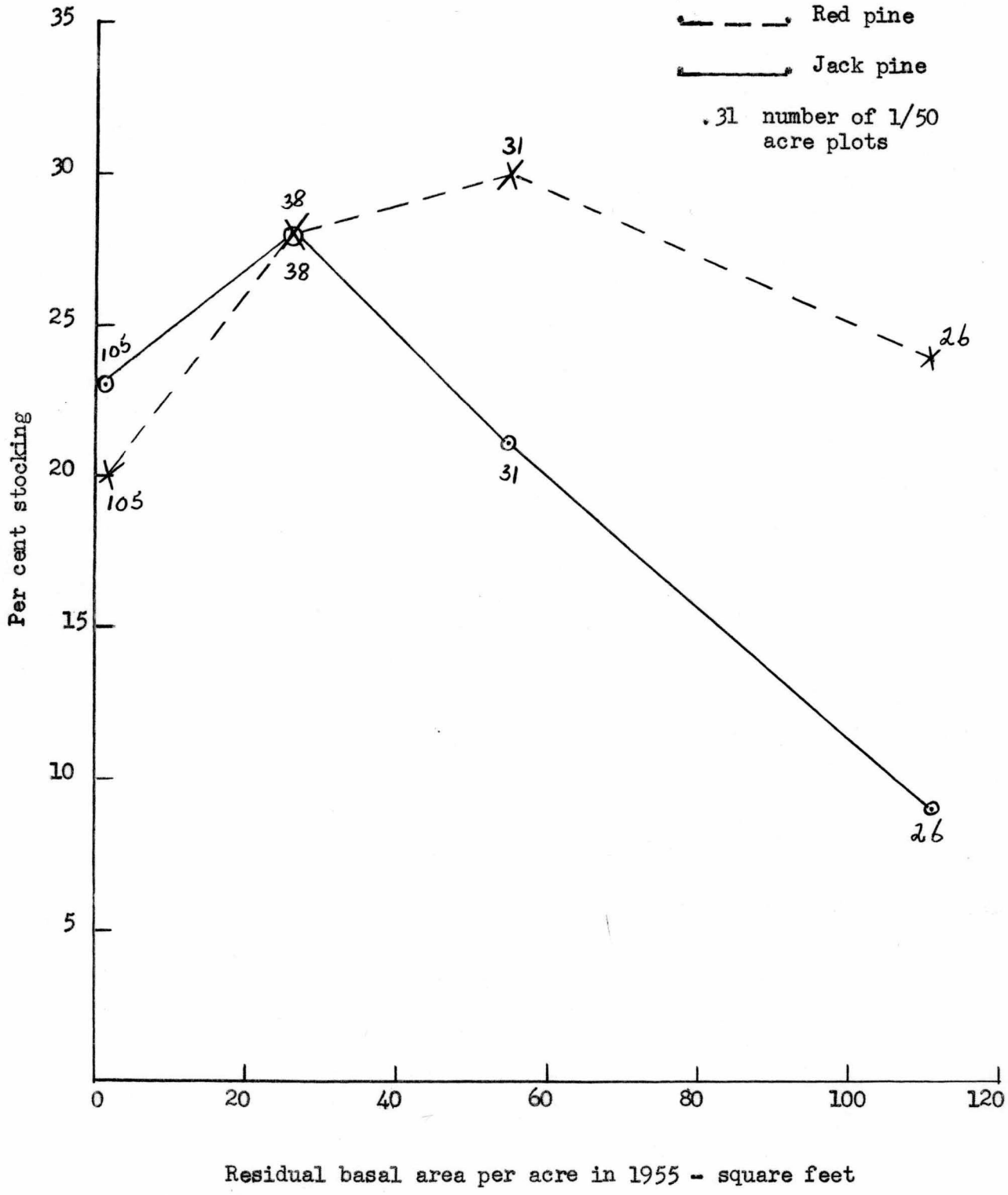
PER CENT STOCKING AND NUMBER PER ACRE, 1964 - TEMPORARY TRANSECTS

Cutting unit	Per cent stocking - Regeneration and advance growth[1]		
	Jack pine	Red pine	Jack pine or red pine
1	11.9	15.2	22.9
2	16.4	21.6	31.8
3	33.5	36.2	53.6
4	25.0	20.8	37.7
Average	21.7	23.4	36.5
	Number per acre - Regeneration and advance growth		
	Jack pine	Red pine	Jack pine and red pine[2]
1	190	320	510
2	460	490	950
3	580	650	1230
4	460	280	740
Average	422	435	858

[1] Based on 1000 milacre quadrats per cutting unit

[2] Based on 100 milacre quadrats per cutting unit

Figure 1. Relationship between stocking and 1955 residual basal area.



Frequency Distribution of Stocking

The distribution of stocking for each cutting unit is shown in Table 3. Fifty-one per cent of the subplots on the four cutting units were understocked or a failure (Candy 1951). Forty-nine per cent of the subplots were moderately to fully stocked.

Stocking was best on cutting units 3 and 4. A total of 78 and 52 per cent respectively of the 1/50 acre plots were moderately to fully stocked. On cutting units 1 and 2 a total of 24 and 40 per cent respectively were moderately to well stocked.

TABLE 3

FREQUENCY DISTRIBUTION OF STOCKING

(Basis: 50, 1/50 acre plots[1] per cutting unit)

Stocking Condition	Percent of 1/50 acre plots				
	1	2	3	4	Total
80 - 100% (fully stocked)			14	6	5
60 - 79% (well stocked)	4	4	22	10	10
40 - 59% (moderately stocked)	20	36	42	36	34
20 - 39% (understocked)	30	36	20	20	26
< 20% (failure)	46	24	2	28	25
Total number of plots per cutting unit	50	50	50	50	

1/ Each 1/50-acre plot consists of a transect containing 20 milacre quadrats.

INCREMENT AND MORTALITY OF RESIDUAL STAND 1955-1965

Volume and Basal Area Increment

Total cubic foot and merchantable board foot volume increment, in cubic feet and board feet respectively, and basal area increment in square feet were calculated for each of the forty 1/10-acre plots for the period from late June of 1955 to September of 1965 and from September of 1960 to September of 1965. Increments for plots grouped by 20-square-foot residual basal area classes are shown in Figures 2 - 4 and in Table 4. Net volume increment increased with increasing residual basal area. Figures 2 and 4 show a drop in total cubic foot and basal area increment for the plot which contained 191 residual square feet per acre after cutting, however, on this plot 15 trees were cut during 1964 and in 1960 their combined basal area was 11.61 square feet per acre.

Volume increments for the ten year period, by individual plots ranged up to 1,384.8 cubic feet and up to 8,650 board feet; basal area increment ranged up to 36.5 square feet per acre.

Diameter and Height Increment

Diameter and height increment for the period 1955-1965 is shown by 2-inch diameter classes for three residual basal area classes in Figures 5 and 6.

Diameter increment for trees in the 121-200 square foot basal area class was less than for trees in the more open stands, particularly for trees less than 10 inches in diameter. Diameter increment in the 1- to 60-square-foot class was greater than in the 61- to 120-square-foot class. Diameter increments by 2-inch diameter classes is related in Table 5 to 20-square foot basal area classes. Diameter increment decreased

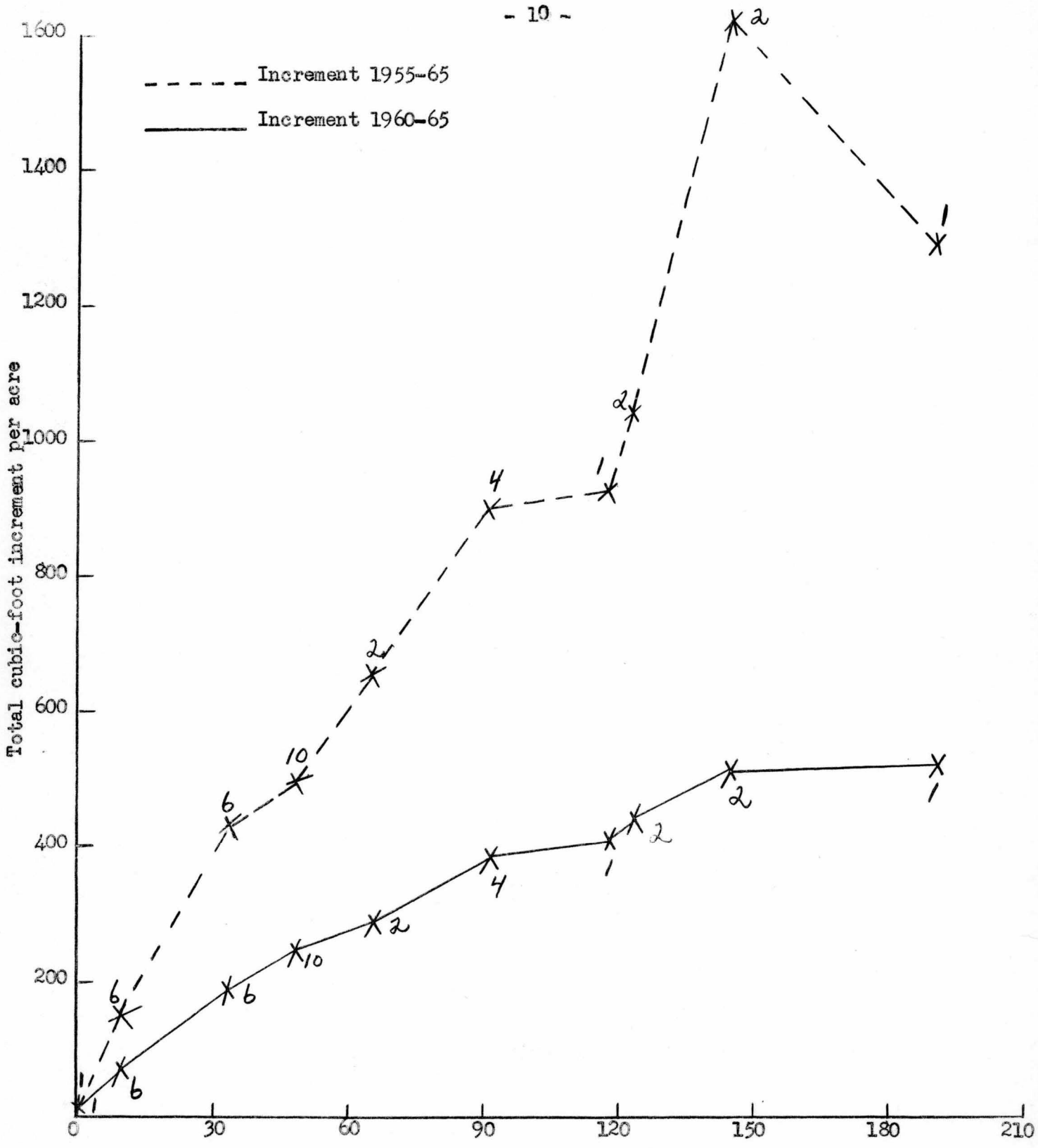
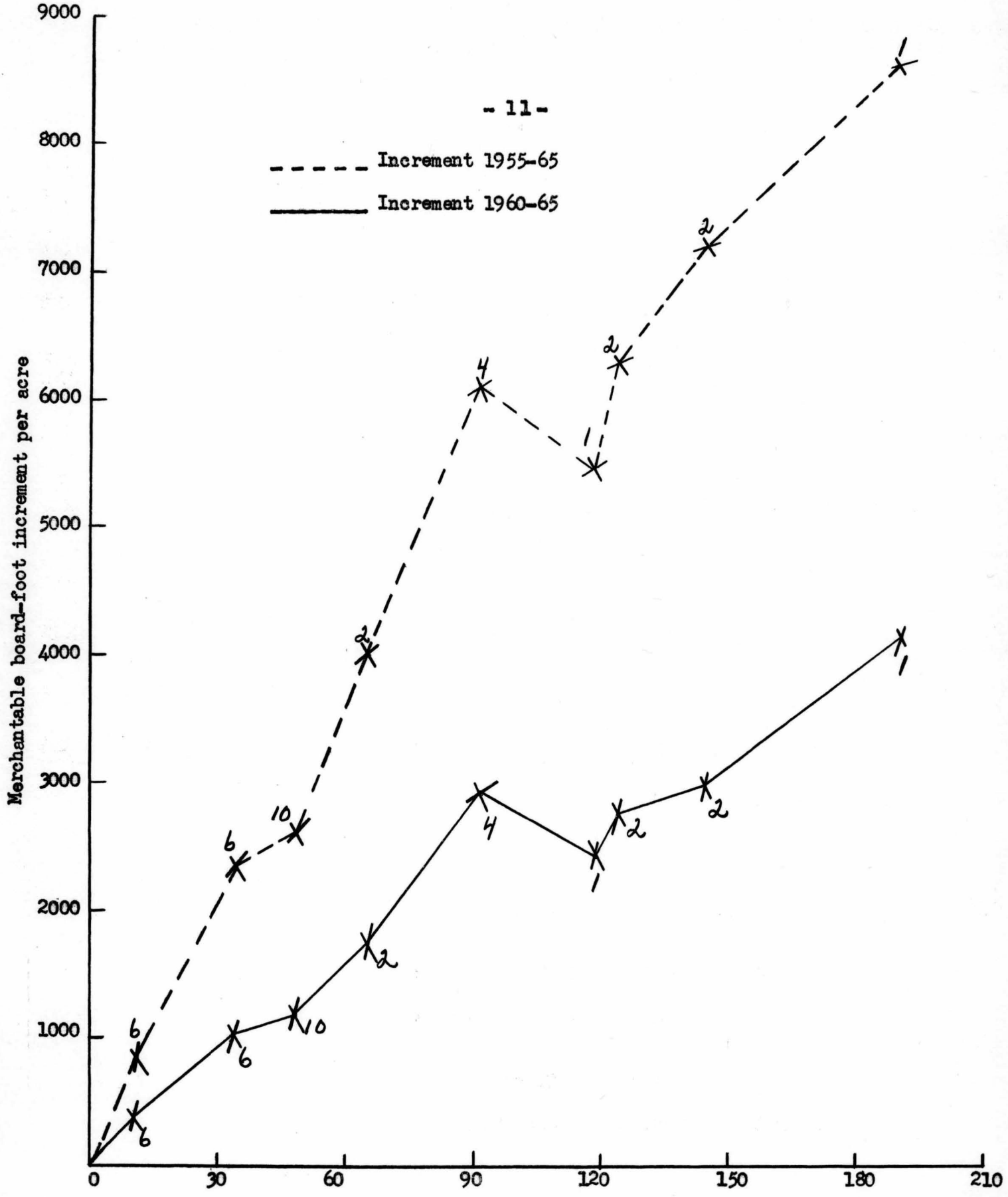
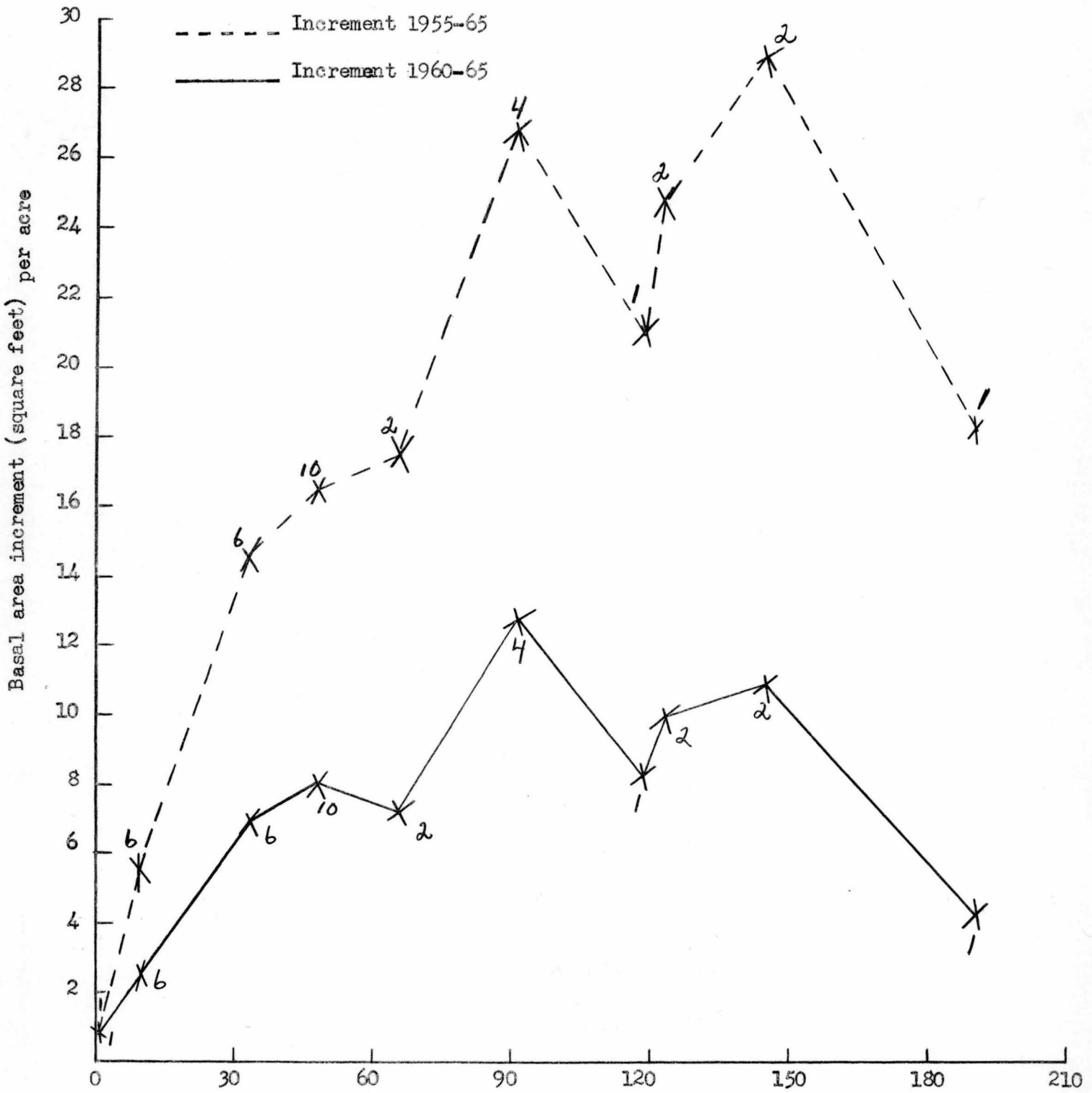


Figure 2. Total cubic-foot volume increment 1955-65 and 1960-65.



Residual basal area per acre in 1955 - square feet.

Figure 3. Merchantable board-foot volume increment 1955-65 and 1960-65.



Residual basal area per acre in 1955- square feet.

Figure 4. Basal area increment 1955-65 and 1960-65.

TABLE 4

VOLUME AND BASAL AREA INCREMENT PER ACRE, 1955-1965

Residual basal area class (sq.ft.)	Basal area (sq.ft.)			Total Vol. (cu. ft.)			Merch. Vol. (bd.ft.)			Basis-no. of plots
	1955	1965	Increment	1955	1965	Increment	~~1960~~1955	1965	Increment	
<1	0.07	0.22	0.15	0.97	2.55	1.58	0	0	0	6
1-20	9.65	15.16	5.51	236.80	387.12	150.32	1062	1887	825	6
21-40	33.46	48.04	14.58	835.00	1264.30	429.30	3923	6242	2319	6
41-60	48.29	64.74	16.45	1211.90	1707.16	495.26	5481	8086	2605	10
61-80	65.72	82.84	17.12	1746.80	2402.55	655.75	8235	12240	4005	2
81-100	91.71	118.55	26.84	2524.80	3425.75	900.95	12080	18205	6125	4
101-120	118.61	139.57	20.96	3076.40	4001.95	925.55	14150	19630	5480	1
121-140	123.37	148.14	24.77	3365.15	4407.15	1042.00	15960	22255	6295	2
141-160	145.36	174.34	28.98	3833.20	5465.50	1632.20	17300	24500	7200	2
181-200	191.15	209.46	18.31	4797.80	6093.40	1295.60	17940	26590	8650	1

with an increase of basal area.

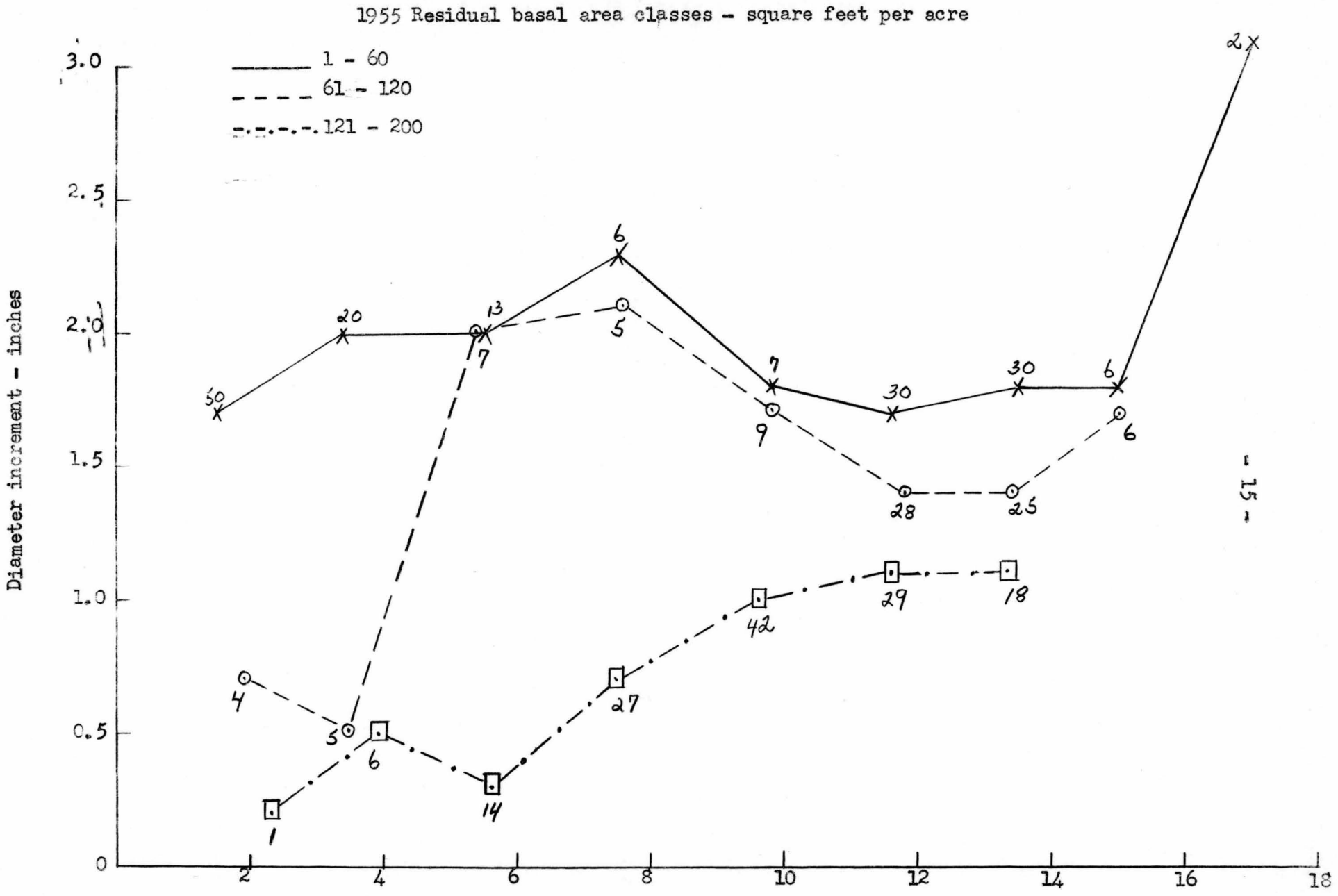
Height increment of trees in the open stands (1- to 60-square-foot class) was considerably greater than in the denser stands for trees 5 inches or less in diameter; this was reversed for trees 10 or more inches in diameter.

TABLE 5

DIAMETER INCREMENT 1955-1965 BY BASAL AREA CLASSES

Basal area class (square feet)	Increment (inches) Diameter in 1955 (inches)				
	3 - 4	5 - 6	9 - 10	11 - 12	13 - 14
1 - 20	2.6	2.8	—[1]	2.9	2.8
21 - 40	2.3	2.5	2.1	2.0	2.3
41 - 60	1.8	1.8	1.8	1.5	1.4
61 - 80	0.4	1.9	2.3	1.3	1.4
81 - 100	—[1]	2.3	1.9	1.6	1.5
101 - 120	0.6	0.8	1.1	1.1	0.9
121 - 140	1.2	—[1]	0.9	1.4	1.1
141 - 160	0.4	0.6	1.0	1.0	1.0
181 - 200	0.2	0.2	1.1	1.0	—[1]

[1] No data



Diameter in 1955 - inches.

Figure 5. Diameter increment for the period 1955 - 1965

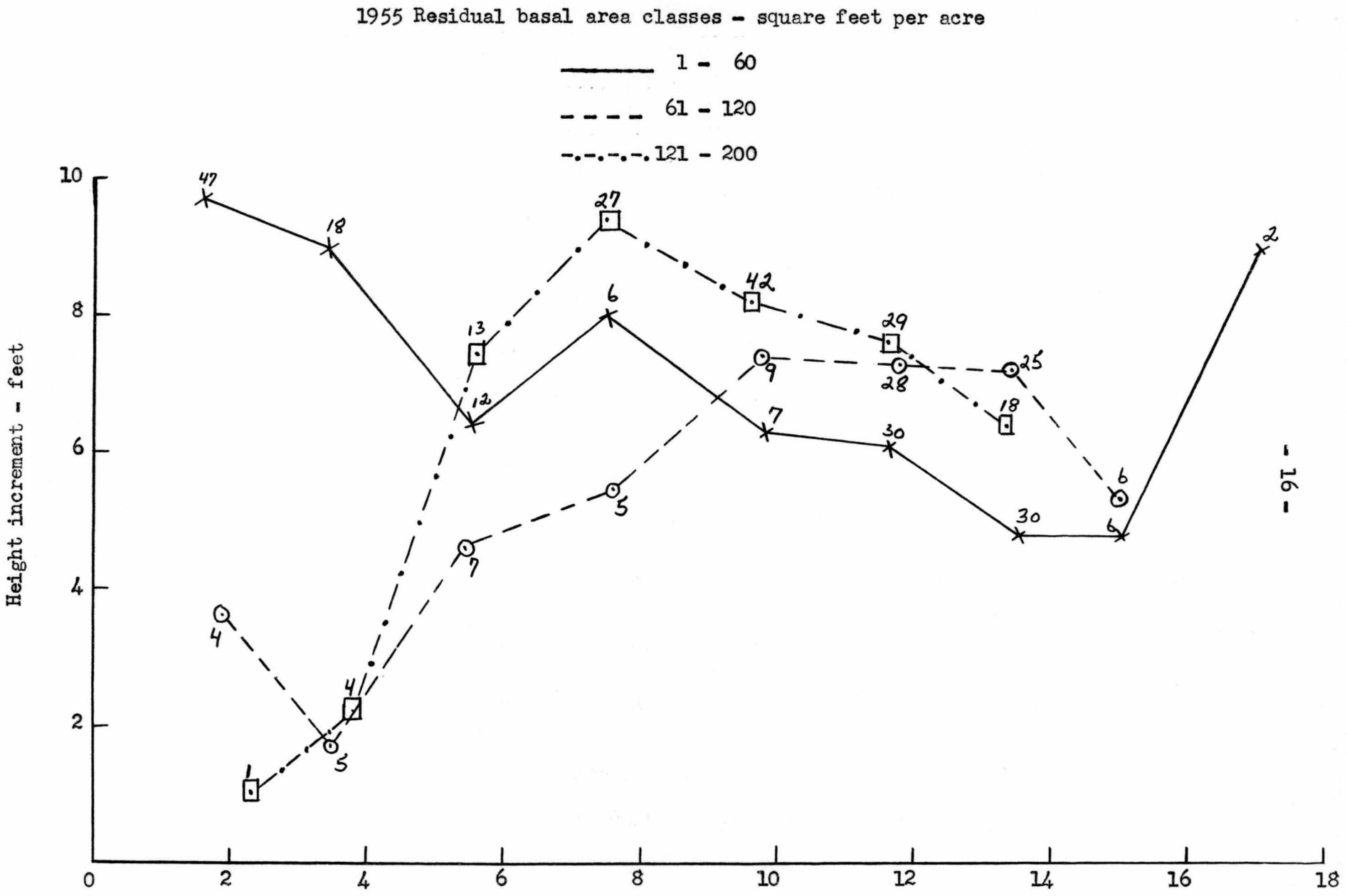


Figure 6. Height increment for the period 1955 - 1965.

Mortality

Mortality of red pine and jack pine for the 1955-65 period is shown in Table 6. Mortality of jack pine for the ten year period was 26.5 per cent and of red pine 7.3 per cent. The 11-inch red pine which died between 1955-60 was fire damaged during the burning of slash piles at the time of logging. Cutting on plot 1 accounts for 75 per cent of the red pine mortality between 1960-65. Of the remaining red pine that died between 1955-65 all were four inches or less in diameter and mortality is largely attributed to suppression.

FUTURE WORK

Cutting units 1 and 2 will be abandoned as the Manitona government is interested in inlucing them in their seed collection area. Cutting unit 2 will however be retained to August of 1967 as part of the red pine seedfall project (MS-193).

Cutting units 3 and 4 will be retained and the next scheduled re-measurement is in 1970.

TABLE 6

MORTALITY OF RED AND JACK PINE 1955 - 1965

Diameter in 1955 (inches)	Red Pine				Jack Pine			
	Number of trees				Number of trees			
	Living 1955	Dead 1955-60	Dead 1960-65	Per cent mortality 1955-65	Living 1955	Dead 1955-60	Dead 1960-65	Per cent mortality 1955-65
1	33	2	3	15.2	33	6	5	33.3
2	31	1	2	9.7	20	2	1	15.0
3	23	4	4	34.8	15	4		26.7
4	29	3	10	44.8				
5	18		1	5.6				
6	17							
7	20							
8	18							
9	25							
10	33							
11	38	1		2.6				
12	50							
13	42							
14	31							
15	11							
16	1							
17	2							
Total	422	11	20	7.3	68	12	6	26.5
Per cent		2.6	4.7			17.7	8.8	

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