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Forest regeneration 50 years after harvesting in the Lac Édouard Experimental Forest, La Mauricie National Park of Canada

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Introduction

The Lac Édouard Experimental Forest, located in La Mauricie National Park of Canada, Quebec, was created in 1918 to improve assessment of the impact of forestry practices on the regeneration, growth and mortality of forest stands in southern Quebec. It is one of the oldest research sites in North America. Between 1950 and 1956, experimental partial cutting was carried out there in order to establish an uneven-aged management regime, reduce the volume of softwoods harvested, and promote the growth of spruce species (*Picea* spp.) to the detriment of balsam fir (*Abies balsamea* (L.) Mill.). Archambault et al. (2009) conducted a detailed study on forest regeneration more than 50 years after these winter partial harvests, in the two most abundant mixedwood forest types (*Oxalis-Cornus, Viburnum-Oxalis*). The present research note complements the findings of that study in that it assesses the regeneration in the *Cornus* (softwood) forest type following experimental partial cutting.

Methodology

The study area is located about 50 km north of Trois-Rivières, Quebec, in the sugar maple-yellow birch bioclimatic subdomain of eastern Quebec. The study focused on the *Cornus* (softwood) forest type, in which the main commercial species are red spruce (*Picea rubens* Sarg.), balsam fir, eastern white-cedar (*Thuya occidentalis* L.) and white birch (*Betula papyrifera* Marsh.) (Table 1). Post-harvest regeneration data were collected in 2009 from eighteen 404 m^2 sample plots, each comprising nine 4 m^2 regeneration subplots. All the live stems between 5 cm and 4 m tall with a diameter at breast height (DBH) less than 0.5 cm were recorded in the following height classes: 5 to 30 cm, 31 cm to 1 m and 1.01 to 4 m. Stocking (by species and by height class) corresponds to the percentage of regeneration subplots containing at least one live stem. Five of the 18 sample plots were subjected to partial cutting in winter between 1950 and 1956. The mean cutting intensity was 23%, with 25% of softwoods and 3% of hardwoods being harvested.

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Table 1.

Mensurational characteristics (mean ± standard error) of commercial species in control and cut plots

Species	Basal Area (m^2/ha) DBH ≥10 cm		Density (stems/ha) DBH < 10 cm		Density (stems/ha) DBH ≥10 cm	
	Control (n = 13)[1]	Cut (n = 5)	Control (n = 13)	Cut (n = 5)	Control (n =13)	Cut (n = 5)
Yellow birch	0.3±0.2	0.5±0.5	102±98	5±5	12±7	10±10
White birch	0.5±0.2	1.1±0.4	127±81	141±103	21±7	79±32
Red maple	0.2±0.1	0.4±0.3	86±68	5±5	8±4	15±10
Hardwood species	1.0±0.4	1.9±0.6	315±200	151±113	41±13	104±38
Red spruce	33.4±2.4	25.4±4.0	398±133	161±64	644±54	425±32
Balsam fir	1.1±0.4	4.2±1.7	1572±548	2192±609	78±28	324±154
Eastern hemlock	0.1±0.1	-	78±78	-	2±2	-
Eastern white-cedar	3.0±1.0	5.7±3.5	54±44	141±113	90±31	226±149
Softwood species	37.6±1.5	35.3±1.6	2102±555	2494±526	814±36	975±145
All species	38.6±1.5	37.2±2.2	2417±610	2645±581	855±36	1079±173

[1]Number of sample plots

Results and discussion

The commercial softwood species with the most abundant total regeneration (Figures 1 and 2) were red spruce (control plots: 27,735 stems/ha; cut plots: 11,611 stems/ha) and balsam fir (control plots: 14,701 stems/ha; cut plots: 8,444 stems/ha). The corresponding stocking levels were high (red spruce, control plots: 97%; cut plots: 81%; balsam fir, control plots: 93%; cut plots: 87%). The total density of red spruce and balsam fir was lower in the cut plots than in the control plots. Red spruce density as a proportion of total softwood density was higher in control plots (59%) than in cut plots (47%). Eastern white-cedar was also present, but in smaller amounts, with 1,752 stems/ha in control plots (stocking: 12%) and 1,333 stems/ha in cut plots (stocking: 11%). Red maple (*Acer rubrum* L.) was the most abundant commercial hardwood species, with 1,581 stems/ha in control plots (stocking: 25%) and 1,444 stems/ha in cut plots (stocking: 37%). Eastern white pine (*Pinus strobus* L.), eastern hemlock (*Tsuga canadensis* (L.) Carrière), yellow birch (*Betula alleghaniensis* Britt.), sugar maple (*Acer saccharum* Marsh.) and trembling aspen (*Populus tremuloides* Michx.) were also present, but the quantities were negligible. The proportions of softwood regeneration density (control plots: 94%; cut plots: 89%) and hardwood regeneration density (control plots: 4%; cut plots: 10%) relative to total density were comparable in the two types of plots. However, total softwood regeneration density was lower in the cut plots (24,667 stems/ha) than in the control plots (47,329 stems/ha).

Figure 1.

Mean and standard error of the density of commercial species, by height class

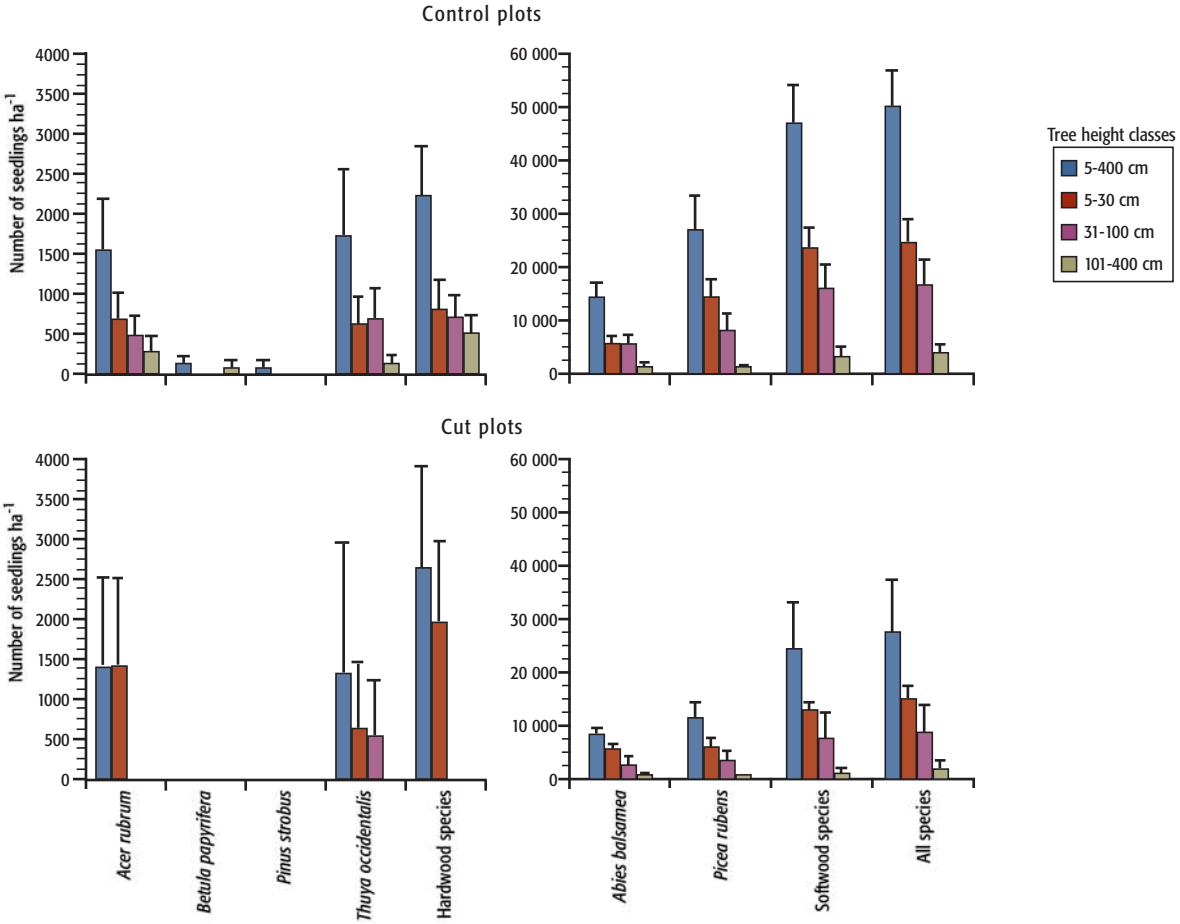
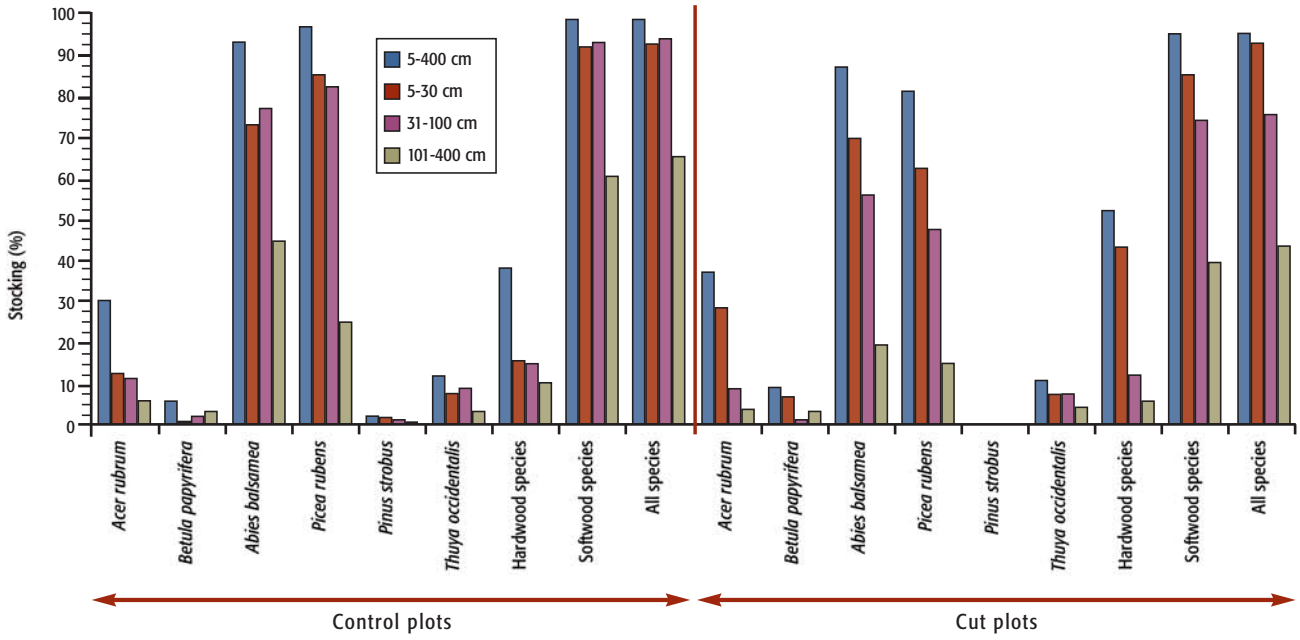


Figure 2.

Stocking of regeneration of commercial species, by height class



Conclusion

More than 50 years after partial cutting in winter, the total amount of red spruce and balsam fir regeneration was lower in cut stands than in control stands. However, the density and the stocking levels indicate that sufficient red spruce and balsam fir regeneration exists to ensure renewal. Given the existing amount of regeneration, the present softwood cover type is likely to be maintained. The experimental partial cutting in 1950-1956 was done during the winter. Had these forestry operations been carried out in the summer, the impact on regeneration would likely have been different. Permanent sample plots like those used in this project should be protected and developed since the actual effects of forestry interventions on forest ecosystems can only be assessed over the long term.

Reference

Archambault, L.; Delisle, C.; Larocque, G.R. 2009. Forest regeneration 50 years following partial cutting in mixedwood ecosystems of southern Quebec, Canada. For. Ecol. Manag. 257, 703-711.

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