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SECOND-GROWTH BLACK SPRUCE STANDS ON PEATLANDS PROVIDE LESSONS FOR CURRENT SILVICULTURE

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CATEGORY: Stand management
KEY WORDS: Black spruce, peatland sites, operational groups, working group, uneven-aged, second growth

INTRODUCTION

Forest managers recognize that it is neither financially possible, nor silviculturally desirable, to artificially regenerate all harvested forest areas. In many circumstances, the objective of adequately restocking harvested sites can be accomplished by making use of natural regeneration. Second-growth black spruce stands are common on northeastern Ontario peatlands that were logged over 50 years ago. This fact suggests that natural regeneration can be successful on sites of this type.

These second-growth stands developed following winter logging, whereby trees were felled and processed at the stump with hand tools and then forwarded using horse-drawn sleighs. It seems possible that similar stands could result from the present day use of careful, mechanized logging methods designed to protect advance growth.

Second-growth and natural[a] black spruce stands growing on a variety of peatland and transitional peatland sites have been examined by the Canadian Forest Service–Ontario (Groot and Horton 1994). The objectives of this study were: (i) to determine the extent to which advance growth contributed to the current stands, and (ii) to compare the age, size, spatial distribution, and volume of second-growth stands with natural stands.

LOCATION

Field work was carried out in 1985 and 1986 in Ontario's Northern Clay Belt region of the boreal forest, near Iroquois Falls and Kapuskasing. Forty black spruce peatland stands that regenerated after logging were sampled in a variety of Forest Ecosystem Classification (FEC) operational groups (OGs) (Jones et al. 1983) (Table 1).

Table 1. Postlogging black spruce peatland stands sampled by FEC operational group.

Operational groups	Number of sample plots	
	Second-growth	Natural
Poor swamp types		
OG 11 *Ledum*	8	4
OG 12 *Alnus*–herb poor	8	4
Rich swamp/transitional types		
OG 8 Feathermoss–*Sphagnum*	5	3
OG 9 Conifer–herb–moss rich-mixed	-	-
OG 13[a] *Alnus*–herb rich	5	3

[a]OG 9 and 13 were combined because of the rarity of the former and their apparent similarity in productivity.

METHODS

Sample plot design and mensurational methodologies have been previously reported in detail by Horton and Groot (1987a).

[a] Refers to previous uncut or virgin stands.

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The stands selected for sampling were all well stocked. Second-growth stands were logged from 50 to 70 years previous to the date of sampling.

RESULTS

The six natural stands younger than 160 years were essentially even-aged (Fig. 1). There were eight stands older than this that were all uneven-aged (Fig. 2); however, three of these displayed a strongly even-aged character but also contained a number of stems in older age classes (Fig. 3).

Most of the second-growth stands were uneven-aged, although younger age classes (41–80 years), which contained trees released by the harvest, dominated in many cases (Fig. 4). Trees older than 120 years were still present in most second-growth stands.

Diameter distributions in second-growth stands usually had the highest frequencies in the small diameter classes and lowest frequencies in the large diameter classes (Fig. 5). In contrast, the smaller size classes usually did not dominate the diameter distributions of natural stands (Fig. 6).

Age–frequency distributions of the second-growth stands revealed that, on average, 83% of the stems now above breast height were of preharvest origin. These trees accounted for more than 90% of the total volume. Table 2 summarizes these results for the various operational groups.

At the time of measurement, the number of merchantable stems, mean height of dominant stems, merchantable basal area, and merchantable volume of second-growth stands were all smaller than for well-stocked, mature natural stands (Table 3).

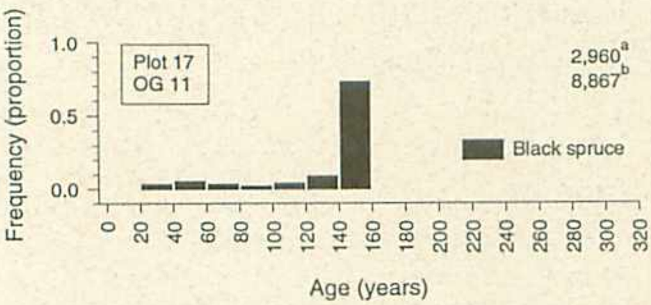

Figure 1. Example of the age structure of an even-aged natural stand. [a] Density (stems per ha) of stems >1.4 m tall. [b]Estimated density (stems per ha) of stems <1.4 m tall.

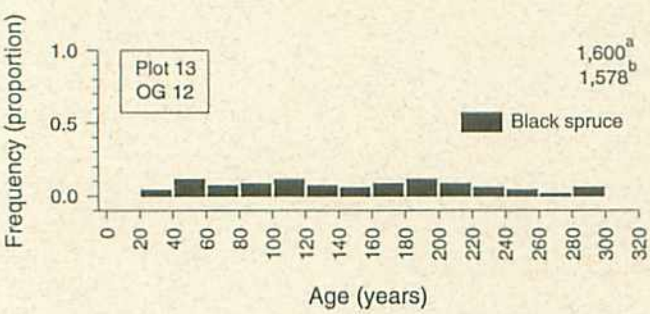

Figure 2. Example of the age structure of an uneven-aged natural stand. [a] Density (stems per ha) of stems >1.4 m tall. [b] Estimated density (stems per ha) of stems <1.4 m tall.

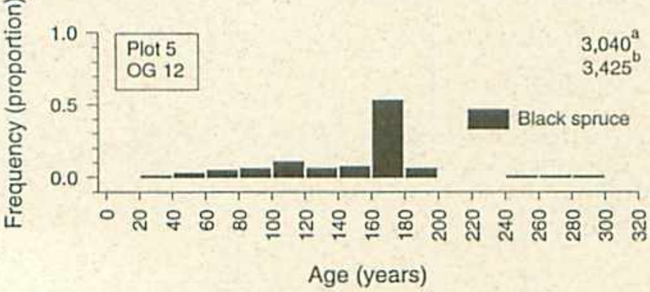

Figure 3. Example of the age structure of an uneven-aged natural stand with strongly even-aged character. [a]Density (stems per ha) of stems >1.4 m tall. [b]Estimated density (stems per ha) of stems <1.4 m tall.

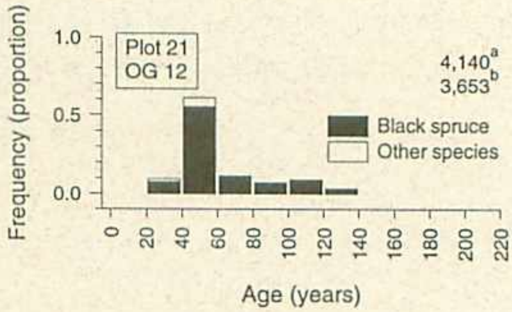

Figure 4. Example of the age structure of a second-growth stand. [a]Density (stems per ha) of stems >1.4 m tall. [b]Estimated density (stems per ha) of stems <1.4 m tall.

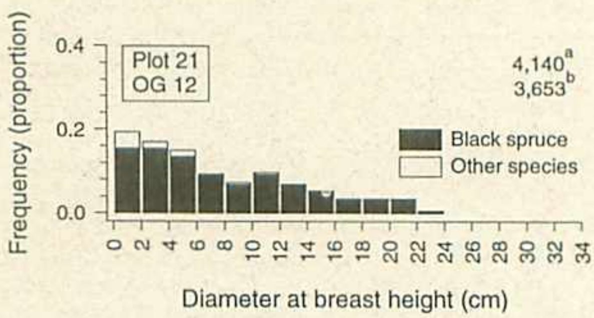

Figure 5. Example of the size structure of a second-growth stand. [a]Density (stems per ha) of stems >1.4 m tall. [b]Estimated density (stems per ha) of stems <1.4 m tall.

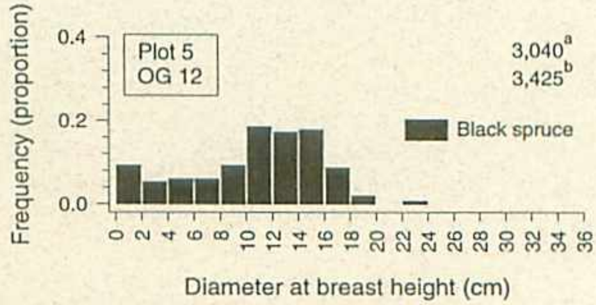

Figure 6. Example of the size structure of a natural stand. [a]Density (stems per ha) of stems >1.4 m tall. [b]Estimated density (stems per ha) of stems <1.4 m tall.

Table 2. Percentage of stems and total volume accounted for by advance growth.

Operational groups	Advance growth as a percentage of stand	
	Number of stems >1.4 m tall	Volume (m^3/ha)
	%	%
Poor swamp types		
OG 11	89	99
OG 12	79	96
Rich swamp/transitional types		
OG 8	89	99
OG 9, 13	88	96

The postharvest response of advance growth was ascertained by calculating the Specific Volume Increment (SVI), which represents the average growth ring width over the entire tree length.

Marked growth responses were evident in the logged stands (Fig. 7). The response peaked after about 15 years and then declined steadily. The SVI of trees in natural stands decreased gradually, but steadily, regardless of size (Fig. 8). The SVI levels were initially higher in the rich swamp sites than in the poorer swamp sites, but by the end of the measurement period both were at the same SVI level.

Minimal differences were found between second-growth and natural stands in terms of tree quality, as measured by basal sweep (32.2 and 30.5%, respectively) and butt rot (4 and 8%, respectively).

DISCUSSION AND CONCLUSIONS

Peatland black spruce stands that originated some 50 to 70 years ago following harvest operations have developed largely from residual trees and advance growth present at the time of logging. More than 80% of the stems in these stands predate logging, and these constitute over 90% of the current total volume.

Advance growth responded well to the release triggered by

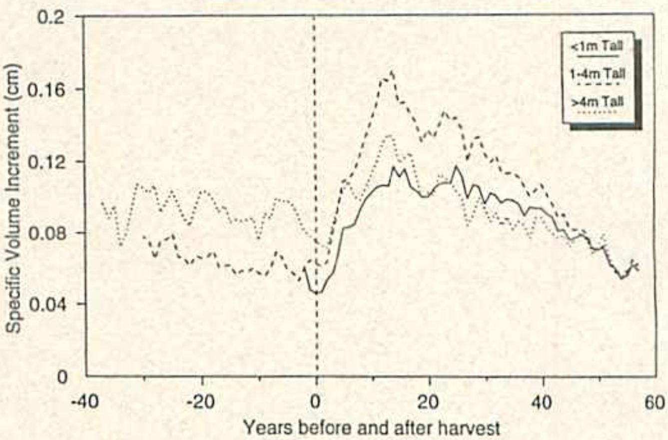

Figure 7. Specific Volume Increment (SVI) over time for large, medium, and small trees at the time of harvest in second-growth stands in OG 11.

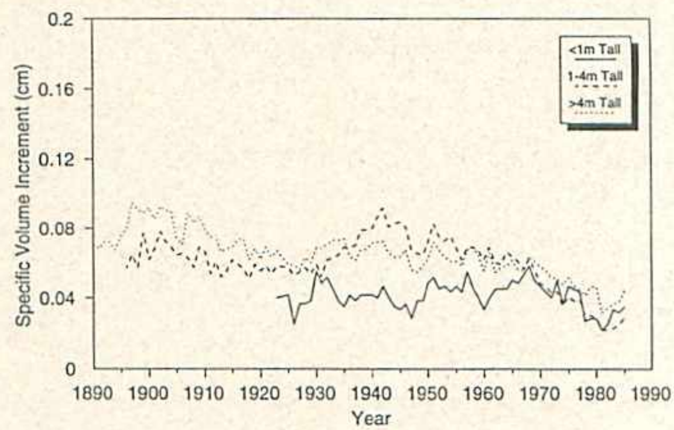

Figure 8. Specific Volume Increment (SVI) over time for large, medium, and small trees at the time of harvest in natural stands in OG 11.

Table 3. Comparison of second-growth and natural stands for the various operational groups in terms of numbers of merchantable stems, dominant height, merchantable basal area, and merchantable volume.

Origin/site (OG)	Merchantable stems (#/ha)	Dominant height (m)	Merchantable basal area (m^2/ha)	Merchantable volume (m^3/ha)
Second-growth stands				
OG 8	1749	15.3	33.9	188
OG 11	1519	13.5	25.6	123
OG 12	1261	13.5	22.4	107
OG 13	1280	17.0	31.5	198
Weighted average	1438	14.5	27.3	145
Natural stands				
OG 8	2252	16.5	38.6	250
OG 11	1691	14.1	28.2	147
OG 12	1440	15.9	30.4	169
OG 13	1739	17.8	39.5	271
Weighted average	1750	15.9	33.5	202

logging, especially in the smaller size classes. Second-growth stands have not yet achieved merchantable volume equal to that of well-stocked, mature natural stands. However, volume over age relationships suggest that the productivity of second-growth stands should be at least as good as that of well-stocked, mature natural stands on similar site types (Fig. 9). Since most second-growth stands have an uneven-aged stand structure, careful logging will again permit the next rotation to be based on advance growth.

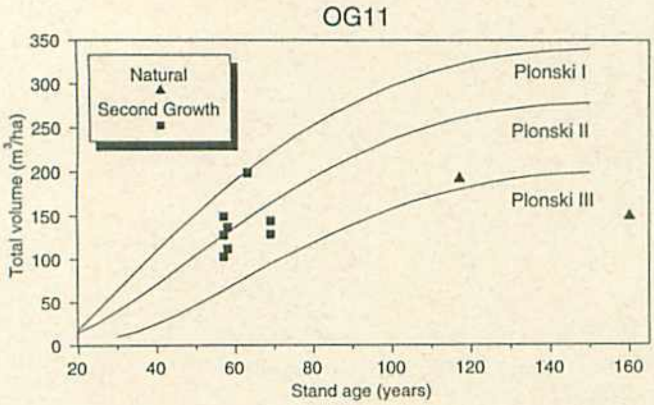

Figure 9. Volume over age relationships, in comparison with Plonski relationships, for natural and second-growth stands growing in OG 11.

This study suggests that differences in basal sweep and butt rot are not large between stands of differing origin.

A final comparison of second-growth and natural stands can be made only at the end of the current stand rotation. However, the present second-growth stands, 50 to 70 years after logging, are productive and of good quality.

An important question is whether today's highly mechanized, large-scale, year-round logging methods can be modified to protect advance growth to the same extent as did winter horse logging operations. The possibility of avoiding costly artificial regeneration may provide sufficient financial incentive to justify the increase in costs associated with more careful logging.

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