



NOTES

BOREAL MIXEDWOOD SILVICULTURE SHOULD EMULATE NATURAL ECOSYSTEM DYNAMICS

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INTRODUCTION

Current silvicultural practices in the southern boreal mixedwood forest frequently ignore natural ecosystem dynamics, often leading to the re-establishment of stands with a similar composition. In the natural system, however, succession generally involves a transition of stand types. Boreal mixedwoods typically revert to intolerant hardwoods, such as aspen and birch, following fire disturbance. Maintaining pure hardwood or softwood stands over the longer term could induce serious problems in site productivity and biodiversity maintenance.

The lack of appreciation for natural ecosystem dynamics is in part responsible for some of the forest renewal problems experienced in southern boreal mixedwoods. For example, the objective of regenerating softwood stands on upland mixedwood sites often necessitates artificial regeneration and chemical or mechanical control of intolerant hardwoods.

A new approach to southern boreal mixedwood management, which emphasizes maintenance of natural processes, is discussed here. The proposed management system is based upon a 10-year research program focussing on the natural disturbance regime and natural ecosystem dynamics in the Lake Duparquet Research and Teaching Forest located in northwestern Quebec (Bergeron, Y.; Harvey, B. 1997. Basing silviculture on natural ecosystem dynamics: an approach applied to the southern boreal mixedwood forest of Quebec. *For. Ecol. Manag.* 92: 235-242).

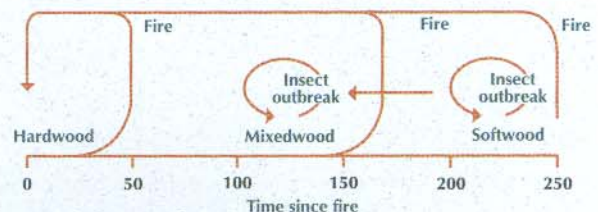
NATURAL DYNAMICS

Natural dynamics of the Lake Duparquet boreal mixedwood sites can be characterized by successive rotations of hardwood, mixedwood, and softwood dominance (Figure 1). The rate of succession can vary greatly and is highly dependent on the rate at which hardwood stands are invaded by softwood species. At any time fire can reset the successional clock and return the site to intolerant hardwoods. Jack pine can also form pure or mixed stands on these sites following fire.

The fire-dominated forest ecosystem in this boreal region is characterized by the presence of intensive crown fires, the frequency of which has been decreasing since the mid-1800's. In addition, severe spruce budworm outbreaks in the study area have been shown to cause higher mortality and large canopy openings in older, fir-dominated stands on mixedwood sites.

Studies in the Lake Duparquet forest have shown that above-ground biomass, nutrient availability and pH, as well as the richness and diversity of vascular plants all decrease as stands pass from hardwood to softwood dominance.

Figure 1.
Model of natural dynamics on mixedwood sites.



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SILVICULTURE BASED ON NATURAL DYNAMICS

Research undertaken in the Abitibi region has led to the development of a proposed silvicultural system for boreal mixedwood sites based on a transition from one stand type to another on the same site (Figure 2). For example:

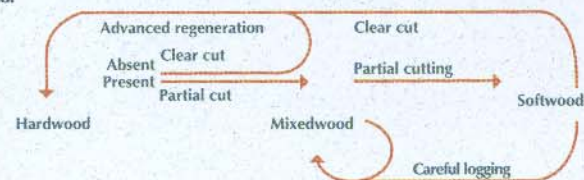
- where advanced softwood regeneration is absent, clearcutting, like fire, will return the stand to intolerant hardwoods;
- where advanced softwood regeneration is present, gradual extraction of a portion of the stems from the overstorey resembles the break-up of the aspen overstorey that occurs in natural succession; and
- as the softwood proportion of the stand increases, partial cutting should give way to careful logging, with measures to protect the advanced regeneration and soil. On some sites, a return to intolerant hardwood stands would be favoured.

By using the proposed silvicultural system, the need for softwood plantations is reduced except to fill-plant skid trails and in situations close to mills and on fertile sites that justify intensive management and higher silvicultural investments.

Although mixedwood silviculture that is based upon natural ecosystem dynamics may be more complex and operationally complicated, its adoption could reduce a number of problems currently experienced in softwood stands. For example, mixedwood stands are less susceptible to spruce budworm outbreaks and are more likely to contain abundant advanced regeneration. Also, because vascular plant diversity is greater in mixedwood stands than in softwood forests, mixedwoods may be more resistant to the invasion of pioneer plant species.

Figure 2.

Proposed silvicultural model based on natural dynamics of mixedwood sites.



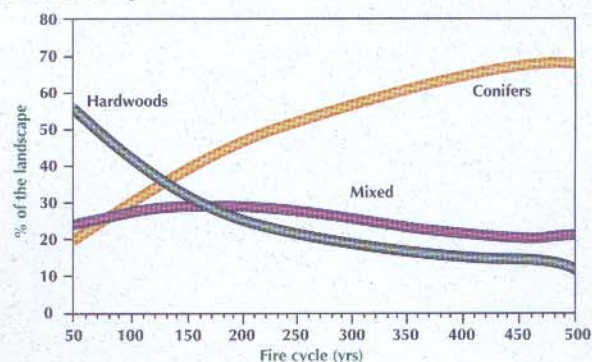
MANAGING THE LANDSCAPE

In this study the natural disturbance regime, driven by fire and spruce budworm, is being used to determine the best way to distribute the stands over the landscape. For boreal mixedwoods, Bergeron and Dansereau (1993) (see Bergeron and Harvey, 1997) developed a simple model that enables prediction of the proportion of each stand type as a function of the fire cycle (Figure 3). In the Lake Duparquet Forest, hardwoods dominate the landscape up to a fire cycle

of 100 years and the proportion of softwood-dominated stands increases as the fire cycle lengthens. Mixedwood stands, however, remain abundant even for very long fire cycles. This is due to the constant presence and periodic outbreaks of spruce budworm, which contribute to the maintenance of a good proportion of mixedwood stands. In assuming a natural fire cycle of approximately 100 years, for example, the landscape should ideally be made up of about 50% hardwood, 35% mixedwood and 15% softwood stands.

Figure 3.

Proportion of hardwood, mixedwood and softwood stands in the landscape in relation to fire cycle.



CONCLUSIONS

Two processes that may be essential for the maintenance of diversity and long-term productivity are temporal replacement of species and the presence of a natural mosaic of stands at the landscape level. These two principles should be applied in a flexible manner in order to take operational limitations into consideration. The need to adhere to strict forest management regulations and silvicultural prescriptions should be avoided and variations in scenarios should be advocated.

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