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NOTES ON BLACK SPRUCE MANAGEMENT AND RESEARCH IN QUEBEC

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INTRODUCTION

The forest industries of Quebec have recently begun to tap the last large wood reserve in the province, represented on the forest region map of Canada (Rowe, 1959) as the Chibougamau-Natashquan Section, or B.1b (Figure 1). This Section in Quebec is an east-west band about 800 miles long by 100-170 miles wide with an area of 94,400 square miles, about 50,000 sq. miles of which are forested.

The most impressive characteristic of the Section, in common with the Clay Belt to the west, is the vastness of the black spruce forest which covers all sites from flat low peaty areas to well-drained rocky uplands. Balsam fir, although a frequent and often important associate, is scarce, relative to the forests further south and jack pine is scarce, relative to Section B.3 to the west. Small groves of white birch are common, particularly in forests of recent fire origin where this species also forms mixedwood stands with black spruce.

In the foreseeable future, more and more of Quebec's pulpwood needs will be drawn from this black spruce forest. Is there any reason to suspect that present day forestry practice may be detrimental to the renewal of this resource? Are there any current trends in forestry practice that may affect this forest? What is known about black spruce; what is the current research program and should it be supplemented by additional studies? A brief look at these questions is the subject of this paper.

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Current Forestry Practice in Relation to Regeneration

At a colloquium on regeneration held last spring at the Forestry Faculty of Laval University, an opinion was presented from the floor which held that Quebec's forest industry had two choices of forestry practice. First, it could manage its forest intensively and increase yields by securing immediate and complete restocking of cut-over areas, naturally or artificially, or second, it could practice extensive forestry and not be too concerned by any understocking it might encounter on its cutovers. The choice would be made after study of the economics of the two alternatives. The choice of extensive forestry as defined above is obviously the practice referred to by Smith (1960), editor of the Forestry Chronicle, where he says:

> "Throughout most of Canada the practice of forestry involves only low operating and investment costs per acre. Most of us are practicing forestry extensively, if at all. We are presiding over the liquidation of natural resources and, in many cases, do not even provide a decent burial".

Whether forestry, or forest management, is referred to as intensive or extensive, in my opinion neither term is applicable if adequate regeneration is not secured after logging. The choice presented at the colloquium was between intensive management and exploitation. However, is there not a third choice possible - extensive management with adequate regeneration secured on cut-over and burned areas?

Clear cutting is the most commonly practiced harvesting system in black spruce stands, and is a well-recognized and acceptable silvicultural system. As practiced in Quebec's spruce-fir pulpwood forests to date, it has generally resulted in quite satisfactory regeneration, due largely to the regenerative capacity of fir. Unfortunately, wildfires have all too often offset this success to some extent.

A recent summary report on a regeneration questionnaire circulated by the Quebec Section, Canadian Institute of Forestry supports the conclusion that in general there have been few regeneration problems after pulpwood logging in Quebec. A regeneration survey reported by Candy (1951) led to the same conclusion. However, it is quite clear from these and other reports that balsam fir provides the bulk of the new stands. Clear also is the fact that much of the black spruce regeneration after logging is layering, the future value of which is uncertain. Almost none of Candy's survey, and only one reply to the C.I.F. survey, dealt with Quebec's black spruce forest. What is known about black spruce regeneration after logging in this northern forest?

It is noteworthy that the lack of adequate black spruce regeneration on some cut-over forests in Ontario is considered by many to be that province's number one problem. The lone reply to the C.I.F. questionnaire which reported on Quebec's northern black spruce forest states that there was a serious problem on medium and good sites. Last summer I visited black spruce stands on nine Quebec timber limits over a period of 5 weeks and drove about 4,500 miles (Figure 1). While very little time was available for sampling, I gathered three impressions of black spruce cutover, 1) that stocking to black spruce was very variable depending on site, 2) that much of this regeneration was of layer origin, and 3) that balsam fir did not regenerate as prolifically in B.1b as in forests further south. But very little information is available on Quebec's northern spruce forest to support or refute these impressions. So far as I could determine companies had very limited regeneration survey data for their limits. It is probably safe to conclude that the degree to which black spruce regenerates after clear cutting in Quebec is at

present unknown but that there is some evidence suggesting it may be inadequate on some sites.

Current State of Knowledge of Black Spruce

It is not the intention here to present a detailed review of black spruce literature but rather to submit the conclusions of some knowledgeable men and to examine two widely-held beliefs concerning the species.

In some notes on black spruce research prepared for the Forestry Committee, C.P.P.A., in April 1963, Drs. Lowry and Weetman of the Pulp and Paper Research Institute of Canada wrote as follows:

> "Although it is Canada's major pulpwood species, very little basic research, specifically aimed at this species, is being carried out. A small amount of applied work is being done by various agencies. Good information on the species is meagre, ... The silvics of the species is inadequately known and there is little information on its physiology or of the carbon, nitrogen, energy or water cycles or of its total dry weight productivity. Experimental work on black spruce has been extremely limited."

A recent and comprehensive review of black spruce literature has been provided by A.B. Vincent of the Canadian Department of Forestry. Vincent's (1962) paper lists 170 references. Although many of these papers deal with facets of black spruce knowledge applicable to some extent throughout its range, the fact remains that of these 170 papers only 15 report on studies in Quebec. It is reasonable to suspect that for reasons of varying climate, topography and soil that some of the findings noted by Vincent would not apply to black spruce in this province. Vincent's review tends to support the contention of Lowry and Weetman.

Perhaps we do not even know as much about the species as we think we do. Let us examine two impressions about black spruce that are often accepted as truisms. The first of these is that black spruce is a

slow grower and should be managed on long rotations. Indeed, the large growth rings and leaders often noted for other spruces and fir are seldom recorded for black spruce. It seldom reaches the dimensions commonly achieved by many other conifers. Large forested areas support a meagre crop of small black spruce perhaps 200 or more years old. Large forests are also found where the net growth is zero. These facts probably have contributed most to the feeling that the species is a slow grower. But these facts are of little importance in judging the species as a pulpwood producer. What is important is the quantity of pulpwood that can be produced in operable stands within a reasonable rotation age as compared to other pulp species.

The following figures (Table 1) for 64 and 120-year-old black spruce stands are from Lake St-Pierre, about 65 miles north of Baie-Comeau in Section B.1b. These data are from a systematic sampling over two blocks of timber and thus do not represent only the best stands.

In the 64-year-old forest, well over half the stands are producing merchantable sized pulpwood at a rate over 1/2 cunit per acre per year (Table 1); about 1/4 of the stands are currently producing nearly one cunit per year on acres where standing pulpwood volumes already exceed 18 cunits (Table 2). The poorest site sampled is producing 1/3 cunit per year in both 64 and 120-year stands. While these growth rates are not exceptional, they are certainly comparable to rates often determined for more southerly and supposedly faster-growing forests.

Much of the large forested area of black spruce where net growth is reported as very low or zero is no doubt composed of overmature stands. It should be remembered that in overmature forests, net growth at or near zero is not a feature unique to black spruce stands. The Lake St-Pierre

study does not prove black spruce a fast-grower but at least it suggests the possibility that foresters may be amiss in referring to the species as slow growing. Comparison of the Lake St.Pierre data with yield table figures suggests that black spruce has grown faster at Lake St.Pierre than in many other areas throughout its range (Hatcher 1963).

A second common belief is that black spruce is unique because while having a very wide geographic distribution, it has a very low competitive ability. It has been suggested that finding the answer to why this should be so would provide the key to black spruce management. However, before embarking on such research, would it not be wise to examine more closely the question of black spruce competitive ability? Vast expanses of black spruce forest do suggest the possibility of a low-competitive capacity but could this vast forest also suggest the possibility that the species simply outlives its original associates? Company data on the age-class distribution of some of Quebec's northern forest reveal that as much as 70% of the forest may be classified as 100 years or 120 years plus. This classification also includes uneven-aged stands, a 1300-acre forest of which was studied at Lake St.Pierre. Here the conclusion was that there had been a light fire about 150 years ago which gave rise to the bulk of today's forest, and that there were also veterans from the previous stands plus some ingrowth. In such stands, would any of the common associates of black spruce (jack pine, white birch, aspen, balsam fir) have been expected to survive in any quantity after 150 years? Probably not.

It is a well-known fact that following intensive forest fires which destroy most of the soil organic matter, black spruce regeneration takes place under a cover of white birch and/or aspen, or if the original

stand contained jack pine, then under cover of this latter species. In the 64 year burn at Lake St.Pierre, pure black spruce stands were encountered but many stands contained considerable amounts of white birch (Table 2). The development of black spruce does not seem to have been adversely affected by this hardwood component. On the contrary, the addition of hardwood leaf litter to the humus may be responsible for the good growth. The above does not suggest that black spruce has a high competitive capacity but it does indicate that further study of the question is warranted before beginning a search for a "key" which may not exist.

Trends in Forestry Practice

Four current trends in forestry practice are noteworthy because they probably will influence to some extent the future management and research programs in black spruce forests.

1) Provincial governments seem to be increasingly concerned with management practice on Crown land. This interest is manifested in regulations in British Columbia concerned with reforestation, and by the Ontario government's acceptance of the responsibility for regeneration on Crown land in that province. Howie (1964) also draws attention to this trend in the March 1964 issue of the Forestry Chronicle, and states:

> "Currently the trend seems to be for the government to assume control and direction in many (of these) fields which were formerly the responsibility of industry. The present apparent attitude of certain provincial governments would seem to be directed towards creating the impression, in the licensee's mind, that the licensee's sole interest in the forest is the harvest of the current crop. Such an attitude can only result in a minimum effort on the part of the licensee in the whole field of forest management."

Thus we see the advent of a shared responsibility in forest management. Whether such division of the total responsibility is desirable

or not is a topic beyond the scope of this paper. Suffice to note that the jury of pulp and paper companies has not yet reached a unanimous verdict. In the same issue of the Forestry Chronicle where Howie obviously regrets the trend, Bunney (1964) states as follows:

> "In Ontario, up to 1960, the problem of regeneration on cut-over areas was deemed the responsibility of the Industry. This was a responsibility that was not generally accepted by the Industry."
>
> "In 1960 the Crown Timber Act of Ontario was changed and the Department of Lands and Forests has assumed responsibility for regeneration and maintaining productivity of the Crown forested areas. This is only right, as the Industry only leases the land from the Province with the sole right to buy and harvest the timber off the area."

2) The most dramatic evidence of the pulp and paper industry's intention to meet the challenge of increased competition in world paper markets is the use of more heavy machinery, and less men, in logging operations. Because these machines are large and costly it follows that large scale clear cutting of conifers will continue. The possibility seems remote that any sophisticated harvest cutting methods might be adopted in Boreal Forest, although modifications of the clear cut system are possible.

3) The trend in the organization of operations is towards the building of larger and better camps that serve larger areas. Recently constructed main limit roads are much better than those built just 10 years ago. Summer logging is becoming the rule rather than the exception and most operations are completed long before the heavy snows of late winter. Operations are beginning earlier in the summer so that the period of activity is being extended. One result of this important change towards a stabler woods operation and associated administrative and social advantages is the undesirable production of large contiguous areas covered with highly combustible slash (Goodfellow 1964).

4) All indications are that the pulp and paper industry of Quebec will not tolerate huge forest fires sweeping their cutovers for much longer, and a trend may develop in the use of controlled burning of slash as a fire prevention measure. Great interest has certainly been shown in the recent experimental controlled burning reported by Goodfellow (1964). However, some claims about the value of spring burning should be closely examined. Goodfellow (1964) concludes:

> "... it has been appreciated that logging slash accumulation constitutes an extreme fire hazard. This hazard can be eliminated or greatly reduced by establishing burned-out fire breaks through the slash beds of pure softwood stands."

Catto (Bernier 1964), in a report to the sub-committee on Slash Disposal and Prescribed Burns, Associate Committee on Forest Fire Protection, National Research Council, states:

> "I will say advisedly that burning at this time of year (spring) is the biggest step forward in fire protection in the last thirty years."

and further, that:

"There is absolutely no danger of the fire running in the green bush."

These are the hopes, if not the expectations, of all foresters but because of the relatively small amount of work done and the short time that has passed since experimenting began, conclusions of this kind are certainly premature.

It is appropriate here to suggest that fire might be used as a double-edged sword, both to reduce fire hazard and also to produce a suitable seedbed for natural or artificial seeding. Perhaps burning a few days later in the spring would produce the desired result.

Current Research on Black Spruce in Quebec

A complete review of research on black spruce is contained in Vincent's paper (1962). The following paragraphs give a very brief outline of work currently being done in Quebec.

Work on the nutrient requirements of black spruce seedlings is underway at the Pulp and Paper Research Institute of Canada and at the Forest Research Laboratory, Department of Forestry in Quebec City. Field experiments in the application of chemical fertilizers in black spruce stands have recently been initiated by PPRIC, the Department of Forestry, and at least one company.

Soil and site productivity correlation studies are underway at the PPRIC, as are the cycling of nitrogen and rate of litter and humus decomposition in a black spruce stand; closely related to the above are studies on the microbiology of forest soil. Laval University's Forestry Faculty is investigating the effects of forest fire on soil properties.

The provincial Department of Lands and Forests is conducting a small program of field and laboratory study on various seedbeds and their influence on seed germination and seedling survival. One company in 1962-63 carried out a small-scale but comprehensive aerial seeding experiment in a 1962 burn. The Forest Research Branch, Canada Department of Forestry, has included black spruce in two seeding experiments and two planting experiments initiated since 1957.

The Forest Research Branch has established 11 five-square-mile observation areas in cut-over forest and one in virgin forest of the Boreal Region to study stand development. Study has begun on black spruce crown volume-tree diameter relationships. Yield tables for the Boreal Region, to accompany Linteau's (1955) forest classification are being prepared.

At least two companies have recently done some small-scale thinning experiments in black spruce and spruce-fir stands. A very few scarification trials with mechanical scarifiers have recently been done.

One company has tried spring controlled burning of slash and others may soon follow. The provincial Department of Lands and Forests has also experimented with spring and fall controlled burning.

Future Research

Basic or fundamental research on black spruce should be greatly accelerated because as Vincent (1962) says:

> "... fairly basic research will, in the long run, have the most effective results in making possible the most economical and efficient management of our black spruce forests."

In drawing up a program of applied research, the trends observed in current forestry practice should be kept constantly in mind so that work priorities can be realistically established. For example, there is little to be gained from experimenting with silvicultural practices that have no hope of being adopted in Canada because of their incompatibility with modern techniques of mechanized harvesting. It is reasonable to suppose that when the time comes to tackle the problem of inadequate stocking after logging or fire that a mechanistic approach will be applied and many planting machines, seeding and planting guns, aerial seeding projects and prescribed burning techniques will be tried. Initial research effort should be directed towards providing knowledge that will aid in securing success for these future undertakings.

The Quebec District Office, Canada Department of Forestry made a regeneration survey of black spruce cutovers and burns this summer and has begun the establishment of a Research Forest of several square miles in the Chibougamau area, through the co-operation of the Consolidated Paper Corporation. Preliminary plans have been prepared for an expanded research program in the black spruce forest.

Permit me to conclude this paper with two quotations from the C.I.F. Silviculture Committee's report (Crossley 1964):

> "Too many research foresters appear to be talking to their scientific colleagues rather than to those foresters who are in a position to put their findings into practice. The author must overcome any desire to parade his erudition else he will lose the main audience he should be attempting to capture."

and,

> "It was agreed that basic research and pilot scale trials were the duty of the research organizations, but that large scale field trials should be the responsibility of those intending to use the proposed techniques. The reluctance to assume this obligation is largely responsible for the fact that many promising techniques die aborning."

which to my mind sum up the joint responsibility of the forest industry and research investigators in developing the silvicultural techniques which we require.

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TABLE 1*. ANNUAL VOLUME INCREMENT, 1950-1961
ONE INCH D.B.H. PLUS, LAKE ST.PIERRE, P.Q.

Site Type	% of total area	Annual Increment	Volume Increment Total Cubic Feet Per Acre			Total
			Spruce	Fir	White Birch	
			1840 Fire-Origin Stands			
Hyp.	44	Net	33.3	3.1	-3.4	33.0
		Gross	51.7	3.7	1.4	56.8
Ka-Le, clad.	44	Net	29.8	0.8	-0.6	30.0
		Gross	47.6	0.8	1.8	50.2
			1896 Fire-Origin Stands			
Hyp.	26	Net	105.8	9.2	3.9	118.4
		Gross	108.7	9.8	10.5	129.7
Cal-Va.	20	Net	69.4	5.4	4.2	79.0
		Gross	71.2	5.5	14.7	91.5
Ka-Le.	16	Net	61.6	4.0	-2.4	63.6
		Gross	62.7	4.1	2.4	69.6
Ka-Le, clad.	12	Net	42.9	1.3	-6.6	38.1
		Gross	43.0	1.3	0.4	45.1

* Small amounts of aspen and tamarack not shown.

TABLE 2*. VOLUME PER ACRE, BY SPECIES AND YEAR
TOTAL CUBIC FEET, FOUR INCHES D.B.H. PLUS, LAKE ST.PIERRE, P.Q.

Site Type	Spruce		Fir		White Birch		Total	
	1950	1961	1950	1961	1950	1961	1950	1961
			1840 Fire-Origin Stands					
Hyp.	2,403	2,806	57	83	149	124	2,609	3,013
Ka-Le, clad.	1,437	1,774	6	13	18	22	1,461	1,809
			1896 Fire-Origin Stands					
Hyp.	828	1,778	38	89	202	228	1,072	2,106
Cal-Va.	635	1,294	14	38	534	570	1,183	1,902
Ka-Le.	525	1,057	2	21	102	83	629	1,165
Ka-Le, clad.	259	623	2	8	89	29	355	671

* Small amounts of aspen and tamarack not shown.

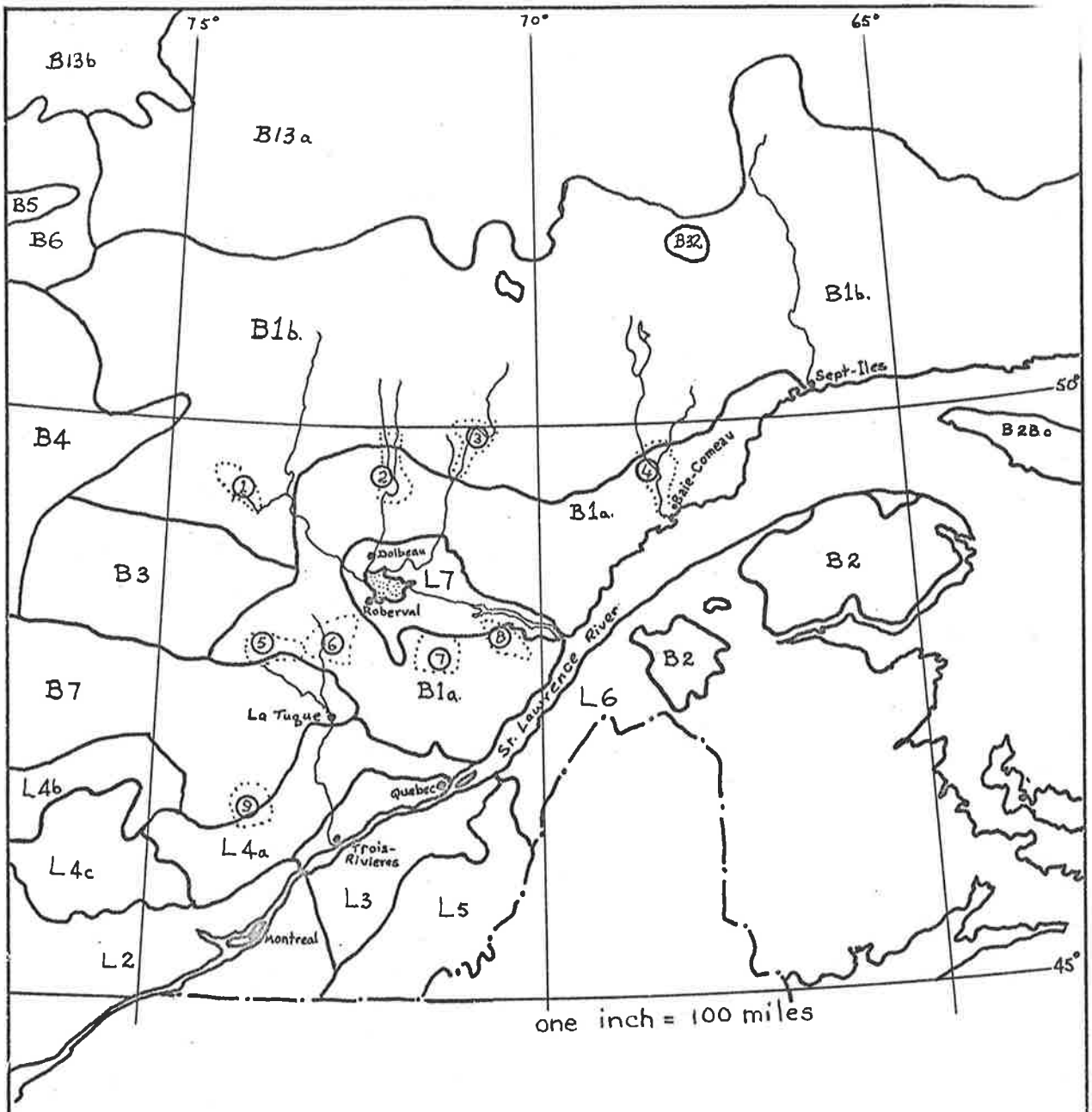

Figure 1. Map of Quebec showing areas visited during summer of 1963.

① Nicauba - Consolidated Paper Corp.
② Riviere aux Rats - Domtar Newsprint Ltd.
③ Peribonka - Consolidated Paper Corp.
④ Manicouagan - Quebec North Shore Paper Co.
⑤ St. Maurice - Canadian International Paper
⑥ Trenche - Consolidated Paper Corp.
⑦ South Kenogami - Price Brothers & Co. Ltd.
⑧ Mars Ha Ha - Consolidated Paper Corp.
⑨ Upper Mattawin - Consolidated Paper Corp.