

FOREST RESEARCH BRANCH



REGENERATION STOCKING
IN
BLACK SPRUCE CUTOVER
AND
CUTOVER AND BURNED STANDS
IN
QUEBEC.
(Q-115)

by

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TABLE OF CONTENTS

	<u>Page</u>
Introduction	1
Method	1
Results	4
Discussion	6
References	8

REGENERATION STOCKING IN BLACK SPRUCE CUTOVER
AND CUTOVER AND BURNED STANDS IN QUEBEC.

R.J. Hatcher^{1/}

INTRODUCTION

In January 1964 an assessment of silvicultural problems relating to management of black spruce in Quebec was prepared (Hatcher, 1964.) This assessment, made after 5 weeks travel and study in Quebec's Forest Sections B.1a and B.1b, provided much information for use in the preparation of a research program. However, regeneration success or failure in cutovers and burns could not be properly assessed owing to a lack of reliable data.

During the summer of 1964, the author studied regeneration stocking in black spruce cover types, both in logged stands and logged stands that subsequently burned. The aim was to provide data for use in deciding what priority should be given to research in regeneration silviculture in relation to the whole program. The results of the 1964 study are presented herein in tabular form.

METHOD

Study stands were selected from 5 forest concessions ranging from Chibougamau in the west (49°40'N, 74° 05'W) to Baie Comeau in the east (49°40'N, 68°20'W). Within each concession, areas for study were selected in the office from maps delineating cutovers by year. Within a given year of cutover, samples were taken through the range of physiographic sites encountered.

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Sampling was limited to stands where black spruce formed an ocularly estimated 50 per cent or more of the original stand volume. Efforts to identify the site type for each stand were unsuccessful. Slightly more than half the 96 sample stands were pure black spruce, and their distribution by condition was as follows: Clear cut 63, clear cut and burned 26, burned and salvage cut 5, burned (uncut) 2.

Regeneration stocking was determined by a sequential stocked-quadrat tally outlined by Dick (1963), and had two advantages over most stocked quadrat surveys: 1) the reliability of the stocking estimate was predetermined, and 2) the minimum number of quadrats was examined to provide the chosen reliability. According to Snedecor (1957), the allowable error of estimate, L , at the 95 per cent level of probability, in estimating a binomial proportion is

$$L = 2\sqrt{pq/n} - - - - - 1.$$

where p is the proportion of quadrats stocked, q is $1-p$, and n is the number of quadrats examined. The sample size to estimate p within limit L is

$$n = 4pq/L^2 - - - - - 2.$$

Substituting L values of .1 and .05, and maximizing pq , results in $n = 100$ for 10 per cent error and $n = 400$ for 5 per cent error. Considering the greatly increased effort required to reduce the error from 10 to 5 per cent, the former level was accepted as sufficiently precise for the purpose.

Fewer than 100 quadrats were required when the proportion stocked was other than 50 per cent. The magnitude of n for various values of $p \pm 10$ per cent is defined by equation 2. above. The number

of stocked quadrats within the total, pn , is derived by multiplying both sides of equation 2. by p

$$pn = 4p^2q/L^2 - - - - - 3.$$

This relationship (Figure 1) is the basis for the field procedure permitting determination of p by a single examination. Values calculated in formulae 2 and 3 are used to delimit a zone of non-determination.

The examination of an area consisted of tallying milacre quadrats at $\frac{1}{2}$ -chain intervals along randomly-located traverse. Each quadrat was recorded in sequence on the tally sheet (Figure 1). Non-stocked quadrats were indicated by tracing a line one unit to the right. Stocked and conditionally stocked quadrats were noted by coloring a square indicating one unit right, one unit upward. Quadrats containing a spruce, fir or pine seedling, or a spruce layer, were considered stocked. Quadrats containing other conifers, any hardwood, or a residual tree over 3.5 inches d.b.h. were considered conditionally stocked. One symbol was added opposite each stocked quadrat, taken in the following order of priority: spruce seed-origin stem, spruce layer, fir seedling or layer, pine, other conifer, hardwood, residual tree.

A minimum of 20 quadrats was examined and the additional tally, if any, needed to reach the limit of the nondetermination zone was estimated and the traverse extended. When the trace of the tally intersected the limit line, total stocking was estimated. Then the number of quadrats conditionally stocked was counted, the end of the trace was dropped by an equal number, and the tally continued until the limit line was reached again. This procedure was repeated until conifer stocking was estimated.

In the region studied, spruce seedlings and layers, fir seedlings and layers, and pine seedlings were considered as acceptable regeneration, and in the above order of descending value. As only one of the above was noted for each stocked quadrat, the survey provides estimates for the total stocking of spruce seed-origin stems, and cumulative values for spruce seed-origin stems or layers, spruce or fir, spruce or fir or pine, and total of spruce, fir and pine plus conditional stocking.

For each sample stand, dates of logging and fire and, if possible, the logging method were noted. Additional notes were taken on the dominant ground vegetation, topography and surface, geological formation, soil profile, drainage, probable site class and cover type of the previous stand.

In compiling the data, samples were grouped by stand origin i.e. cutover, cutover and burned, burned and cutover, burned. Average stocking values were calculated for the 63 cutover plots on the basis of 7 physiographic sites, by 5 pre-cut cover types, and by location and year of logging. Burned stands were compiled by location, year of fire and original cover type.

RESULTS

A surprising and interesting discovery in cutover stands was the remarkably similar, and high, conifer stocking on 5 of the 7 physiographic sites (Table 1). The expectation was for some degree of variation in spruce stocking between sites. Less surprising but of considerable significance, is the dominance of black spruce layers.

The range of total conifer stocking from 85 to 92 per cent rates as "Fully stocked" by Candy's (1951) yard-stick of success. The 71 per cent stocking for bedrock sites rates as "Well stocked". As expected,

the addition of the conditionally stocked quadrats added almost nothing to total stocking apart from a few hardwoods.

Somewhat greater variation in stocking appeared when the samples were grouped by pre-cut cover type (Table 2), although again conifer stocking rated "Well" to "Fully stocked". However, differences in species proportions are quite obvious, particularly the lower spruce values in the Black Spruce-Jack Pine and Black Spruce-Balsam Fir-White Birch cover types. The importance of balsam fir, largely obscured by the physiographic site grouping, is quite evident for those cover types that contained this species before logging.

Conifer stocking varied only slightly between locations and differences are believed to be insignificant (Table 3). Older cutovers seem to have slightly higher stocking than recent cutovers but this small difference may be due as much to the difficulty of locating small stems in dense slash as to any other factor.

It had been hoped to determine the degree to which mechanization in logging had affected regeneration stocking but this proved impossible owing to the difficulty of delineating areas operated exclusively with the various machines. However, in most concessions, it was possible to separate machine-operated areas from those where no machines were used. In 30 cutover stands operated without machinery, average conifer stocking was 87 per cent; in 30 stands logged with tracked and wheeled skidders or large wheeled forwarders, average conifer stocking was 85 per cent.

Regeneration stocking on logged areas that subsequently burned was in general very poor (Table 4). A wide variation in stocking was encountered between fires due largely to variation in the factors of

degree of fire effect on seedbed, and distance to nearest seed source. For example, the relatively high conifer stocking in black spruce stands in the 1955 Baie Comeau burn is attributed to the many small, unburned pockets of timber throughout much of the burned area. Mineral soil was exposed over much of the area presenting a favourable seedbed for spruce and fir. The Dolbeau fires (black spruce cover type) in 1951 and 1962 were judged to have had roughly the same chance as the Baie Comeau fire for natural seeding but a thick, scorched moss cover remained which presented a very unfavourable seedbed. Hardwoods invaded some burns in large numbers but were completely absent in others.

Five areas were studied where fire had burned lightly through standing timber that was subsequently salvage logged. Conifer stocking on the best area was 49 per cent; conifer stocking on the other 4 areas was less than 7 per cent. Two burned uncut stands were examined. One stand was 100 per cent stocked with spruce seedlings but the second stand had nil stocking. A scorched moss seedbed was present in the second stand compared to bare mineral soil in the first.

DISCUSSION

Priority in the research program of regeneration silviculture in black spruce forest in northern Quebec should be given to the problem of restocking burned cutover forest. Logged black spruce forest seems to present only minor problems, such as the somewhat low stocking in black spruce-jack pine stands, provided that black spruce layers are an acceptable form of regeneration. At present there is no evidence which suggests that layers could be classed as unacceptable regeneration; on the contrary, layer-origin stands in the older cutovers often are

indistinguishable at a distance from seedling origin stands. However, some long-term observations on layers, and their growth rates compared with that of seedlings, should be initiated. In particular, the spatial distribution of layers should be studied to provide data on their potential for full use of the site.

The results do not indicate to what extent, if any, the use of machinery has affected black spruce regeneration stocking. Inasmuch as the industry seems likely to adopt, on a large scale, some form of large, 4-wheeled skidder, it would be wise to determine the effect of this skidder on black spruce layers. From observing such a machine at work, the author suspects that, in general, damage to layers is slight but damage to fir seedlings is moderately severe. Increased destruction of regeneration could be expected when the machines are operated on wet ground and after heavy rains. If, in future, whole trees are skidded to a centrally located de-brancher, then greater destruction of regeneration might occur.

The study of burns reveals the tendency of each slash fire to produce a unique set of post-fire forest conditions. The reasons for this phenomenon are many and obvious and need not be enumerated here. However, the warning to those involved in regeneration silviculture is clear: treat each burned area as a separate entity and develop the regeneration program to suit the peculiar circumstances encountered.

Unsatisfactory stocking after fire appears, in most burns, to result primarily from the presence of poor seedbeds and secondly from a lack of seed. Unless the fire intensity is very high, a layer of moss with a hard, scorched crust often remains over much of the burn. It is

hard to imagine a more unsuitable seedbed for black spruce. Experimentation should be undertaken into ways of disturbing, scarifying or disposing of this crust, jointly with studies of direct seeding and planting.

REFERENCES

- DICK, J. 1963. Forest stocking determined by sequential stocked-quadrat tally. J. For. 61: (4).
- HATCHER, R.J. 1964. An assessment of the silvicultural problems in black spruce management in Quebec with proposals for a research program. Canada, Dept. of Forestry, For. Res. Br. Mimeo 64-Q-5.
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SEQUENTIAL STOCKED - QUADRATE TALLY

AREA _____, EXAMINED BY _____, DATE _____

STOCKING

- S - Spruce seedling
- L - Spruce layer
- F - Fir seedling or layer
- P - Pine
- X - Unstocked

CONDITIONAL STOCKING

- O - Other conifers
- H - Hardwoods
- T - Residual tree

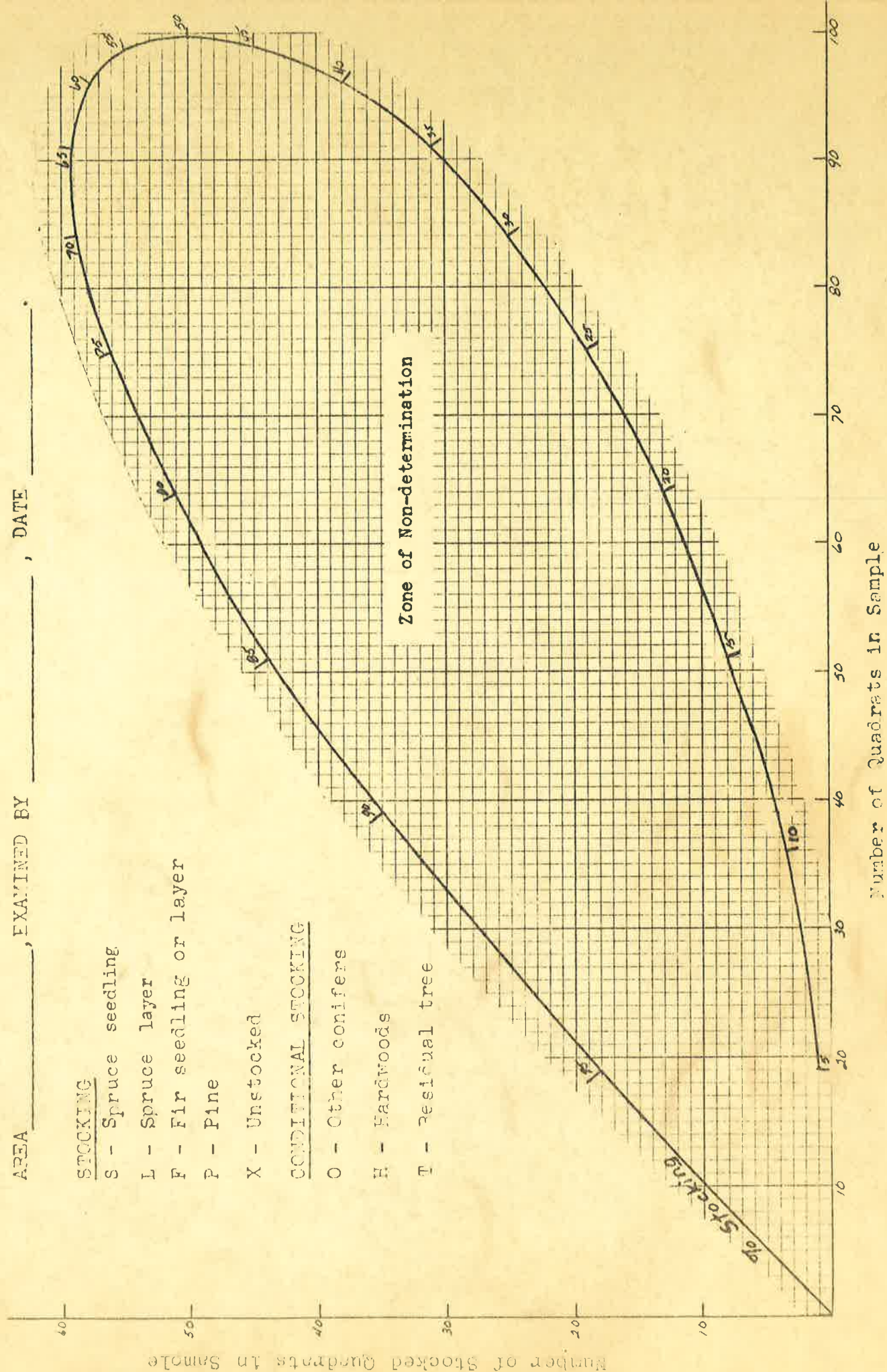


Figure 1. Sample of field tally sheet

Table 1. Regeneration Stocking of Black Spruce Cutovers by Site; Per Cent of Milacre Quadrats
Containing At Least One Stem of the Indicated Regeneration

Site	Number of		Black Spruce,	Black Spruce,	Black Spruce,	Black Spruce	Conifers	
	Stands	Seed-Origin Stems	Seed- or layer-	Origin Stems	Balsam Fir	or	All	plus
							Conifers	Hardwoods
Bedrock, no B soil horizon	3	4	70		70		71	71
Shallow Till, less than 2 feet	18	17	74		88		88	88
Deep Till, 2 feet or more	17	19	81		84		85	86
Floodplain	4	9	82		88		88	88
River Terrace	11	16	85		88		88	89
Outwash	7	23	87		88		88	88
Lacustrine	3	33	70		92		92	94
Total	<hr/>							
	63							

Table 2. Regeneration Stocking of Black Spruce Cutover by Cover Type Before Logging; Per Cent of Milacre Quadrats Containing At Least One Stem of the Indicated Regeneration

Cover Type	Number of	Black Spruce,	Black Spruce,	Black Spruce	Conifers
Before Logging	Stands	Seed-Origin Stems	Seed- or Layer-	or	plus
			Origin Stems	Balsam Fir	Conifers
					Hardwoods
Black Spruce	38	18	86	90	91
Black Spruce - Jack Pine	8	10	69	70	71
Black Spruce - Balsam Fir	5	24	71	96	96
Black Spruce - Balsam Fir - White Birch	5	17	55	84	85
Black Spruce - Jack Pine - Aspen	7	20	74	78	80
Total	63				

Table 3. Regeneration Stocking in Cutover Black Spruce Cover Type by Location* and Time of Logging

Location	Year of Logging	Number of Stands	Average Stocking Per Cent	
			Conifers	Total
Chibougamau	1960-63	6	92	92
	1953-59	7	93	94
Dolbeau	1960-63	5	85	85
	1929-59	6	94	94
Peribonka	1960-63	5	80	81
	1955-59	3	100	100
Baie Comeau	1960-63	1	100	100
	1937-59	4	84	84
Total	1960-63	17	87	87
	1929-59	20	92	93

* One black spruce stand at Portneuf River not shown.