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Institut de recherche sur les feuillus nordiques Inc.
Northern Hardwoods Research Institute Inc.

Effects of Juvenile Suppression on Stem Quality Development of Sugar Maple and Yellow Birch

September 2015

Technical Note

Resource Characterization

Introduction

Sugar maple (*Acer saccharum* Marshall) and yellow birch (*Betula alleghaniensis* Britton) trees are supposed to endure long period of juvenile suppression. Longer suppressed trees are more prone to be repeatedly damaged by wildlife and operations. Size and intensity of such damages may deteriorate stem quality. This study, thus, aims at exploring effects of juvenile suppression on subsequent tree grade development (presence or absence of damages on tree stem).

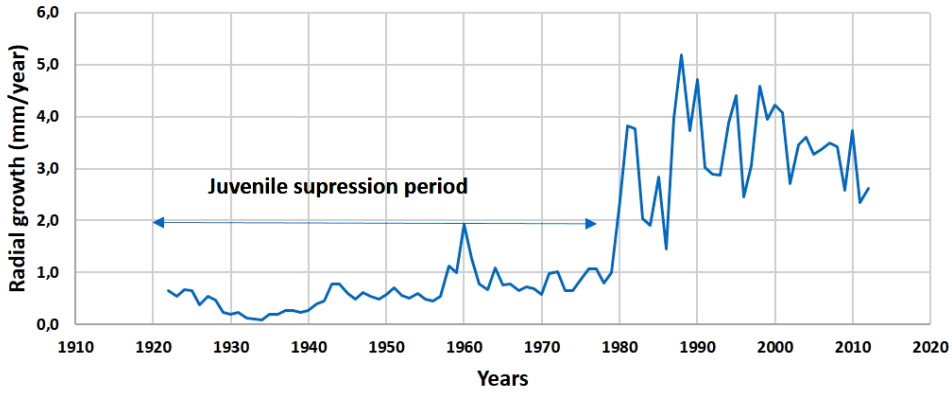

Figure 1: Tree ring chronology of sugar maple showing a period of juvenile suppression.

Highlights

- ***Trees that are suppressed longer tends to be defective in the future, which may reduce stand quality and reduce sawlogs yields.***
- ***Site factors (slope and productivity) and numerous harvest entries are other factors that influence tree grade and value.***

Methodology

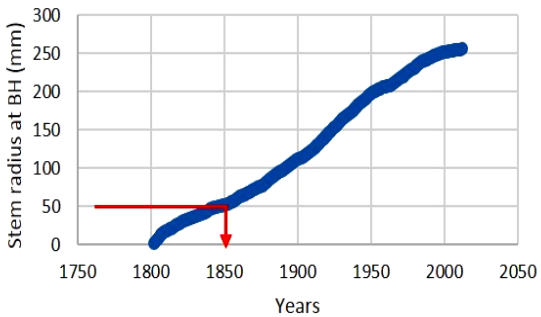

Figure 2: An approach to determine period of juvenile suppression.

The study was conducted in the northern hardwood forests of the Acadian region in northwest New Brunswick. It was based on a sample of 334 trees of sugar maple and yellow birch growing in 116 different plots located in 46 different stands from northeastern side of Edmundston, New Brunswick. The

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sample trees were cored at breast height for estimating period of juvenile suppression. Period of juvenile suppression was defined as years taken to reach 10 cm diameter at breast height as shown in Figure (2). Stand characteristics as well as presence of defects on sample trees were observed during field survey. Previous harvesting records were obtained from Acadian Timber Corp, physiographic information was extracted from digital elevation model obtained from Department of Natural Resources, New Brunswick. An index of site quality (biomass growth index) for each plot was obtained from Acadian site model.

Assessment of tree stem quality

A generalized linear model with binomial distribution was calibrated to predict the occurrence of stem damage because the probability of a tree to be associated with stem damage (dependent variable) is designed as a binary response. This study examined these next effects on the stem damage of trees: tree's diameter, age, period of juvenile suppression, number of harvest entries, stand basal area, slope of the land, altitude, site quality, and species. In the model's formula, the probability of a tree to be damaged would be between 0 and 1 ($0 \leq D_p \leq 1$).

$$D_p = \frac{1}{1 + e^{[-(a_0 + a_1 \times PJS + a_2 \times NHE + a_3 \times Slope + a_4 \times SBA + a_5 \times SQI)]}}$$

Where:

D_p = Probability of a tree to be associated with damages

PJS = Period of juvenile suppression (years)

NHE = Number of previous harvest entries

Slope = Slope of the land (%)

SBA = Residual stand basal area at the time of last harvest (m^2/ha)

SQI = Site quality index (ton/ha/yr.)

a_i = Parameters to be estimated

Results

1. Longer suppressed trees are more likely to possess stem damage (Figure 3).

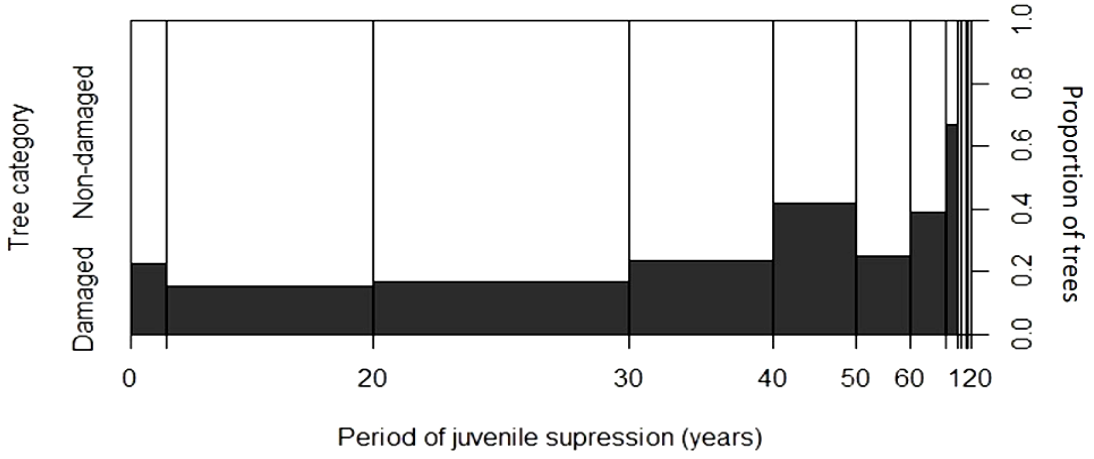

Figure 3: Proportion of sample trees possessing stem damages as period of juvenile suppression increases.

2. Effects of stand and site variables on probability of a tree to have defects (Figure 4).

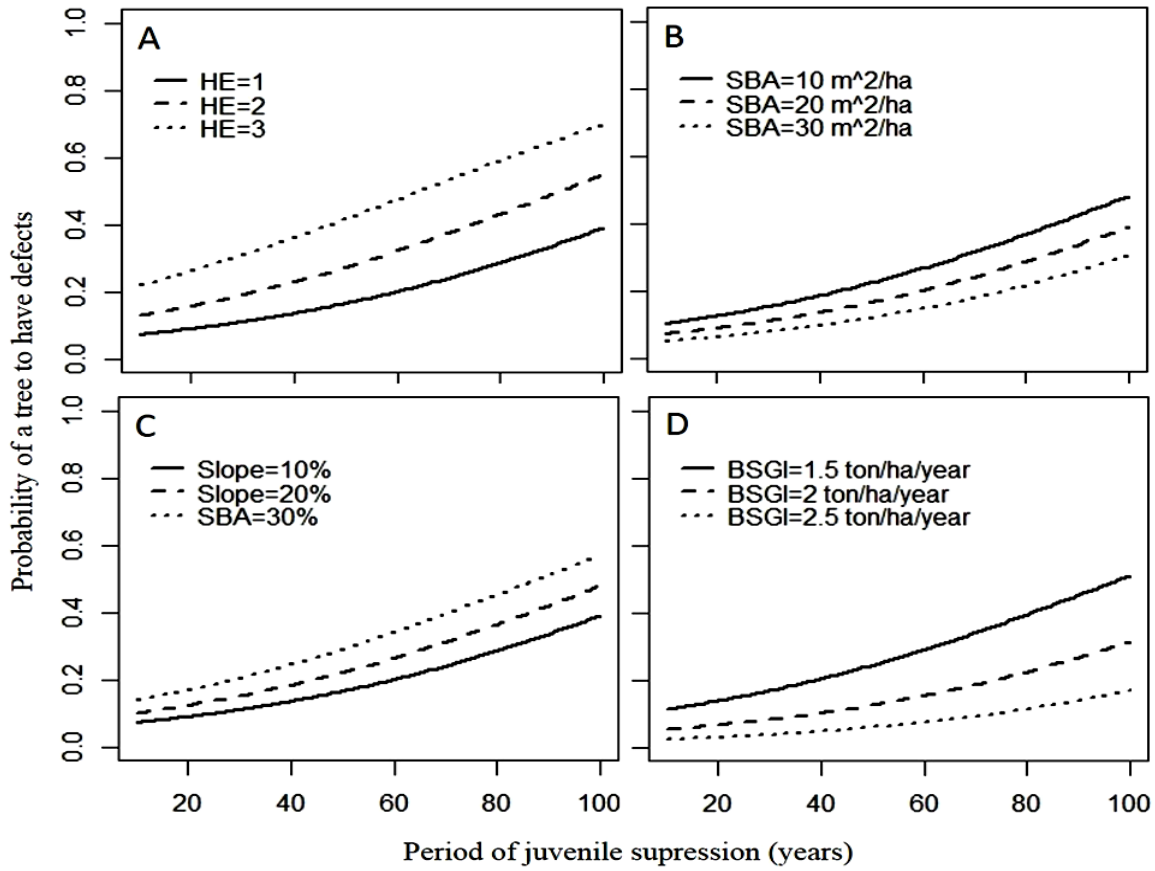

Figure 4: Predicted probability of a tree to have defects with increasing period of juvenile suppression, (A) effects of number of previous harvest entries (1,2, and 3), (B) effects of stand basal area at the time of recent harvest (10,20, and 30 m^2/ha), (C) effects of slope (10%,20%, and 30%), and (D) effects of site quality index by biomass growth index (BSGI:1.5, 2.0 and 2.5 ton/ha/year). Mean value was used to control the effect of other explanatory variables.

Conclusion

Since advance regeneration and saplings are more likely to be damaged during harvesting operations by repeated harvest entries and by wildlife, the probability of a tree being damaged increases as the period of juvenile suppression history gets longer. Moreover, trees are more prone to damage as the slope of the site increases. Thus, it would be less probable for a tree to be damaged in a better-quality site, achieving a given diameter tree size faster due to a shorter time exposure to damaging agents.

Although the likelihood of a tree to be damaged decreases as the distance between residual trees increases, our findings indicates that there is a higher probability that a tree could be injured in a lower residual basal area stand. This might be because previous harvesting entries, in which most of the quality trees were harvested, left low-vigour, residual trees in the lower basal area stand.

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