

SILVICULTURAL IMPLICATIONS OF MECHANICAL LOGGING ESTABLISHMENT REPORT: Q-138



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FOREST RESEARCH LABORATORY
QUEBEC REGION
INTERNAL REPORT Q-9

FORESTRY BRANCH
MARCH, 1968

Ministère des Forêts et du
Développement rural
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Rural Development





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INTRODUCTION

Although extensive developments have taken place in the field of mechanical logging of pulpwood stands, little quantitative work by research silviculturalists has been carried out to assess the effects of the new logging systems on advance growth, on the degree of soil scarification, and on the quality and quantity of the residual regeneration on the cutover. That little factual data are available is of increasing concern to foresters.

It can be fully appreciated that any project dealing with mechanized logging in eastern Canada involves a vast field. In 1965, after meetings between officials of the Canada Department of Forestry, the Pulp and Paper Research Institute of Canada and several pulp and paper companies, a study was proposed (P.P.R.I.C. 65-2) to investigate the silvicultural implications of mechanical logging. Similar studies were set up by the Department of Forestry in New Brunswick and Quebec. This paper records the establishment of the Quebec study.

OBJECTIVES

These are: a) to assess the damage to the advance growth caused by mechanized equipment; b) to determine the effects of mechanical logging on the quantity and quality of regeneration on the cutovers; c) to assess the degree of soil scarification caused by the logging equipment and d) to set up a series of such surveys in a range of major forest types and logging system combinations.

THE STUDY AREAS

All but one of the eleven study areas reported herein were established in the summer of 1966 by the Forest Research Laboratory, Quebec. With the exception of areas 6, 8, and 9, all areas were remeasured immediately following the logging operation in late summer of 1966. Even with the postcut measurement being carried out immediately following the logging operation, a period of 6 to 8 weeks usually existed between pre- and postcut measurements. As this was during the growing season, a small portion of the advance growth occasionally passed from one size class to the next. Areas 6, 8, and 9 were remeasured in June 1967. Area 11 was established in October 1965 and remeasured in June 1966.

The approximate location of the eleven study areas is shown in Figure 1. More detailed information on forest section, longitude, latitude, company ownership and locality is given in Table 1. Very detailed location maps of each area are registered in the project file.

There were major differences in forest type and stand composition between all areas, and for this reason, each is given in a brief description (Table 2).

METHODS

The method consisted of establishing sample plots on the uncut stand. These plots were remeasured immediately following the logging operation. Subsequent remeasurements of these plots will take place in the 3rd, 5th, and 10th year after logging.

The sampling design was developed by the P.P.R.I.C. The design employed in area 10 was different from all other areas. This was the original method established in 1965 for testing the suitability of the sampling procedure. It was subsequently revised for the 1966 field season, reducing the area from eight to four acres and the size of the sample plots within the block from 1/10th acre plots to 1/50th acre strip plots. Detailed accounts of this original sampling design are registered in the project file.

On the other ten study blocks, a minimum area of four acres¹⁾ was chosen. This was rectangular in shape and was sampled using a system of strips and milacre quadrats. These were selected on sites typical of machine operating conditions. Each area was located so that it incorporated all the usual characteristics of the logging system with the wood going to one landing.

The most common dimension of study area was 5 x 8 chains (Figure 2). Four strips, 20 links wide, were randomly located within a 1 $\frac{1}{4}$ chain grid. Each strip was divided into 8 plots, one chain long, and staked in the field. To determine the stand table all trees greater than one inch d.b.h. were tallied for each of the 32 plots.

The amount and distribution of advance growth up to three inches d.b.h. was based on a milacre quadrat tally. Five groups, of 10 milacres each, were randomly distributed on each traverse line which was the centre line of the tally strip. With four such lines on a 5 x 8 chain study area, this gave a total of 200 milacre quadrats. A tree seedling count was taken on the first quadrat of each group of ten and a presence/absence tally per species was taken on the remaining nine. On all quadrats, advance growth and trees by species were recorded using the following size classes; 0-6.5", 6.6"-18.5", 18.6"-36.5", 36.6"-54.5", 54.6"-0.5" d.b.h., 0.6"-1.5" d.b.h. and 1.6"-2.5" d.b.h. Each milacre strip were permanently marked so that they could be easily located after logging.

During the logging operation records were kept of machine make and model, load size and crew organization (Table 3). Where possible, information regarding weather conditions prior to and during the logging operation were recorded. Photographs of stand type and forest flora were taken prior to logging together with photographs recording ground conditions, seedbed type and residual stand following logging.

1)

In three instances, smaller areas were selected.

In the postcut sampling each strip was relocated from the original stakes or, if these had been destroyed, by chaining. The strip plots were retallied in the same manner as in the precut tally. The groups of milacre quadrats were similarly relocated and tallied.

For the ground condition classification, two samples, each one square link in area, were taken on each milacre quadrat. These were established at each corner of the quadrat on the side adjacent to the traverse line. The ground classification recorded the depth and density of the slash cover, the shading index of that sample and the degree of soil disturbance occurring both within and outside of the machine tire tracks (Table 4). This classification was developed by D. McLean while with Canadian International Paper Company.

In addition to the quantitative survey of the advance growth, a qualitative survey was taken on certain areas. The assay was determined on the ten "extra" quadrats. Because this survey was limited only to certain areas, the results are not contained in this report but are registered in the project file.

RESULTS

The results are presented as case histories of each of the 11 study areas established. Each is described as to the stand (all stems in the 3" d.b.h. class and above) and advance growth (all stems smaller than d.b.h. class 3") present before and after logging together with a description of the ground conditions on the cutover immediately following logging.

Area 1

The Stand: The distribution of stems by diameter classes is shown in Table 5A. Total precut stem density was 858 per acre with 50 per acre remaining after logging.

Advance Growth: Total precut stem density was 15,250 per acre of which 4,063 per acre remained after logging (Table 5B). Precut and postcut stocking for spruce-fir were 95.0 and 41.0 percent, respectively. The percent stocking by size classes is given in Table 5C. Mortality has been high in the first, second and third size class.

Ground Conditions: The dominating above surface soil conditions were light slash, I (5), and slash less than 6 in. deep, I (7). Lack of heavy slash is indicated in Class II where very little shading affects the greatest proportion of the area (Table 5D). The high percentage of area covered in tire tracks was caused by an excess of timber being forwarded across the area. This was the result of the machines forwarding wood from an adjacent area across the study block.

Area 2

The Stand: The distribution of stems by diameter classes is shown in Figure 6A. Total precut stem density was 340 per acre with 13 per acre remaining after logging.

Advance Growth: Total precut stem density was 31,988 per acre of which 7,124 per acre remained after logging (Table 6B). Total pre- and postcut stocking for black spruce were 99.0 and 84.3 percent, respectively. The percent stocking by size classes is given in Table 6C. Logging mortality created the greatest reduction in the smaller size classes.

Ground Conditions: Loose branches, 1 to 2 ft. deep, I (2), characterized the above surface soil condition (Table 6D). Light slash was distributed over 17.4 percent of the area. Much of the soil surface was influenced by shade from this needle bearing slash as indicated in II (2) and II (3). Forty-one percent of the area outside the zone of timber forwarding IV (11) had a buried soil surface, again indicating a distribution of deep slash over the cutover. Little soil disturbance occurred, 22.2 percent having a slightly scraped humus layer with little mineral soil exposure.

Area 3

The Stand: The distribution of stems by diameter classes is shown in Table 7A. Total precut stem density was 629 per acre with 0 per acre remaining after logging.

Advance Growth: Total precut stem density was 18,507 per acre of which 2,302 per acre remained after logging (Table 7B). These figures were predominantly black spruce. Total pre- and postcut stocking for spruce and fir were 100 and 66.0 percent, respectively. The percent stocking by size classes is given in Table 7C. Greatest losses occurred in the smaller size classes.

Ground Conditions: The greatest proportion of the above surface soil condition, I (6), consisted of dumps of scraped humus (Table 7D). Because of the lack of deep slash coverage much of the soil surface was only slightly shaded or exposed as indicated by II (4) and II (5). Twenty-two percent consisted of tire tracks. Again, because of light slash coverage, a small proportion of the total area fell in IV (11); buried soil surface.

Area 4

The Stand: The distribution of stems by diameter classes is shown in Table 8A. Total precut stem density was 428 per acre with 38 per acre remaining after logging.

Advance Growth: Total precut stem density was 47,166 per acre of which 12,392 per acre remained after logging (Table 8B). The black spruce stem density was greatly reduced in the first and second size classes whereas the reduction of balsam fir was relatively uniform throughout. Total pre- and postcut stocking for spruce-fir were 100 and 81.9 percent, respectively.

The percent stocking by size classes is given in Table 8C. Reduction in total stocking was uniform throughout most size classes.

Ground Conditions: Dumps of scraped humus, I (6), dominated the above soil ground condition (Table 8D). The greatest proportion of the slash coverage was less than 6 in. deep. High exposure, II (4 + 5), resulted from the light slash coverage and the lack of many residual trees on the cutover. Because of the poorly drained soil, a significant proportion of the area was in very deep tire tracks, III (4). Outside the skid trails, a moderate amount of humus disturbance occurred but very little mineral soil was exposed.

Area 5

The Stand: The distribution of stems by diameter classes is shown in Table 9A. Total precut stem density was 791 per acre with 229 per acre remaining after logging.

Advance Growth: Total precut stem density was 34,851 per acre of which 16,378 per acre remained after logging (Table 9B). The greatest proportion of the advance growth for both balsam fir and black spruce were in the first two size classes. Overall reduction in stem density was the same for both species. Total pre- and postcut stocking for spruce-fir were 100 and 71.5 percent, respectively. The percent stocking by size classes is given in Table 9C. Stocking to balsam fir was consistently higher than black spruce. Reduction in stocking was highest in the smaller size classes.

Ground Conditions: A high proportion of the above surface soil condition, I (9), remained undisturbed (Table 9D). This resulted from extensive groups of residual trees remaining on the cutover and was not due to a substantial change in the skidding pattern followed by the forwarders. Despite the numerous groups of residual trees, a high proportion of the area was completely exposed, II (5). An average 14.7 percent of the total area consisted of tire tracks and the data indicates that some deep soil disturbance occurred, III (4 + 5). Outside the tracks, little soil disturbance was noted.

Area 6

The Stand: The distribution of stems by diameter classes is shown in Table 10A. Total precut stem density was 1,277 per acre of which 115 per acre remained after logging.

Advance Growth: Total precut stem density was 112,231 per acre of which 21,597 per acre remained after logging (Table 10B). This advance growth was predominantly balsam fir with black spruce as a minor associate. Percent reduction in stem density was similar for both species. Total pre- and postcut stocking for spruce-fir were 100 and 66.2 percent, respectively. The percent stocking by size classes is given in Table 10C.

Ground Conditions: Very deep slash, I (1), covered an extensive area of the cutover (Table 10D). Because of this extensive deep slash, much of the cutover was well shaded, II (1). Tire tracks covered an average 17 percent. Very little of this was in a muck condition although 9.8 percent had been deeply disturbed, III (3). Because of dense slash cover, a high 53.3 percent represents the 'buried' soil condition, IV (11).

Area 7

The Stand: The distribution of stems by diameter classes is shown in Table 11A. Total precut and postcut stem density was 382 per acre with 97 per acre remaining after logging.

Advance Growth: Total precut stem density was 14,507 per acre of which 1,812 per acre remained after logging. Percent reduction in stem density was greatest in the smaller size classes although overall losses were comparatively uniform. Total pre- and postcut stocking for spruce-fir were 93.0 and 46.0 percent, respectively. The percent stocking by size classes is given in Table 11B. Reduction in stocking was greatest in the first size class, diminishing with increase in size. It is evident from the data that balsam fir was the only advance growth component. A preponderance of mountain maple seedlings and saplings were omitted from the results.

Ground Conditions: A very high proportion of the above surface soil condition, I (1), consisted of a 4 ft. deep layer of loose branches and tops (Table 11D). This resulted from large numbers of hardwood species which were felled and not recuperated. Again indicating the presence of deep slash is that 37.3 percent of the total area was subjected to dense shading, II (1). The occurrence of tire tracks was very low. Outside the skid trails, much of the soil surface was 'buried' under deep slash, IV (11).

Area 8

The Stand: The distribution of stems by diameter classes is shown in Table 12A. Total precut and postcut stem density was 497 per acre with 42 per acre remaining after logging.

Advance Growth: Total precut stem density was 9,645 per acre of which 386 per acre remained after logging (Table 12B). These figures were predominantly black spruce. Total pre- and postcut stocking for spruce-fir were 73.5 and 19.0 percent, respectively. The percent stocking by size class is given in Table 12C. The reduction in stocking has been most severe in the smaller size classes.

Ground Conditions: In comparison with the other areas, an average 12.8 percent of this cutover was covered in very deep slash (Table 12D). The natural soil surface class predominated in the above surface soil condition, I (9). Exposure was high in rating with other cutovers. Tire tracks were practically non-existent. This has been due to the scarifying effects of the tires being kept to a minimum where the machines were operating on dry, stabilized soil. Much of the soil outside trails was buried under deep or compacted slash, IV (11).

Area 9

The Stand: The distribution of stems by diameter classes is shown in Table 13A. Total precut stem density was 611 per acre with 171 per acre remaining after logging.

Advance Growth: Total precut stem density was 7,955 per acre of which 927 remained after logging (Table 13B). Reduction in stem density was uniformly high in all size classes. Total pre- and postcut stocking for spruce-fir were 88.0 and 40.0 percent, respectively. The balsam fir was present only as a very minor associate. The percent stocking by size classes is given in Table 13C. Reduction in stocking was highest in the smaller size classes.

Ground Conditions: An average 14 percent of the area was covered in deep slash although the greatest proportion of the above surface soil condition, I (9), fell into the undisturbed class (Table 13D). Despite deep slash coverage, exposure in this area was quite high, II (4 + 5). In comparison with other areas, the percentage of the cutover area in tire tracks was high. Also, the soil disturbance within the tracks has been severe, III (4 + 5). Outside the skid trails, much of the soil surface was buried under slash, IV (11).

Area 10

The Stand: The distribution of stems by diameter classes is shown in Table 14A. Total precut stem density was 537 per acre with 20 per acre remaining after logging.

Advance Growth: Total precut stem density was 133,955 per acre of which 31,258 per acre remained after logging (Table 14B). Balsam fir was the major advance growth component with red spruce as the secondary species. Total pre- and postcut stocking for spruce-fir were 96.9 and 90.6 percent, respectively. The percent stocking by size classes is given in Table 14C. Logging mortality was high throughout.

Ground Conditions: Deep slash I (1), was well distributed over the cutover, with slash of varying depth covering 49 percent of the total area (Table 14D). Because of the extensive slash coverage, shading was high. An average 14.8 percent of the total area consisted of tire tracks in which some deep soil disturbance occurred. Outside the skid trails, much of the soil surface was buried under deep slash, IV (11).

Area 11

The Stand: The distribution of stems by diameter classes is shown in Table 15A. Total precut stem density was 764 per acre with 399 remaining after logging.

Advance Growth: Total precut stem density was 43,938 per acre of which 3,460 per acre remained after logging (Table 15B). Total pre- and postcut stocking for spruce-fir were 95.6 and 53.1 percent, respectively. The percent stocking by size classes is given in Table 15C. Logging mortality was greatest in the smallest size classes.

Ground Conditions: As this area was selectively logged using horses, a great deal of natural cover remained (Table 15D). The large numbers of residual trees provided a considerable amount of shading. Deep slash, I (1), was present but very little ground disturbance occurred. Naturally, no tire tracks were present.

FUTURE WORK

The second post logging survey of the eleven study areas will be carried out in 1968.

FIGURE 1. LOCATION OF STUDY AREAS.

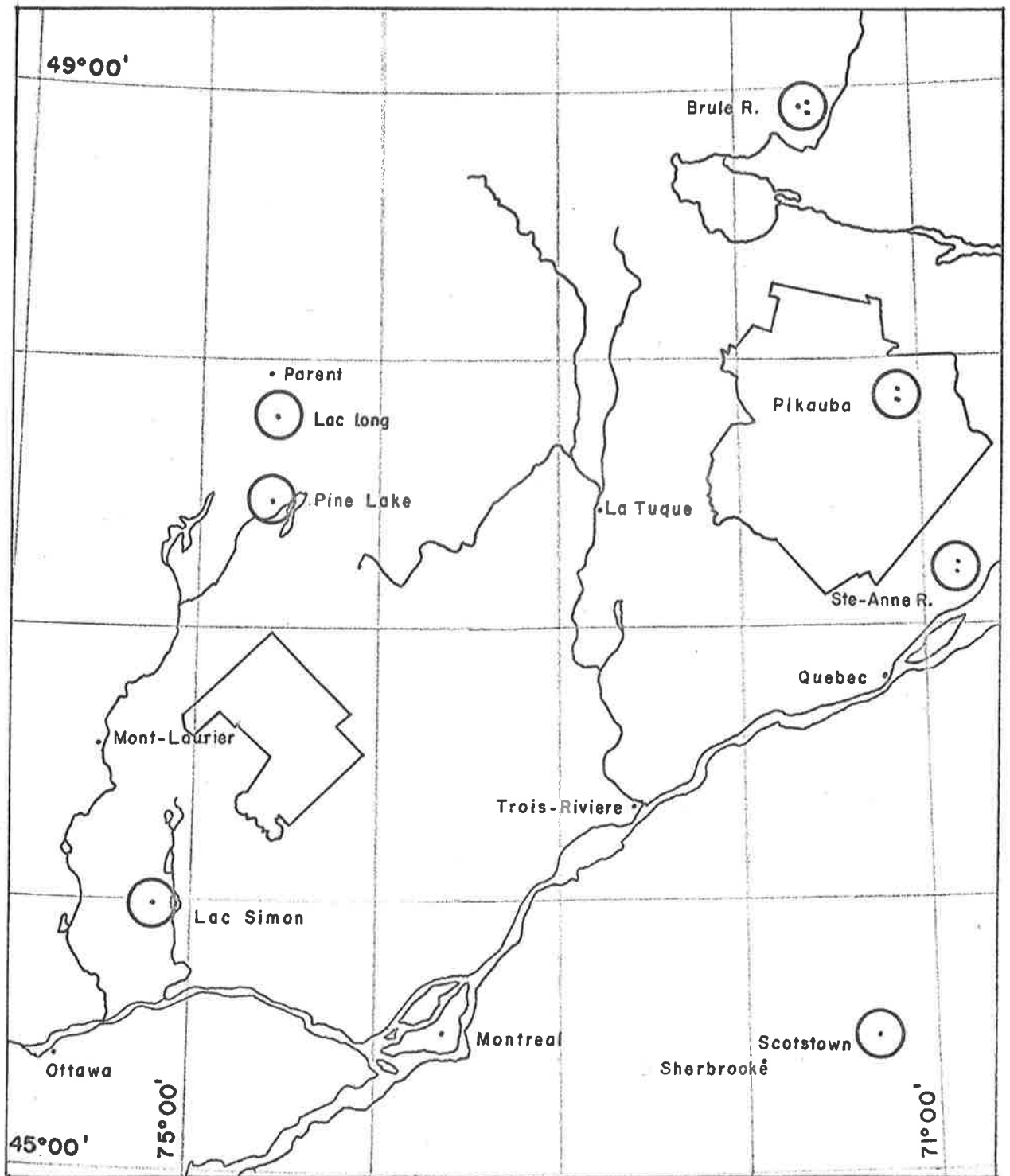
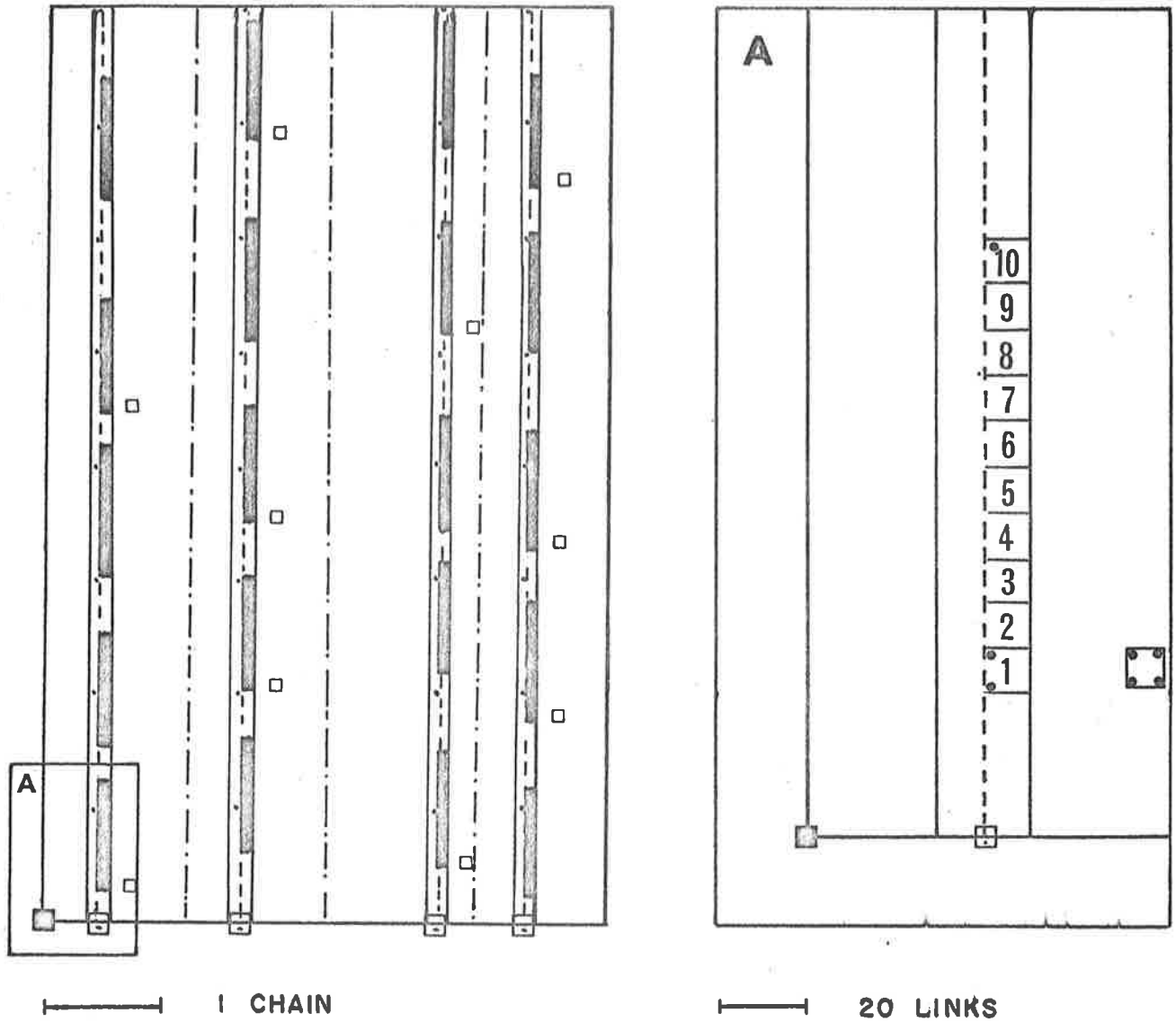


FIGURE 2. SAMPLING DESIGN FOR 4 - ACRE STUDY AREA .



LEGEND

- PAINTED POST (2 FT.)
- PAINTED POST (4 FT.)
- ALUMINIUM PICKET
- EXTRA QUADRAT
- CORNER POST WITH ALUMINIUM PLAQUE
- GRID
- TRAVERSE LINE
- ▬ 10 MILACRE STRIP

Table 1. Location of study areas

Study Area	Forest <u>1</u> / Section	Long.	Lat.	Company	Base Camp, Locality
1	B.1a	48°50'	71°40'	Price Bros.	Camp 5, Brûlé R.
2	B.1a	48°50'	71°40'	Price Bros.	Camp 5, Lac Barnabé
3	B.1a	48°50'	71°40'	Price Bros.	Camp 5, Lac Barnabé
4	B.1a	47°40'	71°10'	Price Bros.	Pikauba, Lac Rond
5	B.1a	47°40'	71°10'	Price Bros.	Pikauba, Cr. Jean-Marie
6	B.1a	47°10'	70°50'	Ste. Anne Paper	Camp 115, Lac Fortin
7	B.1a	47°10'	70°50'	Ste. Anne Paper	Camp 115, Ste. Anne R.
8	B. 7	47°50'	74°40'	James Maclaren	Camp 6, Lac Long
9	B. 7	47°20'	74°40'	James Maclaren	Pine Lake, Camp J.-P. Raby
10	L. 5	45°30'	71°20'	Domtar	Scotstown
11	L. 4	46°00'	75°10'	James Maclaren	Camp 26, Lac Simon

1/ Rowe, J.S. 1959. Forest regions of Canada. Canada, Department Northern Affairs and National Resources, Forestry Branch, Forest Res. Div.
Bull. 123.

Table 2. Description of the eleven study areas

Study Area	Association	Age (years)	Site/Class	Soil Type	Elevation (ft. above sea level)	Aspect	Exposure	Drainage	Slope (%)
1	Black spruce-balsam fir on a <u>Hypnum</u> site type	bS-97 bF-90	II	Glacial till origin; 10 inch organic layer covers a silt loam soil	900	South-east	Moderate	Impeded	2
2	Black spruce on a <u>Kalmia-Ledum</u> site type	bS-126	III	Fluvioglacial origin; 8 inch organic layer covers a very stony, sandy loam soil	700	West	Severe	Impeded	2
3	Black spruce on a <u>Calliargon-Vaccinium</u> site type	bS-124	II	Fluvioglacial origin; a 4 inch organic layer covers a very stony, sandy loam soil	700	West	Severe	Good	3
4	Balsam fir-black spruce on a <u>Hypnum-Hylocomium</u> site type	bF-132 bS-153	II	Till origin; a 12 inch organic layer covers a coarse-textured, sandy soil	3000	East	Severe	Severely Impeded	2
5	Balsam fir-black spruce on a <u>Hypnum-Hylocomium</u> site type	bF-131 bS-146	II	Till origin; a 5 inch organic layer covers a coarse, well drained sandy soil	2700	North-west	Moderate	Good	12
6	Balsam fir-black spruce on a <u>Hylocomium-Oxalis</u> site type	bF-69 bS-98	II	Till origin; a 5 inch organic layer covers a very stony sandy loam soil	3000	North	Severe	Good	5

Table 2. Continued

7	Balsam fir-white spruce-white birch on a <u>Cornus-Mianthemum site type</u>	bF-79 wS-96	I	Till origin; a 4 inch organic layer covers a sandy loam soil	500	North	Severe	Good	10
8	Jack pine-black spruce on a <u>Kalmia-Vaccinium site type</u>	JP-62 bS-51	III	Esker; a 2 inch organic layer covers a coarse, gravelly sand	1800	East	Moderate	Very Good	15
9	Black spruce on a <u>Sphagnum-Ledum site type</u>	bS-122	IV	Glacial drift origin; a 10 inch organic layer covers a sandy loam soil	1200	South	Slight	Severely Impeded	4
10	Balsam fir-red spruce-yellow birch on a <u>Tiarella site type</u>	bF-93 rS-115	--	Till origin; a 4 inch deep organic layer covers a heavy textured, gleyed soil	1300	South-east	Slight	Impeded	3
11	Balsam fir-spruce-maple association <u>on a Dryopteris site type</u>	bF-60	--	Till plain; a 3 inch organic layer covers a sandy loam soil	1100	North-east	Slight	Good	7

1/ Linteau, A. 1955. Forest site classification of the northeastern coniferous section, boreal forest region, Quebec Canada, Dept. Northern Affairs and National Resources, Forestry Branch, Forest Res. Div. Bull 118.

Table 3. Description of logging operation

Study Area	Time of Logging	Logging System	Forwarder used	Mean. No. Trees/Load	Av. d.b.h. of Trees (inches)
1	June	T.L.-R.T. ^{1/}	Tree Farmer C4B	10	6.6
2	August	T.L.-R.T.	Tree Farmer C4B	7-10	7.5
3	August	T.L.-R.T.	Tree Farmer C4B	10	6.9
4	July	T.L.-R.T.	Tree Farmer C4B	10-15	6.6
5	July	T.L.-R.T.	Timberjack 215	10-15	6.9
6	September	Shortwood	Bombardier J-5	--	--
7	August	T.L.-R.T.	Tree Farmer C4B	10	7.8
8	September	T.L.-R.T.	Timberjack D-4	10	6.7
9	September	T.L.-R.T.	Haugh S-7	10	6.4
10	November	T.L.-R.T.	Tree Farmer C4B + Timberjack 215	10-12	7.6
11	August	T.L.	Horse	1-2	6.9

^{1/} T.L.-R.T.; Tree Length - Rubber Tired Skidder.

Table 4. Ground Condition Classification

<u>I</u>	
<u>Above Soil Surface</u>	<ol style="list-style-type: none">1. Loose branches, tree tops 2-4' deep.2. Loose branches, tree tops 1-2' deep.3. Dense compacted accumulation of branches on soil surface.4. Tree boles on soil surface.5. Dump of ground up needles, bark, decomposed wood, and soil components on soil surface.6. Dump of scraped humus.7. Slash less than 6 inches deep or higher slash, if it affords very little shading.8. Rotten wood soil surface.9. Natural soil surface cover.
<u>II</u>	
<u>Shading Index</u>	<ol style="list-style-type: none">1. Heavy slash, usually 2-4' deep, or amongst very dense clump of undergrowth.
High	<ol style="list-style-type: none">2. Slash shade, less dense than No. 1, and does not afford complete shading of some surface. Equivalent influence of topographic position, undergrowth and overhead shade to be taken into account.
Med.	<ol style="list-style-type: none">3. Under birch clump, light shade from slash or saplings.
Low	<ol style="list-style-type: none">4. Partial shading from large trees, shading from topographic position, or light slash.5. Completely exposed.
<u>III</u>	
<u>Soil in Tire Track</u>	<ol style="list-style-type: none">1. Tire track, humus not churned, but humus compacted in place. Original litter and vegetation <u>in situ</u>.2. Tire track on disturbed humus (i.e. slightly mixed) or on scraped humus.3. Tire track on a mixture of soil horizons, deeply disturbed, but not on "muck" condition.

Table 4. continued.

4. Tire track, very deeply disturbed (1-2 ft.), usually filled with water.
5. Tire track, deposit of muck from churning action in wet areas.

IV
Surface-not
in tracks

1. Undisturbed, humus and litter in situ.
2. Humus layer or decomposed wood scraped in winching or skidding. Mineral soil not exposed but roots often exposed.
3. Humus compacted, no evidence of track (extremely rare).
4. Surface soil (mineral soil) exposed.
5. Surface soil mixed with humus.
6. B horizon exposed.
7. Mineral soil superimposed on humus.
8. Rock surface.
9. Stump or root.
10. C horizon exposed.
11. Soil surface buried (i.e. tree bole, dense branch accumulation, dump or ground-up bark and needles).

Table 5A. Area 1; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT			POSTCUT		
	Black Spruce	Balsam Fir	White Birch	Black Spruce	Balsam Fir	White Birch
(Number of trees per acre)						
3	195	71	13	38	6	
4	150	4		6		
5	108	4	4			
6	117		4			
7	67	8	4			
8	54					
9	38					
10	13					
11	4					
Total	746	87	25	44	6	

Table 5B. Advance growth on Area 1; pre- and postcut stem density

Size Class	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	3,625	1,750	875	125
2	4,500	500	1,625	875
3	1,975	500	125	
4	750	500	250	
5	500		125	
1"d.b.h.	237	121	25	13
2"d.b.h.	217	75	19	6
Total	11,804	3,446	3,044	1,019

Table 5C. Advance growth on Area 1; pre- and postcut percent stocking

Size Class	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Balsam Fir	Black	Balsam	Black Spruce & Balsam Fir
	Spruce	Fir		Spruce	Fir	
(Percent stocking)						
1	53.7	52.5	78.8	11.2	8.7	20.0
2	63.7	36.9	73.8	22.5	13.7	30.0
3	55.0	23.7	66.3	6.2	3.7	10.0
4	25.0	13.7	35.0	6.2	3.7	8.8
5	11.2	6.2	21.3	1.2	1.2	2.5
1"d.b.h.	27.5	17.5	38.8	6.2	1.2	7.5
2"d.b.h.	16.5	6.2	22.5	1.2		1.3

Table 5D. Ground condition classes on Area 1 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	3.1	9.4	23.2	33.1
2	16.9	19.4	3.1	6.9
3	10.0	23.1		
4	3.8	23.8	3.1	
5	20.0	19.3		
6	5.6			
7	23.8			
8	3.8			0.6
9	13.0			2.5
10				
11				27.5
Total	100.0	100.0	29.4	70.6

Table 6A. Area 2; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
	Spruce	Fir	Spruce	Fir
	(Number of trees per acre)			
3	48	7	4	2
4	30	3	5	2
5	25			
6	47			
7	60			
8	55			
9	43			
10	17			
11	3			
12				
13	2			
Total	330	10	9	4

Table 6B. Advance growth on Area 2; pre- and postcut stem density

Size Class	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	7,905		286	48
2	14,667	286	2,667	48
3	5,762	48	2,667	
4	1,429	48	857	
5	714		286	
1"d.b.h.	848		198	
2"d.b.h.	271	10	65	2
Total	31,596	392	7,026	98

Table 6C. Advance growth on Area 2; pre- and postcut percent stocking

Size Class	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Balsam Fir	Black	Balsam	Black Spruce & Balsam Fir
	Spruce	Fir		Spruce	Fir	
(Percent stocking)						
1	87.1		87.1	23.8		23.8
2	93.8	0.9	93.8	52.8	0.9	52.8
3	90.9	0.5	90.9	55.7	0.9	55.7
4	59.5	0.5	59.5	41.9	0.5	41.9
5	45.7		45.7	32.3		32.3
1"d.b.h.	45.7		45.7	21.4	0.5	21.4
2"d.b.h.	21.4	0.9	21.9	7.6		7.6

Table 6D. Ground condition classes on Area 2 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	8.6	11.7	9.0	26.9
2	25.7	30.5	8.6	13.6
3	5.0	24.0		
4	7.6	18.1		
5	4.3	15.7		
6	14.5			
7	17.4			
8	0.7			
9	16.2			0.7
10				
11				41.2
Total	100.0	100.0	17.6	82.4

Table 7A. Area 3; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
	Spruce	Fir	Spruce	Fir
	(Number of trees per acre)			
3	9	2		
4	53			
5	81			
6	134			
7	169			
8	122			
9	41			
10	16			
11	2			
Total	627	2	0	0

Table 7B. Advance growth on Area 3; pre- and postcut stem density

Size	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
Class	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	5,850		650	
2	11,200		1,150	
3	1,300		500	
4	150			
5				
1"d.b.h.		2		2
2"d.b.h.	3	2		
Total	18,503	4	2,300	2

Table 7C. Advance growth on Area 3; pre- and postcut percent stocking

Size	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Balsam Fir	Black	Balsam	Black Spruce & Balsam Fir
Class	Spruce	Fir		Spruce	Fir	
(Percent stocking)						
1	79.5		79.5	23.5		23.5
2	83.0	2.5	83.5	60.5	0.5	60.5
3	60.0	1.5	60.5	35.5	0.5	36.0
4	8.0	2.0	10.0	5.0	1.0	5.5
5	1.5	0.5	2.0	0.5		0.5
1"d.b.h.						
2"d.b.h.						

Table 7D. Ground condition classes on Area 3 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	3.7	2.7	5.0	29.8
2	16.0	21.0	16.5	23.5
3		14.5		
4	8.2	23.8	0.2	
5	3.5	38.0		
6	27.5			
7	19.7			
8	2.2			
9	19.2			1.2
10				
11				23.8
Total	100.0	100.0	21.7	78.3

Table 8A. Area 4; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT			POSTCUT		
	Black Spruce	Balsam Fir	White Birch	Black Spruce	Balsam Fir	White Birch
	(Number of trees per acre)					
3	25	79			17	
4	17	39	2		13	
5	46	19	2		4	2
6	116	10	2			2
7	77	13				
8	48	6	2			
9	21	2				
10	2					
Total	352	168	8		34	4

Table 8B. Advance growth on Area 4; pre- and postcut stem density

Size Class	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	6,750	10,187	562	3,250
2	11,688	10,875	1,625	3,188
3	2,750	1,812	1,750	812
4	750	1,187	250	375
5	187	375	125	312
1"d.b.h.	115	165	44	51
2"d.b.h.	50	275	19	29
Total	22,290	24,876	4,375	8,017

Table 8C. Advance growth on Area 4; pre- and postcut percent stocking

Size Class	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Balsam Fir	Black	Balsam	Black Spruce & Balsam Fir
	Spruce	Fir		Spruce	Fir	
(Percent stocking)						
1	81.3	92.5	98.8	41.9	60.0	71.9
2	83.8	91.3	100.0	56.3	69.4	80.0
3	67.5	72.5	92.5	46.3	43.8	70.6
4	31.9	45.0	61.3	16.9	16.9	29.4
5	13.8	21.9	30.6	8.8	9.4	15.6
1"d.b.h.	14.4	29.4	40.0	3.8	5.0	7.5
2"d.b.h.	3.1	18.1	20.6	1.3	1.3	2.5

Table 8D. Ground condition classes on Area 4 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	5.9	9.4	2.2	40.0
2	15.0	12.2	3.8	11.6
3	4.4	23.1	0.9	
4	5.9	20.0	7.1	0.3
5	2.2	35.3	1.9	2.8
6	21.9			
7	19.7			0.6
8	7.5			
9	17.5			1.9
10				
11				26.9
Total	100.0	100.0	15.9	84.1

Table 9A. Area 5; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT			POSTCUT		
	Black	Balsam	White	Black	Balsam	White
	Spruce	Fir	Birch	Spruce	Fir	Birch
	(Number of trees per acre)					
3	41	230	1	16	103	
4	30	137		11	41	
5	19	78		5	23	
6	20	67	2	4	16	
7	17	33			5	
8	31	21			3	
9	20	16	2			
10	9	2			1	
11	9	3				
12		1			1	
13	2					
Total	198	588	5	36	193	

Table 9B. Advance growth on Area 5; pre- and postcut stem density

Size Class	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
	Spruce	Fir	Spruce	Fir
	(Number of stems per acre)			
1	4,000	11,750	1,375	4,937
2	2,450	11,900	1,625	5,125
3	1,150	1,200	625	1,313
4	500	200	250	375
5	250	350	62	250
1"d.b.h.	152	540	63	234
2"d.b.h.	61	348	23	121
Total	8,563	26,288	4,023	12,355

Table 9C. Advance growth on Area 5; pre- and postcut percent stocking

Size Class	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce	Black	Balsam	Black Spruce
	Spruce	Fir	& Balsam Fir	Spruce	Fir	& Balsam Fir
	(Percent stocking)					
1	42.5	96.0	98.0	14.0	45.0	48.0
2	41.5	95.5	96.5	20.5	53.5	58.5
3	31.5	74.0	83.0	13.0	43.5	47.5
4	19.5	48.0	57.5	6.0	16.5	20.0
5	15.0	33.5	42.5	7.5	15.5	21.0
1"d.b.h.	16.0	54.0	64.0	5.5	18.5	23.0
2"d.b.h.	6.5	28.0	32.5	1.5	8.5	9.5

Table 9D. Ground condition classes on Area 5 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	13.5	19.0	3.3	44.5
2	9.5	15.3	6.3	8.5
3	4.8	23.5	0.7	0.5
4	6.8	19.7	1.7	
5	5.7	22.5	2.7	1.8
6	13.5			
7	14.0			
8	5.7			
9	26.5			2.0
10				
11				28.0
Total	100.0	100.0	14.7	85.3

Table 10A. Area 6; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT				POSTCUT			
	Black	Balsam	White	White	Black	Balsam	White	White
	Spruce	Fir	Spruce	Birch	Spruce	Fir	Spruce	Birch
	(Number of trees per acre)							
3	10	316		22		48		6
4	7	287	2	20	1	33		5
5	8	250		13		10		2
6	10	138	2	15		2		2
7	7	75		2		2		
8	5	35	2	2				2
9	2	13		2				
10	8	8	2	1				2
11	2	3	1					
12	1		1					
13								
14	3	2						
Total	63	1,127	10	77	1	95		19

Table 10B. Advance growth on Area 6; pre- and postcut stem density

Size	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
Class	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	1,143	99,762	333	15,810
2	571	9,857	48	5,238
3	48	381		143
4		95		
5		95		
1"d.b.h.	13	84		3
2"d.b.h.	7	175	2	20
Total	1,782	110,449	383	21,214

Table 10C. Advance growth on Area 6; pre- and postcut percent stocking

Size	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Balsam Fir	Black	Balsam	Black Spruce & Balsam Fir
Class	Spruce	Fir		Spruce	Fir	
(Percent stocking)						
1	13.8	100.0	100.0	2.8	63.8	63.8
2	14.8	86.2	87.6	2.8	41.9	42.4
3	3.3	28.6	30.0		5.2	5.2
4	1.4	12.9	12.9		0.5	0.5
5	1.0	7.6	8.6			
1"d.b.h.	0.5	6.2	6.7		1.0	1.0
2"d.b.h.	1.9	15.7	17.1		1.9	1.9

Table 10D. Ground condition classes on Area 6 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	27.4	27.2	0.5	6.7
2	18.6	18.8	5.2	4.5
3	4.8	11.4	9.8	8.1
4	8.1	16.4	0.7	1.0
5	7.9	26.2	0.7	2.4
6	15.2			0.5
7	7.1			1.9
8	1.9			0.7
9	9.0			2.6
10				1.4
11				53.3
Total	100.0	100.0	16.9	83.1

Table 11A. Area 7; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT				POSTCUT			
	White	Balsam	Yellow	White	White	Balsam	Yellow	White
	Spruce	Fir	Birch	Birch	Spruce	Fir	Birch	Birch
(Number of trees per acre)								
3	8	36	6	13	2	13	6	5
4	2	36		12	1	13		2
5	3	22	3	9	1	8	3	5
6		33		6		2		4
7	3	42	2	20		6	2	5
8	2	30		13				5
9	3	20		5		2		3
10		9	3	10			2	3
11		5	3	5			3	
12		3		2				
13		2						
14	2		2	2			1	
15	2			3				
Total	25	238	19	100	4	44	17	32

Table 11B. Advance growth on Area 7; pre- and postcut stem density

Size Class	PRECUT		POSTCUT	
	Balsam	White	Balsam	White
	Fir	Spruce	Fir	Spruce
	(Number of stems per acre)			
1	11,600		1,000	
2	1,000		250	
3	1,000		350	
4	350		100	
5	400		50	
1"d.b.h.	102		32	
2"d.b.h.	55		30	
Total	14,507		1,812	

Table 11C. Advance growth on Area 7; pre- and postcut percent stocking

Size	PRECUT					POSTCUT				
	White Spruce	Balsam Fir	White Spruce & Balsam Fir	White Birch	Yellow Birch	White Spruce	Balsam Fir	White Spruce & Balsam Fir	White Birch	Yellow Birch
1	2.5	80.5	80.5	1.5	0.5	0.5	27.5	27.5	0.5	0.5
2	4.5	49.5	51.0	3.5	2.0	0.5	13.5	13.5	0.5	0.5
3	2.0	34.5	35.5	1.5	1.0		6.0	6.0		0.5
4	1.0	18.0	18.5	0.5	0.5		5.5	5.5		
5	2.0	10.5	12.5	0.5	0.5	1.0	4.0	5.0		0.5
1" d. b. h.		11.0	11.0	0.5			3.5	3.5		0.5
2" d. b. h.	0.5	5.5	6.0	0.5	1.0	0.5	4.5	5.0		1.5

(Percent stocking)

Table 11D. Ground condition classes on Area 7 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	24.6	37.3	1.9	32.9
2	13.3	6.0	1.3	3.3
3	12.8	31.7	0.3	
4	6.3	18.7		
5	5.0	6.3		0.8
6	5.8			0.3
7	14.4			0.5
8	5.0			
9	12.8			2.3
10				
11				56.4
Total	100.0	100.0	3.5	96.5

Table 12A. Area 8; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT			POSTCUT		
	Black	Balsam	Jack	Black	Balsam	Jack
	Spruce	Fir	Pine	Spruce	Fir	Pine
(Number of trees per acre)						
3	52	3	2	10	1	1
4	46	5	20	6		1
5	62		31	9		2
6	33		58	5		2
7	25		45	3		
8	3		66			2
9			34			
10			9			
11			3			
Total	221	8	268	33	1	8

Table 12B. Advance growth on Area 8; pre- and postcut stem density

Size	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
Class	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	3,000	50		
2	4,450		100	
3	1,350	50		200
4	300			
5	250		50	
1"d.b.h.	114	12	17	3
2"d.b.h.	53	16	14	2
Total	9,517	128	181	205

Table 12C. Advance growth on Area 8; pre- and postcut percent stocking

Size	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Fir	Black	Balsam	Black Spruce & Fir
Class	Spruce	Fir	Balsam Fir	Spruce	Fir	Balsam Fir
(Percent stocking)						
1	48.0	3.0	49.0	0.5		0.5
2	60.5	2.5	61.0	6.0	1.0	7.0
3	48.5	2.0	50.0	7.5	2.5	9.5
4	17.5	1.5	19.0	3.0	0.5	3.5
5	16.0	0.5	16.5	4.5		4.5
1"d.b.h.	13.5	2.0	15.5	3.0	0.5	3.5
2"d.b.h.	3.5	1.0	4.5	1.0		1.0

Table 12D. Ground condition classes on Area 8 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	12.8	12.5	0.5	11.5
2	17.5	18.0	4.2	4.7
3	13.2	16.8	3.0	16.2
4	5.5	24.5		3.0
5	19.5	28.2	0.3	3.3
6	7.0			0.5
7	0.5			2.0
8	1.0			
9	23.0			1.0
10				3.5
11				46.3
Total	100.0	100.0	8.0	92.0

Table 13A. Area 9; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT			POSTCUT		
	Black	Balsam	White	Black	Balsam	White
	Spruce	Fir	Birch	Spruce	Fir	Birch
	(Number of trees per acre)					
3	184	3	2	98		2
4	108	2		44	1	
5	117	2		20		
6	86		2	5		
7	36					
8	25					
9	25		2			1
10	11					
11	6					
Total	598	7	6	167	1	3

Table 13B. Advance growth on Area 9; pre- and postcut stem density

Size	PRECUT		POSTCUT	
	Black	Balsam	Black	Balsam
Class	Spruce	Fir	Spruce	Fir
(Number of stems per acre)				
1	1,850	100		
2	3,800		350	
3	1,150		150	
4	250		100	
5	200		50	
1"d.b.h.	341	20	145	2
2"d.b.h.	238	6	124	6
Total	7,829	126	919	8

Table 13C. Advance growth on Area 9; pre- and postcut percent stocking

Size	PRECUT			POSTCUT		
	Black	Balsam	Black Spruce & Spruce & Fir	Black	Balsam	Black Spruce & Spruce & Fir
Class	Spruce	Fir	Balsam Fir	Spruce	Fir	Balsam Fir
(Percent stocking)						
1	64.5	0.5	65.0	3.5		3.5
2	71.0	1.0	71.0	19.0		19.0
3	51.0	1.5	52.0	15.0	0.5	15.0
4	17.5	2.0	18.5	8.5		8.5
5	20.0	1.0	21.0	6.5		6.5
1"d.b.h.	37.5	2.5	38.5	12.5		12.5
2"d.b.h.	16.0	0.5	16.5	8.0	0.5	8.0

Table 13D. Ground condition classes on Area 9 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	14.0	13.4		18.0
2	12.3	11.1	4.3	1.1
3	6.3	11.5	6.6	11.7
4	2.8	32.0	5.1	1.1
5	8.3	32.0	4.8	4.0
6	22.6			0.6
7	0.6			2.3
8				0.9
9	33.1			1.2
10				
11				38.3
Total	100.0	100.0	20.8	79.2

Table 14A. Area 10; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT					POSTCUT				
	Red Spruce	Balsam Fir	Cedar	Yellow Birch	Maples	Red Spruce	Balsam Fir	Cedar	Yellow Birch	Maples
	(Number of trees per acre)									
3	2	37	13	6			4		1	
4	6	53	11	5			4		1	
5	9	63	6	9	1		1		1	
6	9	46	7	4	1					
7	10	47	3	6					1	
8	13	36	2	2						
9	10	26	4	4	1				1	1
10	13	16	1	1	1				1	
11	8	10	1	1	1				1	
12	7	4		1	1					
13	5	2	1	1					1	
14	2		1	2					1	
15	2	1		1						
16										
17				1					1	
Total	96	341	50	44	6		9		10	1

Table 14B. Advance growth on Area 10; pre- and postcut stem density

Size	PRECUT			POSTCUT				
	Red	Balsam	Cedar	Yellow	Red	Balsam	Cedar	Yellow
Class	Spruce	Fir	Birch	Spruce	Fir	Birch	Yellow	Birch
(Number of stems per acre)								
1	24,563	140,560	1,250	1,375	5,625	20,813		187
2	563	14,563	63	313	375	3,813	125	125
3		563		63		188		
4								
5								
1 nd .b.h.		21	8	4		4		1
2 nd .b.h.		34	9	3		2		
Total	25,126	155,711	1,330	1,758	6,000	24,820	125	313

Table 14C. Advance growth on Area 10; pre- and postcut percent stocking

Size	PRECUT					POSTCUT					
	Red Spruce	Balsam Fir	Red Spruce & Balsam Fir	Yellow Birch	Cedar	Spruce	Fir	Balsam Fir	Red Spruce & Balsam Fir	Yellow Birch	Cedar
1	69.4	96.9	96.9	5.6	6.9	44.4	87.5	87.5	87.5	6.8	1.3
2	25.6	55.6	57.5	12.5	5.0	13.1	41.3	41.3	41.9	6.3	1.3
3	3.8	14.4	15.6	5.0	2.5	1.9	10.6	10.6	10.6	1.2	
4		3.8	3.8	0.6	0.6	0.6	0.6	0.6	1.3	0.6	
5	0.6	1.9	1.9	0.6							
1"d.b.h.		1.3	1.3		1.9		0.6	0.6	0.6		
2"d.b.h.		5.0	5.0	0.6	1.3		0.6	0.6	0.6		

(Percent stocking)

Table 14D. Ground condition classes on Area 10 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	15.1	22.3	5.7	17.0
2	16.3	39.5	1.9	2.8
3	12.5	7.8	0.3	
4	14.1	13.2	5.0	
5	11.6	17.2	1.9	2.5
6	0.3			
7	17.6			
8	6.2			
9	6.3			12.0
10				
11				50.9
Total	100.0	100.0	14.8	85.2

Table 15A. Area 11; pre- and postcut stand table for all trees over 2.5" d.b.h.

D.b.h. Class (in.)	PRECUT			POSTCUT		
	White and Red Spruce	Balsam Fir	Maples	White and Red Spruce	Balsam Fir	Maples
(Number of trees per acre)						
3	12	162	44	3	105	28
4	6	125	15	5	84	15
5	17	102	22	2	81	22
6	15	73	14	3	25	13
7	6	38	6	2	5	3
8	14	21	1			
9	8	13				
10	5	6	2			
11		8	3			3
12	2	4				
13	4	2				
14	8					
15	6					
Total	103	554	107	15	300	84

Table 15B. Advance Growth on Area 11; pre- and postcut stem density

Size	PRECUT				POSTCUT			
	Red	Balsam	Yellow	Red	Red	Balsam	Yellow	Red
Class	Spruce	Fir	Birch	Maple	Spruce	Fir	Birch	Maple
1	3,125	34,000	813	4,750	154	2,538		615
2	62	187		813				154
3		63		125				
4								
5								
1 st .b.h.								
2 nd .b.h.								
Total	3,187	34,250	813	5,688	154	2,538		769

(Number of stems per acre)

Table 15C. Advance Growth on Area 11; pre- and postcut percent stocking

Size	PRECUT					POSTCUT				
	Red Spruce	Balsam Fir	Red Spruce & Balsam Fir	Yellow Birch	Cedar	Red Spruce	Balsam Fir	Red Spruce & Balsam Fir	Yellow Birch	Cedar
1	39.4	93.1	93.8	21.9	5.0	8.5	46.9	47.7	6.9	0.8
2	3.8	14.4	17.5	3.1	0.6		1.5	1.5	1.5	
3	0.6	3.1	3.8	3.8						0.8
4		1.9	0.6							
5		2.5	2.5	1.3			1.5	1.5		
1 nd .b.h.	0.6	8.8	9.4			0.8	3.1	3.7		
2 nd .b.h.	3.1	9.4	12.5	0.6		0.8	7.7	8.5		0.8

(percent stocking)

Table 15D. Ground condition classes on Area 11 (% of total area)

Sub Class	Condition Class			
	I	II	III	IV
1	11.3	18.7		49.5
2	20.6	18.3		5.8
3	7.0	33.8		
4	6.2	25.3		
5	14.0	3.9		
6	2.0			
7	15.6			
8	2.3			
9	21.0			3.5
10				
11				41.2
Total	100.0	100.0		100.0