Understorey Protection as an Alternative to Clearcutting in Boreal Mixedwoods

Introduction

Fig. 1. Aspen-spruce mixedwood stand, showing overstorey aspen with understorey white spruce.

Trembling aspen (*Populus tremuloides* Michx.) and white spruce (*Picea glauca* (Moench) Voss) dominated mixedwoods in the western Canadian boreal forest are an important source of wood fibre to the forest products industry, and these species provide many ecological benefits. Many of these stands are characterized by immature white spruce under a mature aspen canopy. Conventional practice had been to clearcut these stands and allow aspen and poplar trees to regenerate by sucker or seed, while attempting to protect immature white spruce by avoiding single trees during tree-length harvest and skidding. Only a few white spruce trees remain standing after harvest, because of harvest and skidding damage; most of those blow down soon afterward. In light of this situation, forest managers are seeking innovative ways to manage and regenerate these stands.

Methods

Fig. 2. Aerial photo mosaic of northern Alberta study site, June 1999, after second pass harvest.

In response to this concern, the Canadian Forest Service established two studies in central and northern Alberta, Canada, in 1987 and 1993, respectively, in cooperation with industrial, government, and research partners. These studies tested harvesting equipment and various partial-harvest silvicultural systems designed to protect and minimize wind damage to the retained immature white spruce as well as encourage vigorous hardwood regeneration following harvest of the aspen overstorey. These studies used innovative harvesting systems to remove the aspen overstorey (often leaving some aspen residual for wind protection) while retaining the white spruce understorey. The tested silvicultural systems included modified uniform shelterwood, strip shelterwood, alternate strip harvest, progressive shelterwoods, and clearcutting with avoidance of immature white spruce.

Fig. 3a and 3b. Two-pass modified uniform shelterwood, after first and second pass harvest, northern Alberta study

Fig. 4. White spruce growth response, 5 years after harvest, central Alberta.

Results

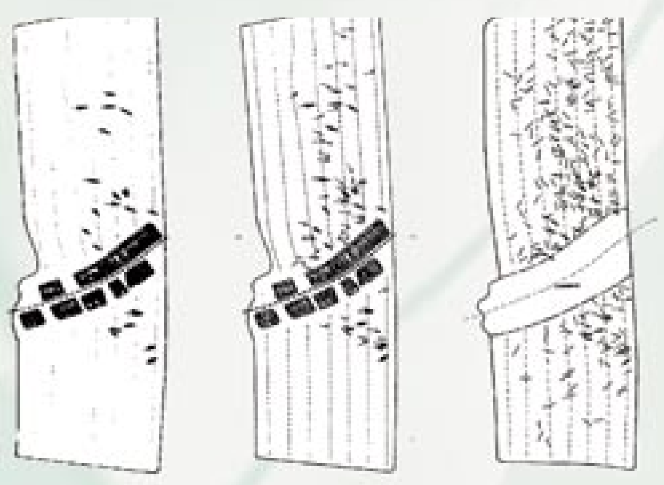

Fig. 5. Pattern of white spruce windthrow over 4-year period in 150-m alternate two-pass strip cut, northern Alberta study.

Research showed that the best silvicultural systems protected up to 60% of the immature white spruce during aspen harvest, while maximizing post-harvest wind protection and growth response of the spruce. These systems provided a range of wind protection, with immature white spruce greater than 7 m tall or trees in cut areas greater than 80 m wide (2.5 x canopy height) being most susceptible to windthrow.

The tradeoff between spruce growth response and wind protection was best met with 8-15% aspen retention, using a 5-m uncut aspen residual strip alternating with 30-40 m of overstorey harvest. The 5-year post-harvest periodic annual volume increment of individual white spruce has doubled in some cases, with an area-based average growth increase of at least 20% in some cases over the uncut controls. The central Alberta study showed an increase in the rate of growth after the initial 5-year post-treatment period.

Results also indicate significant hardwood regeneration in a range of harvest systems. The success of hardwood regeneration was related to the pre- and post-harvest density and distribution of overstorey aspen and understorey spruce, the harvest pattern used, the number of machine passes down an extraction corridor, the season of harvest, and the amount of ground disturbance during harvesting.

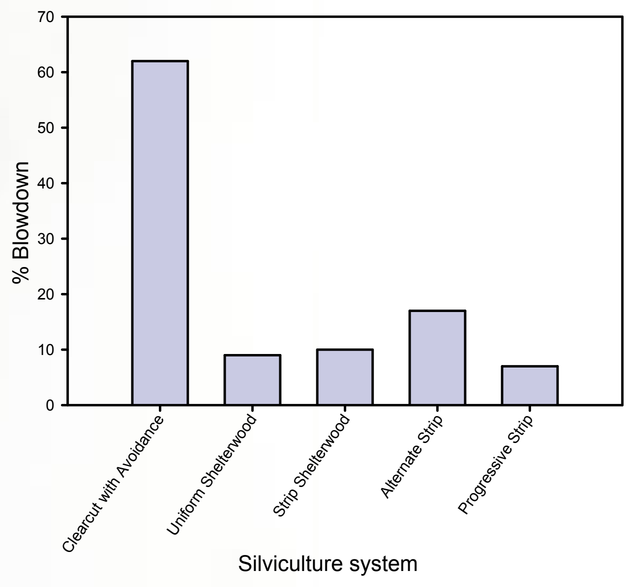

Fig. 6. Windthrow, 5-year response by silvicultural system, northern Alberta study.

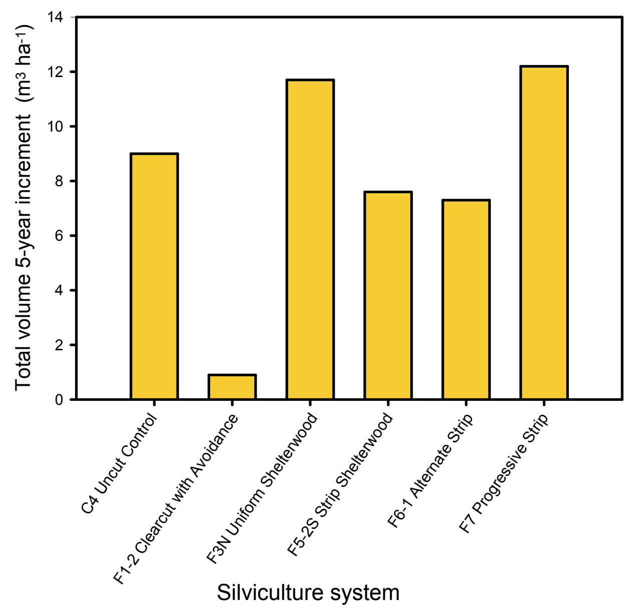

Fig. 7. White spruce volume growth response for high vigour trees, 5 years after harvest, by selected treatments, northern Alberta.

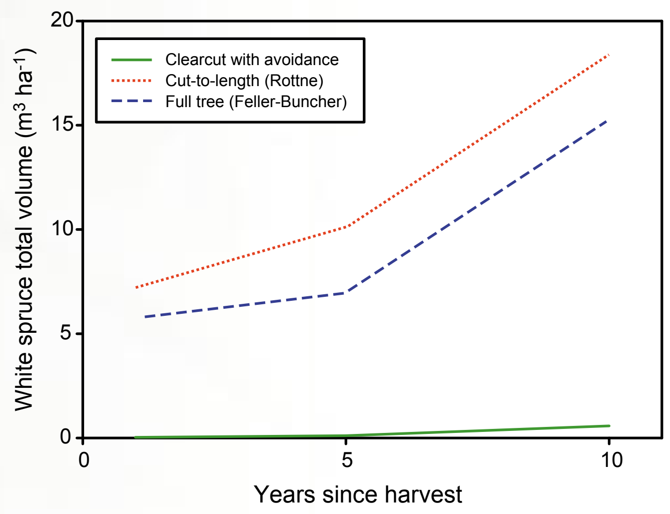

Fig. 8. White spruce volume growth response 10 years after harvest, central Alberta.

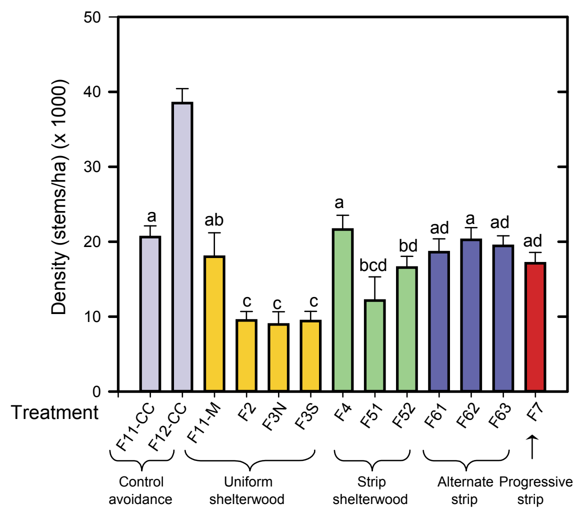

Fig. 9. Broad-leaved deciduous regeneration 8-year density response, northern Alberta study.

Conclusion

Current research questions include the development of longer term growth projections for the immature white spruce to determine the potential tradeoffs between coniferous and deciduous users of the mixedwood landbase. As well, we are working on the longer term response of coniferous and deciduous regeneration established after an understorey-protection harvest and the influence of pre- and post harvest mixedwood density and spatial relationships in subsequent stand development and productivity. The collection of additional data from these long-term studies will provide invaluable information to assist in answering these questions.

Mixed-wood silviculture systems are an increasingly important tool being considered by forest land managers to sustainably manage forests around the world. This research is being used to develop monitoring protocols, modelling approaches, and longer term growth projections for mixed-wood stands. This will assist managers to more efficiently coordinate their harvesting and stand-tending activities in order to improve forest management for both conifer and deciduous users. The systems developed in this research can be modified and applied to a variety of stand compositions, density, and stocking situations and to a range of sites across the circumpolar boreal biome. In addition, they provide a management template for other forest regions. Given the international focus on sustainable forest management and a desire to balance areas under intensive plantation management with extensive management practices, the results of this research may be transferable to other countries that have similar forest types and structures.

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