APPLYING THE ECOSYSTEM MO
MANAGEMENT IN WE

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ABSTRACT: FORCYTE-11 gives a plausible simulation of white spruce (Picea glauca Moench [Voss]) and aspen (Populus tremuloides Michx.) mixedwood stand development and response to management. We have reasonable confidence in the relative ranking of alternate scenarios. Absolute yield predictions have not been validated and we do not consider them reliable. Conifer conversion which uses aspen as a source of nutrients may improve the site quality and increase the yield of spruce. The results of this analysis for the mixedwood forest suggest that the "double-entry" whole-tree harvest system may degrade the site over multiple rotations. Better calibration field data, particularly for soil and litter components, is required. Dependence of yield results on the magnitude and frequency of slash removal (conventional, whole-tree and complete-tree) should be simulated.

INTRODUCTION

The boreal mixedwoods are an important part of the economic forest land base of west-central Canada and present major challenges for effective stand management. Although softwoods have traditionally been favoured over hardwoods, recent aspen market opportunities have forced the need to manage for both species. In the absence of long-term field data, ecosystem simulation studies with FORCYTE-11 are used to assess long-term site productivity impacts of proposed management practices. FORCYTE-11 (Kimmins et al. 1990) is an ecologically-based forest stand model for the examination of the medium- and long-term consequences of different management scenarios for site fertility, nutrient cycling, and biomass yield.

METHODS

A dataset for three nutritional site qualities (low, medium and high) for white spruce and aspen has been assembled. The dataset is based on field data, literature, STEMS* projection (Grewal et al. 1989; 1990) and estimation. This developmental mixedwood dataset allowed simulation of changes in nutrient status over a range of site qualities.

The model was used to simulate three mixedwood management systems over two 110 year rotations. In all cases, 50,000 aspen were allowed to sprout at year 1, and 6,000 white spruce regenerated at year 15 in each rotation.

The three management systems (repeated in each rotation) were:

1) Unmanaged mixedwood forest development:

   - simulation of intra- and inter-specific competition between the spruce and aspen:
   - both species allowed to grow freely until age 110.

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2) Conifer release:

- spruce released from aspen at 40 years. Aspen stems + slash left on forest floor to enhance decomposing litter nutrient pool. Herbicide treatment to prevent aspen re-growth.

3) Double-entry harvest:

- harvest of large aspen stems at year 60, allow subsequent aspen suckering.

For all three scenarios, a whole-tree harvest of all standing biomass at the end of each rotation was simulated.

RESULTS

1) Unmanaged forest simulation. Rapid initial increase in aspen stemwood. After 70 years, spruce dominates through competition for light and nutrients. Yields of both species maintained over the two rotations.

2) Conifer release. High spruce stemwood yield at the end of the rotation. May maintain site productivity over multiple rotations if aspen slash left on ground. Produced similar yields in the second rotation as for the first, although a slight decline in aspen stemwood biomass was noted.

3) Double-entry harvest. Maximum utilization of the resource with encouraging yield results. Slight decline in total yield at the end of the second 110 year rotation - may be a result of nutrients removed from the site through the multiple whole-tree aspen harvests. This indicates nutrient conservation or fertilizer applications should be considered to maintain site productivity.

DISCUSSION

Model simulation of mixedwood stand dynamics is sensitive to the empirical description of the species' autecology in the input data. Specifically, the dominance of spruce over aspen is determined by: a) longer retention of spruce foliage; b) deeper spruce canopy development; c) shade tolerant spruce foliage; d) less shade tolerant aspen foliage; and e) spruce photosynthesis during winter when aspen leafless. The yield declines with double entry harvest appears to be related to nutrient losses. Can this be averted by stem-only harvest practises? This analysis does not include effects of soil compaction and erosion, both of which may have a significant impact on site productivity.

LITERATURE CITED

GREWAL, H., M.J. APPS, D.A. MACISAAC. 1989. Using the STEMS and FORCYTE-11 computer models for mixedwood forest management. Pages 175-179. in E.N. Hogan, ed. Seventh Canadian Bioenergy R&D Seminar. Ottawa, Canada. Energy, Mines, and Resources Canada.

GREWAL, H., M.J. APPS, and D.A. MACISAAC. 1990. Using a traditional growth and yield model (STEMS) to drive a management simulator (FORCYTE-11). Page 225-233. in L.C. Wensel and G.S. Biging, technical editors. Forest Simulation Systems. Proc. Int. Union For. Res. Organ. Conf., November 2-5, 1988, Berkeley, California. Univ. of Calif., Div. Agric. Nat. Resour., Oakland, California. Bull. 1927.

KIMMINS, J.P., K.A. SCOULLAR, M.J. APPS. 1990. FORCYTE-11 Users' Manual. Forestry Canada, Northwest Reg., North. For. Cent., Edmonton, Alberta.

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