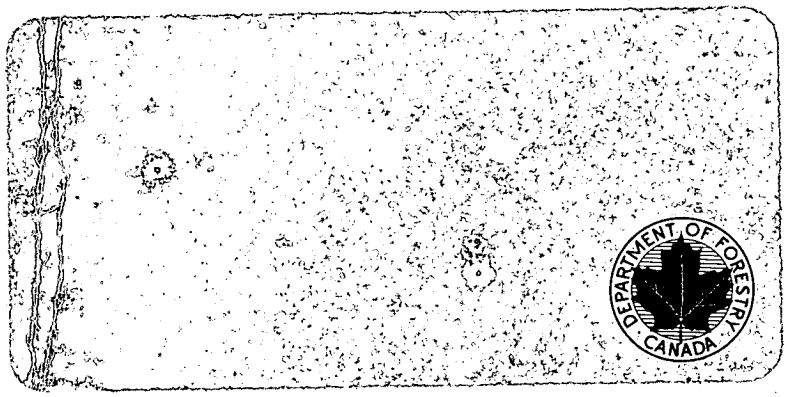

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REGENERATION AND GROWTH FOLLOWING CLEAR CUTTING AND SHELTERWOOD CUTTING OF BLACK SPRUCE ON THE SANDILANDS FOREST RESERVE, MANITOBA

Project MS-162

by

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Progress Report MS-162

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INTRODUCTION

A study was initiated in 1952 in a 60- to 80-year-old black spruce (Picea mariana (Mill.) BSP.) stand growing on the Sandilands Forest Reserve in southeastern Manitoba. Its objectives are to study the effects of clear cutting and shelterwood cutting on growth and mortality of the residual stand and upon regeneration. Five-year results, based on an examination in 1958, have been reported in detail (Cayford 1961, Jarvis and Cayford 1961); this report presents the results of an examination made in 1963, ten years after cutting.

DESCRIPTION OF EXPERIMENTAL AREA

Location

The experimental area is located in the Rainy River Section, L. 12, of the Great Lakes - St. Lawrence Forest Region (Rowe 1959). It is about 50 miles southeast of Winnipeg and situated within the Sandilands Forest Reserve.

Forest Description

The area selected for the experiment supported a well-stocked stand in which about 98 per cent of the trees were black spruce; the remainder were tamarack (Larix laricina (Du Roi) K. Koch), jack pine (Pinus banksiana Lamb.), and eastern white cedar (Thuja occidentalis L.). Black spruce varied

from 65 to 80 years of age, diameters from one to 11 inches, and heights of dominant and co-dominant trees from 50 to 65 feet. The site index at 50 years averaged 36.

Soils and Topography

The experimental area is located on a slight westerly slope. Soils are fine sands overlain by poorly to well-decomposed moss and woody peat that vary in depth from two to more than 36 inches. Sites vary from moist to very wet; moisture regimes were rated from 5 to 8. Ninety-five per cent of the area is very moist or wet, while the remainder is moist or very wet.

Minor Vegetation

Before cutting, minor vegetation consisted primarily of a moss cover with scattered shrubs and herbs. Feather mosses (Calliergonella schreberi (BSG.) and Hylocomium splendens (Hedw.) BSG.) were dominant on moist and very moist sites; scattered small patches of sphagnum (Sphagnum spp.) were also present. On wet and very wet sites, sphagnum was dominant and feather mosses were confined to small patches.

METHODS

The experiment, which consisted of three 4.8-acre blocks, was begun in 1952. One half of each block was clear cut; the other half was cut by the shelterwood system and from 30 to 80 per cent of the merchantable volume was removed. Logging was carried out during the winter of 1952-53 under the supervision of the Manitoba Department of Mines and Natural Resources.

Thirty permanent one-tenth-acre growth plots were established in

1953 and remeasured in 1958 and in 1963. In 1958, 1,008 milacre regeneration quadrats were established; regeneration surveys were carried out in 1958 and in 1963. Presence of regeneration by species and height classes was recorded; a total count was made on approximately 10 per cent of the quadrats. Each quadrat was rated by moisture regime, and its seedbed types listed.

DEVELOPMENT OF RESIDUAL STANDS

Development of the residual stands on clear-cut and shelterwood-cut areas for the ten-year period after logging is summarized in Table 1. Substantial losses in number of trees, basal area and volume occurred on all areas during both the first and second five-year periods.

As reported previously (Cayford 1961) heaviest losses occurred on the area cut most lightly by the shelterwood method. However, this area was directly exposed to a very severe windstorm that occurred in June 1954. Considering the other two shelterwood cuts, losses were much less when 48 per cent of the stand was removed than when 81 per cent of the stand was removed.

Mortality per acre during the period 1953-63 averaged 308 stems on clear-cut areas and 626 stems on shelterwood-cut areas. On clear-cut areas nearly 90 per cent of the mortality occurred between 1953 and 1958; on the shelterwood-cut areas 63 per cent occurred during this period and the remainder between 1958 and 1963 (Table 2).

The most important cause of mortality was a severe windstorm that occurred in June 1954 when storm-force winds with gusts exceeding 70 miles per hour swept across southeastern Manitoba for a two-day period. Another important cause of mortality was a glaze storm that occurred in 1958 (Cayford and Haig 1961). Other windstorms caused some damage, while many suppressed trees died following exposure by logging.

Table 1

Development of residual stands for the ten-year period after cutting
Number of trees, basal area, total and merchantable volume per acre

	Shelterwood cutting	Shelterwood cutting	Shelterwood cutting	Clear cutting
Block number	3	1	2	1 - 3
Merchantable volume before cutting (cubic feet)	1,872	1,352	1,405	1,714
Merchantable volume removed				
(cubic feet)	528	646	1,135	1,713
(per cent)	28	48	81	100
		Number of trees		
1953	612	1,354	968	354
1958	152	1,078	468	81
1963	68	812	180	46
Net change 1953-63	-544	-542	-788	-308
Per cent change 1953-63	- 89	- 40	- 81	- 87
		Basal area - square feet		
1953	80	76	50	11
1958	17	68	30	3
1963	7	61	14	2
Net change 1953-63	- 73	- 15	- 36	- 9
Per cent change 1953-63	- 91	- 20	- 71	- 84
		Total volume - cubic feet		
1953	1,619	1,209	750	126
1958	325	1,116	473	29
1963	124	917	209	18
Net change 1953-63	-1,495	-292	-541	-108
Per cent change 1953-63	- 92	- 24	- 72	- 86
		Merchantable volume - cubic feet		
1953	1,344	706	370	1
1958	261	695	265	2
1963	95	631	136	4
Net change 1953-63	-1,249	- 75	-234	+3
Per cent change 1953-63	- 93	- 11	- 63	+300

Table 2

Mortality between 1953 and 1963 in number of stems per acre

Merchantable volume removed - per cent	Number living trees per acre 1953	Mortality by cause - stems per acre					Total mortality 1953-1963	Number living trees per acre 1963
		Windfall 1954	Misc. 1953-1958	Glaze 1958	Windfall 1958-1963	Misc. 1958-1963		
				Shelterwood cutting				
28	612	334	130	42	12	30	548	68*
48	1,354	136	140	110	14	142	542	812
81	968	292	208	90	32	166	788	180
Avg.	978	254	159	81	13	113	626	350
				Clear cutting				
100	354	106	167	14	1	20	308	46

* includes ingrowth of 4 trees per acre.

REGENERATION

Stocking and Density

Average stocking with black spruce in 1963 was 51 per cent on the shelterwood-cut areas and 38 per cent on the clear-cut areas (Table 3). Comparable figures in 1958 were 31 and 28 per cent, respectively. Stocking increased between 1958 and 1963 by 64 per cent on the shelterwood-cut areas and by 35 per cent on the clear-cut areas. For both cutting methods there were somewhat over 1,000 black spruce stems per acre. There was practically no regeneration of the other species.

Black spruce regeneration increased on both clear-cut and shelterwood-cut areas as soil moisture regime increased. On shelterwood-cut areas all sites were moderately stocked[1] or better, while on clear-cut areas only wet and very wet sites achieved this level of stocking (Table 4).

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[1] According to Candy's (1951) standards. Fully stocked 80-100 per cent, well stocked 60 to 79 per cent, moderately stocked 40 to 59 per cent, understocked 20 to 39 per cent, and failure under 20 per cent.

Table 3

Summary of regeneration,[1] ten years after logging

Treatment	Per cent stocking[2]				Number of stems per acre[3]			
	Black spruce	Jack pine	Cedar	Tamarack	Black spruce	Jack pine	Cedar	Tamarack
Shelterwood cut	51	<1	0	<1	1,143	48	0	48
Clear cut	38	1	1	0	1,387	0	0	0
Both	44	1	<1	<1	1,264	24	0	24

1 Regeneration is considered as all stems that originated after cutting. Observation in 1958 indicated that advance growth was sparse in the cut-over stands.
2 Per cent stocking is based on 500 milacre quadrats
3 Number of stems per acre is based on 62 to 63 milacre quadrats

Table 4

Summary of black spruce regeneration stocking by soil moisture regime

Treatment	Soil moisture class and regime				
	Moist[5]	Very moist[6]	Wet[7]	Very wet[8]	All
	Per cent stocking				
Shelterwood cut	41.7	46.0	60.2	100.0	50.8
Clear cut	16.7	25.4	49.2	87.5	37.8
Both	29.2	37.4	53.5	91.7	44.3

Seedling Size

Seedlings were larger on clear-cut areas than on shelterwood-cut areas (Figure 1). Over forty per cent of the stocked quadrats on clear-cut areas had seedlings greater than 24 inches, whereas the corresponding figure for shelterwood-cut areas was only 10 per cent.

Size of seedlings also varied with site, with an increase in

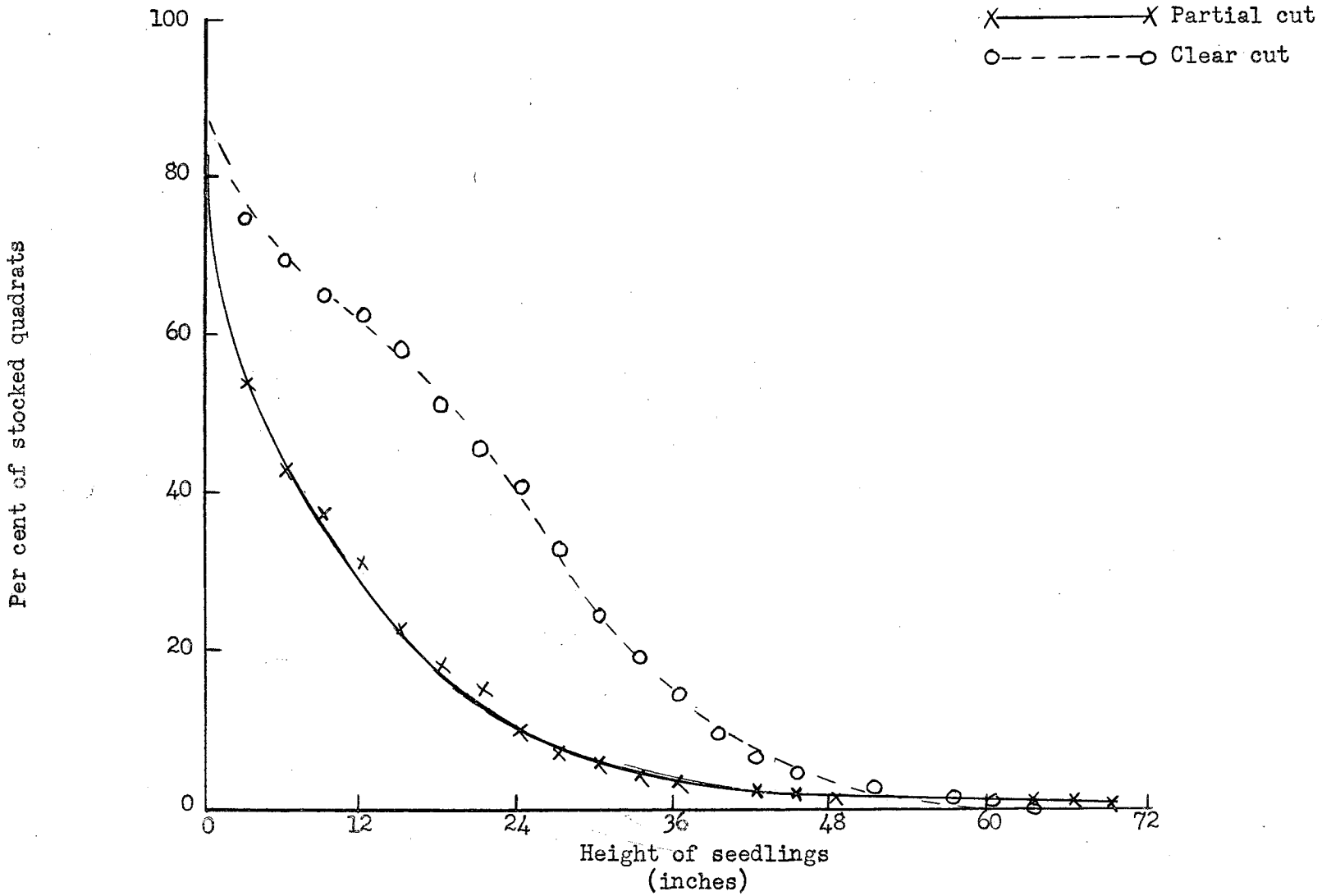

Figure 1. Cumulative frequency curve of stocked quadrats by seedling height classes.

Basis - Tallest seedling on 443 stocked quadrats.

size as soil moisture regime increased. The average height of the tallest seedling per stocked quadrat ranged from 6.9 inches on the moist site, to 26.5 inches on the very wet site.

Effects of Seedbed

The occurrence of seedbed types on the cut-over areas and the per cent of black spruce seedlings growing on each is shown in Table 5. Favourable seedbeds for black spruce were decayed wood, sphagnum and hair-cap moss (Polytrichum commune Hedw.). Feather moss was intermediate, while litter and slash were definitely unfavourable.

The occurrence of the various seedbed types on the different soil moisture regimes is shown in Table 6. Sphagnum, a very favourable seedbed, was common on wet and very wet sites, but relatively uncommon on the moist and very moist sites. The other favourable seedbeds, decayed wood and hair-cap moss, were scarce on all seedbeds. The increase in stocking with increasing moisture regime is primarily attributable to the greater abundance of sphagnum on the wetter sites.

Table 5

Occurrence of seedbeds and black spruce seedlings on cut-over areas[1]

Seedbed type	Seedbed occurrence[1] per cent	Seedling occurrence[1] per cent	Ratio seedlings/ seedbed
Decayed wood	0.2	2.5	12.50
Sphagnum	8.5	32.9	3.87
Hair-cap moss	1.0	1.9	1.90
Feather moss	22.7	36.1	1.59
Litter	56.8	26.6	0.47
Slash	9.2	0	0
Others	1.6	0	0

[1] Data based on an examination of 124 quadrats.

Table 6

Occurrence of seedbeds by soil moisture regime

Moisture regime	No. of quadrats	Seedbed type					
		Spragnum	Hair-cap moss	Feather moss	Litter	Slash	Others
		Per cent occurrence					
5	3	3	3	20	47	24	3
6	68	3	1	24	60	10	2
7	51	16	1	21	53	8	1
8	2	15	0	25	60	0	0

DISCUSSION

Results after ten years generally substantiate those obtained at the five-year remeasurement. They indicate that shelterwood cutting in black spruce can result in severe windfall and mortality, and that only a very light cut will reduce the risk of windfall. Moreover, it it has also been shown that seedling development beneath a canopy is much reduced, and it follows that some form of clear cutting should be used in black spruce. It is also evident that on the moist and very moist sites suitable seedbeds must be prepared if natural regeneration is to be successful.

SUMMARY

In 1952 an experiment was initiated in a 60-to 80-year-old pure stand of black spruce on the Sandilands Forest Reserve in south-eastern Manitoba. Its purposes are to study the effects of clear cutting and shelterwood cutting on development of the residual stand and on regeneration. An examination in 1963 provided the data for this report.

During the ten-year period after cutting substantial losses occurred in number of trees, basal area, and total and merchantable volume on both clear-cut and shelterwood-cut areas. Most losses were attributable to a windstorm in 1954 and a glaze storm in 1958.

Average stocking of black spruce regeneration averaged 51 per cent on shelterwood-cut areas, and 38 per cent on clear-cut areas. Seedlings occurred more frequently on wet and very wet sites because of a greater abundance of favourable seedbeds. Seedlings were much smaller when growing under an overstorey canopy than in the open.

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