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Growth of softwood and mixedwood stands in the Lac Métis Seigneury Observation Area

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Introduction

Wood production in the softwood and mixedwood stands in the balsam fir-yellow birch bioclimatic sub-domain of eastern Quebec is generally high. These stands consist mainly of balsam fir with yellow birch, white birch, white spruce and red spruce as the main companion species. Spruce budworm outbreaks, windthrow and fire are the most frequent natural disturbances that affect their dynamics. However, knowledge of their composition, structure and long-term development is deemed insufficient. Clearcutting and diameter-limit cutting have long been the most used harvesting methods, but they are inappropriate methods.

A detailed study was conducted in the Lower St. Lawrence region by Archambault et al. (2006) to assess the impact of high-intensity diameter-limit cutting carried out in the 1940s and 1950s on the forest dynamics of these ecosystems. The results presented in this research note complete this work by assessing the growth of these ecosystems during the period from 2003 to 2008.

Methodology

The study was undertaken in an area southeast of Rimouski, Quebec. The study area is part of the Lac Métis Seigneury Observation Area established in 1950 by the Canadian government's Department of Northern Affairs and National Resources to study the post-cutting development of forest stands in various regions of Quebec. Changes in the dendrometric characteristics of the forest cover between 2003 and 2008 were assessed using seventeen 400-m^2 permanent sample plots located in softwood and mixedwood stands. Measurements were taken in these sample plots in 1950, 1960, 1970, 2003 and 2008. The sample plots were established in areas where high-intensity diameter-limit cutting was conducted (nearly 60% of the harvested volume). Two types of cutting were carried out: winter cutting from 1942 to 1949 and summer cutting from 1958 to 1960.

Results and discussion

The diameter growth of all stems in winter-logged stands was 40% higher than that of summer-logged stands, which represents 0.14 cm/yr and 0.1 cm/yr respectively (Table 1). Spruces (0.18 cm/yr) and balsam fir (0.16 cm/yr) have had the best diameter growth in winter-logged stands. In summer-logged stands, sugar maple (0.4 cm/yr), trembling aspen (0.8 cm/yr) and eastern white-cedar (0.4 cm/yr) had the best diameter growth, but the total volume of these species was relatively low. The best diameter growth among the other species was that of spruces (0.24 cm/yr).

Table 1.

Variation in average diameter (cm) of merchantable stems (DBH[1] ≥ 10 cm)

	Winter logging (1942-1949)			Summer logging (1958-1960)		
Species	**2003** (n = 10)[2]	**2008** (n = 10)	**2003-2008** (n = 10)	**2003** (n = 7)	**2008** (n = 7)	**2003-2008** (n = 7)
Yellow birch	17.9	18.4	0.5	20.8	20.9	0.1
Paper birch	13.8	13.9	0.1	14.2	14.5	0.3
Red maple	12.0	12.0	0.0	16.7	17.4	0.7
Sugar maple	-	-	-	26.0	28.0	2.0
Trembling aspen	-	-	-	28.0	32.0	4.0
Hardwood species	15.0	15.3	0.3	16.5	17.0	0.5
Spruce[3]	21.0	21.9	0.9	19.3	20.5	1.2
Balsam fir	17.8	18.6	0.8	19.1	19.5	0.4
Eastern white-cedar	29.0	29.0	0.0	38.0	40.0	2.0
Softwood species	18.2	19.0	0.8	19.5	20.1	0.6
All species	17.5	18.2	0.7	18.4	18.9	0.5

[1] DBH: diameter at breast height
[2] Number of sample plots
[3] White spruce and red spruce combined

There was little variation in stem density (Tables 2 and 3). Balsam fir had the greatest fluctuations in stem density. The number of stems with a diameter at breast height (DBH) of less than 10 cm decreased by 23 stems/ha in winter-logged areas and by 60 stems/ha in summer-logged areas. The number of stems with a DBH equal to or greater than 10 cm decreased by 43 stems/ha in winter-logged areas and by 21 stems/ha in summer-logged areas. Natural mortality and windthrow were probably the key factors in the decreased density.

Periodic annual increment in winter-logged stands was good, reaching 3.18 m^3/ha/yr, whereas this increment in summer-logged stands reached 2.32 m^3/ha/yr. In the winter-logged stands, balsam fir (1.56 m^3/ha/yr) and yellow birch (0.56 m^3/ha/yr) had the best growth. Spruces (0.98 m^3/ha/yr) and paper birch (0.38 m^3/ha/yr) were the species with the highest growth in summer-logged stands. The mean annual increment was 3.27 m^3/ha/yr in winter-logged stands and 2.80 m^3/ha/yr in summer-logged stands. These values are higher than the mean annual increment in Quebec's public forests, which is estimated to be 1.40 m^3/ha/yr.

Table 2.

Variation in dendrometric characteristics (commercial species) of winter-logged stands in 1942-1949 (n = 10)[1]

	Density (stems/ha): DBH[2] <10 cm			Density (stems/ha): DBH ≥10 cm			Volume (m³/ha)		
Species	**2003**	**2008**	**2003-2008**	**2003**	**2008**	**2003-2008**	**2003**	**2008**	**2003-2008**
Yellow birch	69	87	18	75	85	10	10.2	13.0	2.8
Paper birch	274	264	-10	180	182	2	14.3	15.0	0.7
Red maple	10	5	-5	3	3	0	0.1	0.1	0.0
Black ash	3	0	-3	0	0	0	0.0	0.0	0.0
Trembling aspen	0	10	10	0	0	0	0.0	0.0	0.0
Hardwood species	356	366	10	258	270	12	24.6	28.1	3.5
Spruce[3]	33	25	-8	100	103	3	26.0	30.6	4.6
Balsam fir	601	578	-23	786	743	-43	127.9	135.7	7.8
Eastern white-cedar	0	0	0	5	5	0	1.8	1.8	0.0
Softwood species	634	603	-31	891	851	-40	155.7	168.1	12.4
All species	990	969	-21	1149	1121	-28	180.3	196.2	15.9

[1] Number of sample plots
[2] DBH: diameter at breast height
[3] White spruce and red spruce combined

Table 3.

Variation in dendrometric characteristics (commercial species) of summer-logged stands in 1958-1960 (n = 7)[1]

	Density (stems/ha): DBH[2] <10 cm			Density (stems/ha): DBH ≥10 cm			Volume (m³/ha)		
Species	**2003**	**2008**	**2003-2008**	**2003**	**2008**	**2003-2008**	**2003**	**2008**	**2003-2008**
Yellow birch	28	42	14	85	92	7	22.7	23.9	1.2
Paper birch	191	134	-57	184	191	7	17.0	18.9	1.9
Red maple	67	85	18	50	50	0	6.1	6.7	0.6
Sugar maple	4	0	-4	4	4	0	1.3	1.6	0.3
Black ash	4	4	0	0	0	0	0.0	0.0	0.0
Trembling aspen	0	0	0	4	4	0	2.0	2.8	0.8
Hardwood species	294	265	-29	327	341	14	49.1	53.9	4.8
Spruce[3]	135	113	-22	96	99	3	21.3	26.2	4.9
Balsam fir	894	834	-60	474	453	-21	92.3	93.5	1.2
Eastern white-cedar	0	0	0	11	11	0	8.0	8.7	0.7
Softwood species	1029	947	-82	580	562	-18	121.6	128.4	6.8
All species	1323	1212	-111	907	903	-4	170.7	182.3	11.6

[1] Number of sample plots
[2] DBH: diameter at breast height
[3] White spruce and red spruce combined

Conclusion

To maintain the productivity of ecosystems and minimize potential problems, such as undesired changes to the forest cover composition and invasion of competing vegetation, it is important to continue developing silvicultural practices suited to habitat conditions. Selection cutting, shelterwood cutting and seed cutting are some of the silvicultural methods to be considered for the selected stands in this study. It is equally imperative to establish and maintain long-term experimental research installations, such as the one used in this project, because it is only over the long term that the actual effects of logging on forest ecosystems can be assessed properly.

Reference

Archambault, L.; Delisle, C.; Larocque, G.R.; Sirois, L.; Belleau, P. 2006. Fifty years of forest dynamics following diameter-limit cuttings in balsam fir - yellow birch stands of the Lower St. Lawrence region, Quebec. Canadian Journal of Forest Research 36:2745-2755.

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