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Contents

Evaluation of a second commercial thinning operation in the boreal forest

Abstract

Stand structure can be modified in different ways during a second commercial thinning. For example, the removal intensity can be altered so as to provide a range of growing conditions for regeneration and residual trees. Two removal rates were tested in a second commercial thinning of a black spruce stand in northern Quebec. The use of a new trail network to protect regeneration that had become established in trails from the first thinning was also examined. Differences in removal intensity and trail creation did not significantly affect the felling and processing productivity. As a result, the choice of treatment method should be based on biological rather than operational considerations.

Keywords:

Commercial thinning, Second thinning, Cut-to-length, Productivity.

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Introduction

Matériaux Blanchet Inc. (Abitibi, QC) has been a leader in the area of commercial thinning of boreal forests for nearly 15 years. The company normally plans to harvest thinned stands of black spruce and jack pine 15 years after the first thinning. Thus far, company foresters have observed good development of these stands after thinning, with little natural mortality and good establishment of regeneration in the extraction trails (Figure 1). The company thus considered conducting a second thinning to promote the production of larger stems and to fill any gaps in the advance regeneration. The Canadian Forest Service (CFS) and FERIC worked with the company to document the results of its trials of second thinning.

Stands that had been first thinned in 1989 and 1990, located about 60 km north of Amos (QC), were thinned for the second time in November 2001. Four treatments that differed based on the removal intensity and on the creation of new trails (or use of existing trails) were evaluated. FERIC studied the productivity of the harvesting operations, whereas CFS measured the effects of the treatments on growth of the residual stand and on the development of regeneration. The single-grip harvester observed in this study was a custom-built machine consisting of a 2.8-m-wide Samsung excavator, a Rotobec boom, and a Pan 828EGS single-grip head. Site preparation to produce seedbeds

Figure 1. Well-developed regeneration in the trails created during the first thinning.

under the residual cover was also assessed, and will be the subject of a second Advantage report (Meek and Cormier, in prep.).

Treatments evaluated

Black spruce has good longevity. Therefore, a second thinning provides another opportunity to harvest the least-vigorous stems and promote the growth of the residual stand. In addition, the thinning opens the canopy of the stand and therefore potentially permits the establishment of spruce regeneration. This approach thus offers similar benefits to those provided by a shelterwood cut, and the double partial cut allows for a better structure of the stand and the enhancement of habitat and biodiversity results.

The four proposed treatments differed by their removal intensity (30 and 50% of basal area) and by their trail network (establishing new trails or reusing trails created during the first thinning). The stem-selection criteria were the same in each of the four treatments, and prioritized the removal of less-vigorous jack pine and spruce (short crowns, defective stems, etc.). The treatment based on reuse of existing trails was intended to maximize the benefits associated with the thinning (maximum selection), whereas the creation of new trails maximized protection of the advance regeneration that had become established in the old trails and created disturbance of the humus layer that would be beneficial to the regeneration of black spruce. Note that the light conditions created by the thinning needed to be controlled so as to promote spruce establishment and growth while avoiding invasion by shade-intolerant competitors. The 30% removal generally provides a better stem distribution in the residual canopy and decreases the risk of windthrow. However, the 50% removal should facilitate the development of the understory by letting more light penetrate to the ground and should thus promote the overall health and vigor of the residual stand.

Table 1 describes the pre- and post-treatment stand characteristics. On average, the pre-treatment conditions were comparable across the stands. The second thinning did not significantly increase the mean DBH of the residual stems because the removal of small, defective spruce stems was compensated for by the felling of large jack pine. The 50% removal objective was not met, since it proved difficult to modify the operators' habit of aiming for a 30% removal.

Table 1. Description of the stands in the four treatments (J.-M. Lussier, CFS, personal communication)

	Old trails		New trails	
Removal target (%)	**30**	**50**	**30**	**50**
Basal area (BA) before treatment (m^2/ha)	32.5	29.2	27.7	30.7
Mean pre-treatment DBH (cm)	14.0	14.1	13.5	14.9
Effective removal level (% of BA)	33	40	29	36
Increase in mean DBH (%)	4	2	4	3

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Results

Table 2 presents the results of FERIC's observations of the single-grip harvester during the various treatments. The high productivity demonstrated the operators' skill and experience in thinning operations, as it equaled that observed elsewhere in clearcutting of trees with comparable dimensions. The time distribution within the work cycle was comparable across the four treatments, although travel time was shorter when new trails were created.

The single-grip harvester's productivity was greatest at the higher removal intensity and with the creation of new trails. However, only stem volume had a statistically significant effect on the observed productivity differences. The experimental setup, which involved 29 time studies conducted over 33 productive machine hours (PMH), indicated that the variations in removal intensity (30 and 50%) and in the type of trails used (old or new) had no direct effect on the productivity of the single-grip harvester. It was the pretreatment conditions, and particularly the mean volume of the harvested stems, that determined the productivity of the felling and processing phase.

Figure 2 illustrates the effect of the mean volume of the harvested stems on the productivity of the second thinning. This curve has been compared with a reference curve for first thinnings in eastern Canada (Meek 2000) and with another curve based on previous observations of the same operator in a first thinning (Meek 2001). The curves show consistently higher productivity in the second thinning (20% at a mean stem volume of 0.100 m³). This can be explained in part by improvements to the harvester since the initial studies of the first thinning. It's also reasonable to assume that the good performance observed during the second thinning related to the lower density of unmerchantable stems in the stands. The lower density of merchantable stems and their well-developed crowns made it easier for the operator to drop the severed stems on the ground and facilitated processing. The trail layout used during the study (new trails created parallel to and between the old trails from the first thinning) rarely required the operator to use

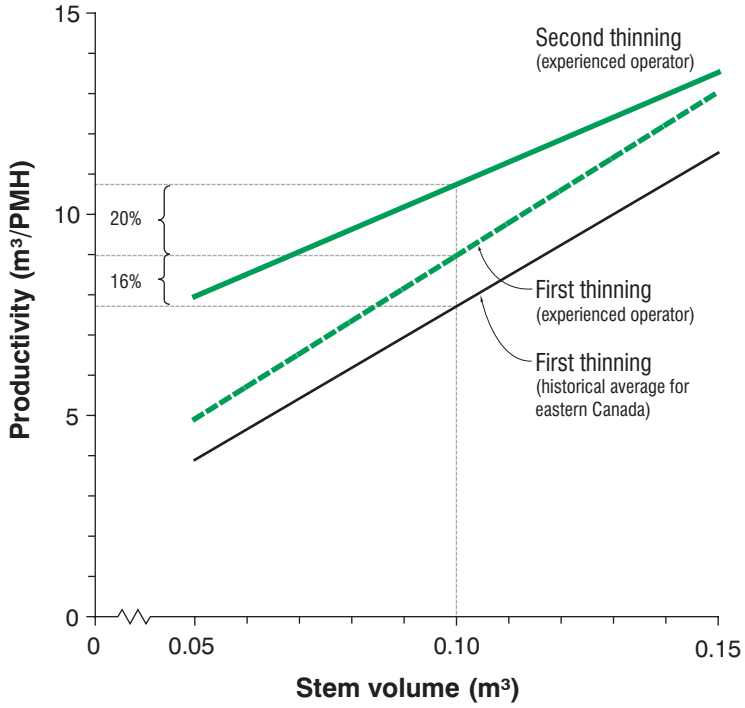

Figure 2. Comparison of average productivity curves for single-grip harvesters.

Table 2. Productivity of the single-grip harvester in the four treatments

	Old trails		New trails	
Target removal rate (% of BA)	**30**	**50**	**30**	**50**
Mean harvested stem volume (m³)	0.083	0.100	0.087	0.107
Productivity (stems/PMH)	116	92	107	103
(m³/PMH)	9.6	9.2	9.3	11.0

the full reach of the boom, since no stems were available for felling in the space occupied by trails from the first thinning.

Implementation

A second commercial thinning lets managers delay final harvesting of softwood stands that have undergone a first thinning and lets them consider a wider range of silvicultural objectives. For example, the goal may be to promote regeneration while producing larger crop trees.

To perform a second commercial thinning, the following guidelines should be followed:

- Before conducting the second thinning, the stand conditions should be such that the stand has acquired sufficient stability after the first thinning (few trees should have fallen or be leaning on standing trees, and an absence of gaps), and trees should have well-developed crowns,
- The selection criteria should target trees that are most at risk of mortality or of losing value before the final harvest: those visually defective, short-lived species, trees with imperfect crowns, trees that occupy a suppressed position within the canopy, and so on, as well as stems that have already reached the desired size for final harvesting.
- The operating methods should be tailored to suit the distribution of the established regeneration. Regeneration concentrated in the extraction trails created by the first thinning suggests that new trails should be created rather than using the old ones. Uniformly distributed regeneration suggests that it may be feasible to use the old trails and thereby maximize selective removal. In addition, the removal intensity should be adjusted to produce the desired light requirements for regeneration of the target species.
- Since the harvesting costs are unaffected by the removal intensity or by the creation of new trails, the cost of implementing a second thinning would likely be 10 to 15% less than that of a first thinning because of the higher mean volume of the harvested stems.
- The use of trails perpendicular to those of the first thinning can be considered. These trails could be spaced so as to improve the productivity of the harvesting equipment or to favor the growth of the residual stand.
- The forwarder is relatively insensitive to the type of treatment used in the second thinning. The most important variables that affect forwarder productivity are the extraction distance and the volume of the piles, which don't differ from those observed in the first thinning.
- The preparation of seedbeds under cover will likely improve the regeneration results.

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