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BALSAM FIR-YELLOW BIRCH FOREST SUCCESSION IN THE LOWER ST. LAWRENCE REGION

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INTRODUCTION

In Quebec, the bioclimatic zone of balsam fir-yellow birch covers an area of 94,768 km^2. Some of the forest cover types in the area, such as balsam fir-yellow birch, are among the most productive in Quebec. Fire, harvesting and spruce budworm outbreaks are the main disturbance types that affect the dynamics of balsam fir-yellow birch ecosystems. However, little is known about the effect of these disturbances on forest succession.

The aim of this study was to identify the post-fire and post-clearcut patterns of succession encountered on mesic sites in the balsam fir-yellow birch bioclimatic zone of the Lower St. Lawrence region.

MATERIALS AND METHODS

The research was carried out southeast of Rimouski, Quebec, primarily within the Lower St. Lawrence Model Forest (Seigneurie du Lac Métis). The data used to identify post-clearcut succession were collected on 30 cutovers where mixed stands of balsam fir and yellow birch had been logged 5, 10 or 20 years earlier. In addition, 10 mature ecosystems were sampled in order to determine the pre-harvest species composition. The study of post-fire succession was conducted in an area of roughly 2,500 ha that was burned in 1932. A total of 28 ecosystems were sampled.

A 0.04-ha circular plot was established in each ecosystem in order to determine the physiographic, soil and vegetation characteristics. Ten 0.0004-ha subplots were used to evaluate the natural regeneration. In the mature ecosystems and post-fire ones, three dominant stems were sampled for age determination.

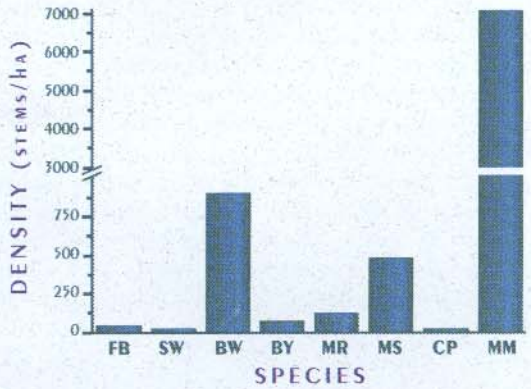
RESULTS AND DISCUSSION

All the ecosystems were located on tills generally thicker than 50 cm, and slopes averaged 11%. The soils ranged from well drained to moderately well drained, and in most of the ecosystems, the C horizon had a medium soil texture (loam). The ecosystems included in the post-clearcut study were located mainly at midslope, whereas those in the post-fire succession component were situated on upper slopes, midslopes or lower slopes.

The 20-year-old cutovers had been invaded by mountain maple (***Figure 1***), with a mean density of 7,025 stems/ha (dbh: 1-9 cm). Mountain maple is a major competing species in hardwood and mixedwood forests. During the 20 years after harvest, the abundance of mountain maple had

Figure 1.

Density of the main commercial species and mountain maple (dbh: 1-9 cm), 20 years after clearcutting.



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substantially reduced the sites' commercial timber productivity, and this adverse impact can be expected to persist for another 20 years. Wild red raspberry and fireweed, two other competing species, were abundant on the 5-year-old cutovers, with 60 and 21% cover respectively. Twenty years after clearcutting, however, these species were virtually absent.

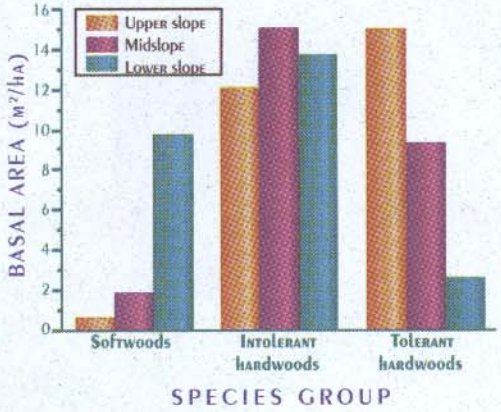
Logging caused a considerable increase in the proportion of commercial hardwood species in the forest cover. In mature stands, commercial hardwood trees (dbh ≥1 cm) accounted for 36% of the total density of commercial species, compared with 89% in the 20-year-old cutovers. While conifer advance regeneration declined after the clearcutting, it was not completely destroyed, given that balsam fir and white spruce stocking decreased from 76% in mature stands to 50% in the 5-year-old cutovers. However, 20 years after harvest, the stocking of balsam fir and white spruce had fallen to only 27%, probably due to competition from mountain maple. Consequently, it is unlikely that the harvested areas will regenerate to the vegetation composition of the original stands in the near future.

In the post-fire situation, the majority of commercial species, including tolerant species, rapidly recolonized the sites. Only eastern white-cedar, which is a late successional species, did not re-establish. In all, 78% of the dominant stems that were sampled had become established 10 years after the fire. Competition from mountain maple appears to have been less serious than in the clearcut areas. Sixty-four years after the fire, mountain maple density (dbh: 1-9 cm) was only 1,732 stems/ha.

The post-fire basal area composition of the main forest cover type varied according to topographic location (***Figure 2***). On upper slopes, tolerant hardwood species (sugar maple, red maple and yellow birch) were more abundant than conifers, accounting for 47 and 3% respectively of the total basal area. The opposite situation was observed on lower slopes, with softwood and hardwood trees making up 34 and 8% of the total basal area respectively. Intolerant hardwood species (white birch and trembling aspen) were abundant in all of the ecosystems, and accounted for between 41 and 55% of the total basal area depending on their slope position. After the intolerant hardwood trees disappear, the vegetation composition should progressively evolve toward that of the original stands, that is, sugar maple-yellow birch on upper slopes, balsam fir-yellow birch on midslopes and balsam fir-yellow birch and cedar on lower slopes.

Figure 2.

Post-fire basal area of commercial species in relation to topographic position.



CONCLUSION

Clearcutting and forest fires exert a major influence on plant succession. However, these two types of disturbance have different effects. In harvested stands, regeneration of commercial species is sparse, and competition from mountain maple is a serious problem. By contrast, following wildfire, regeneration of commercial species is rapid and abundant, and competition is limited.

In light of this situation, it is important to conduct further research into the functioning and dynamics of these ecosystems so that new silvicultural techniques can be developed. For example, cutting with protection of regeneration and soils is an approach that all forestry companies in Quebec are now required to implement. The effectiveness of this method for renewing balsam fir-yellow birch stands will be assessed over the coming years. Furthermore, mountain maple trees propagate naturally mainly by means of stump sprouts but produce few suckers. Destruction of the stems in fires might thus be sufficient to kill mountain maple; hence, controlled burning could be envisaged as a silvicultural treatment for suppressing this species.

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