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An Investigation of Yellow Birch Seedling Recruitment in Retention Seed-Tree Cut Treatments

January 2017

Technical Note

Silviculture

Introduction

In the seed tree silvicultural system, a few live trees are retained on the cut block to provide seeds for the forest regeneration. This method is thought to be an economical option for forest renewal. One concern of this approach of naturally regenerating forest stands is the longevity of the retained trees and interference from non-commercial vegetation. We have investigated the seed-tree approach to naturally regenerate stands in hardwood stands in New Brunswick.

Highlights

- ***Distance to a seed-tree had a significant effect on the relative density of yellow birch and indicates that seed dispersal range is crucial for successful recruitment of yellow birch.***
- ***A best practice is to leave at least 10 to 20, evenly spaced mature yellow birch trees per hectare that are capable of producing seeds.***
- ***After seedlings establishment, competition will become the next important factor.***

Methodology

Six blocks recently harvested using the retention seed-tree cut were selected across northwestern New Brunswick. In each block, two transects were established . We recorded all regeneration (0.3 m ≤ trees ≥ 1.3 m tall) by species in 1.46 m radius circular plots along each transect at 1, 5, 19, 15, 30, 50, 70 m from the base of each seed-tree. The form and risk classes of each seed-tree were recorded. Evidence of regeneration browsing by moose and or deer were also recorded in each circular plot.

We developed and tested three species-specific candidate models that represented relationship between the relative proportion of the species and (1) time since last harvest, (2) distance to seed-tree, (3) seed-tree form class, (4) seed-tree risk class, and (5) the relative density of non-commercial tree species.

Table 1: Summary of variables considered in the models

Variables	Mean ± SE	Minimum	Maximum
Time since last harvest (years)	3.6 ± 0.10	1	6
Distance to seed-tree (m)	26 ± 0.67	1	70
Seed-tree form class	—	F1	F8
Seed-tree risk class	—	R1	R4
Relative density of non-commercial species	0.4 ± 0.02	0	1

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Table 1: Parameter estimates for best model for yellow birch, sugar maple, and red maple seedling proportions.

Variables	Yellow birch	Sugar maple	Red maple
Intercept	-0.160953	-2.406351	-2.50515
Time since last harvest (years)	—	0.202931	1.49269
Time since last harvest poly(2)	—	—	-0.29089
Distance to seed-tree (m)	0.081702	-0.020997	—
Distance poly(2)	-0.001209	—	—
Relative density of non-commercial species	-3.265272	-1.935322	-1.8759

The model to predict the relative density of yellow birch seedling is a function of distance to seed-tree and competition from non-commercial tree species (relative density of non-commercial tree species) (Equation 1), in which (β_x all taken from the "yellow birch" column of Table 1):

Y = prediction model for yellow birch seedlings, Rd_NComm = relative density of non-commercial species

β_0 = intercept coefficient, β_1 = distance to seed tree, β_2 = distance poly(2), and β_3 = relative density

$$Y = \left[1 + e^{\left(-(\beta_0 + \beta_1 \times distance - \beta_2 \times distance^2 - \beta_3 \times Rd\_NComm)\right)}\right]^{-1} \quad (1)$$

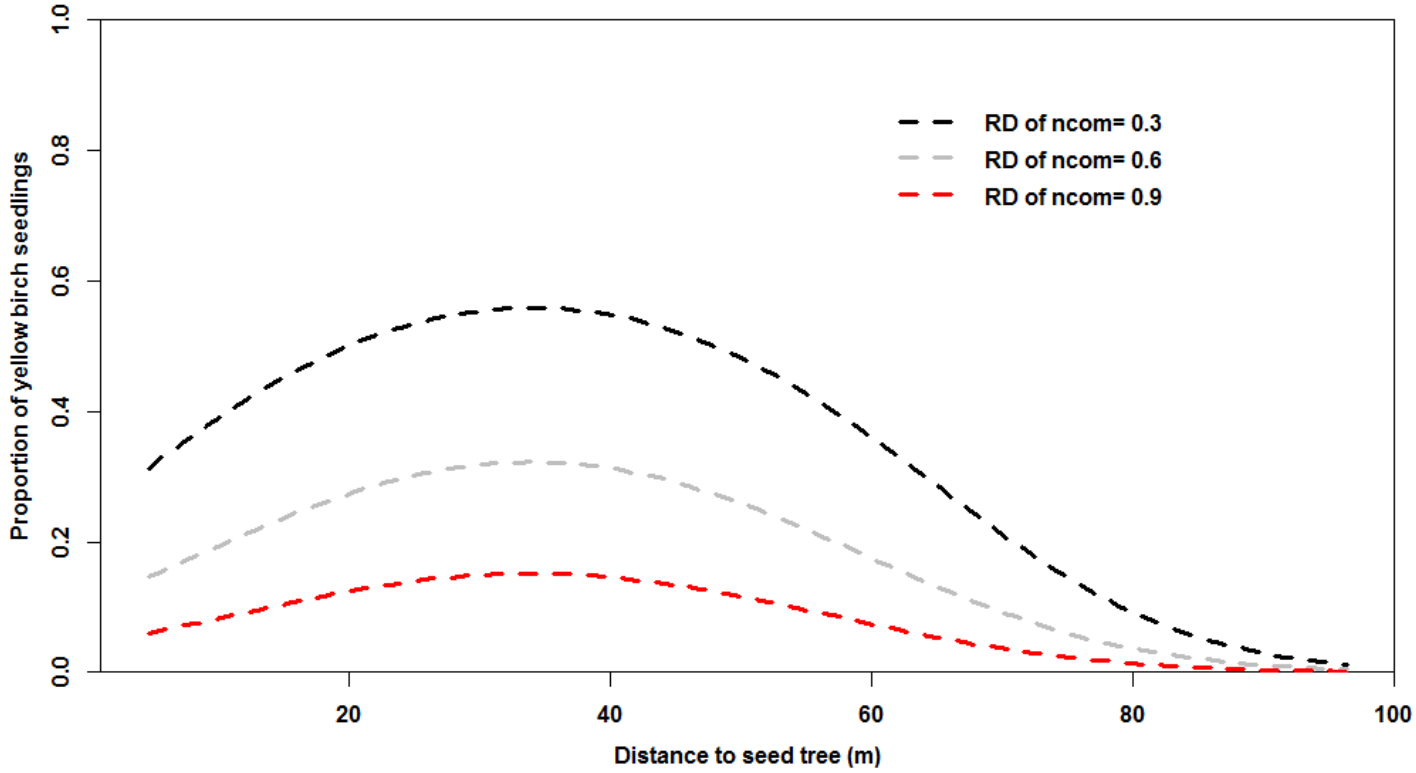

Figure 1: The predicted proportion of yellow birch seedlings as a function of distance to seed-tree and competition from non-commercial tree species.

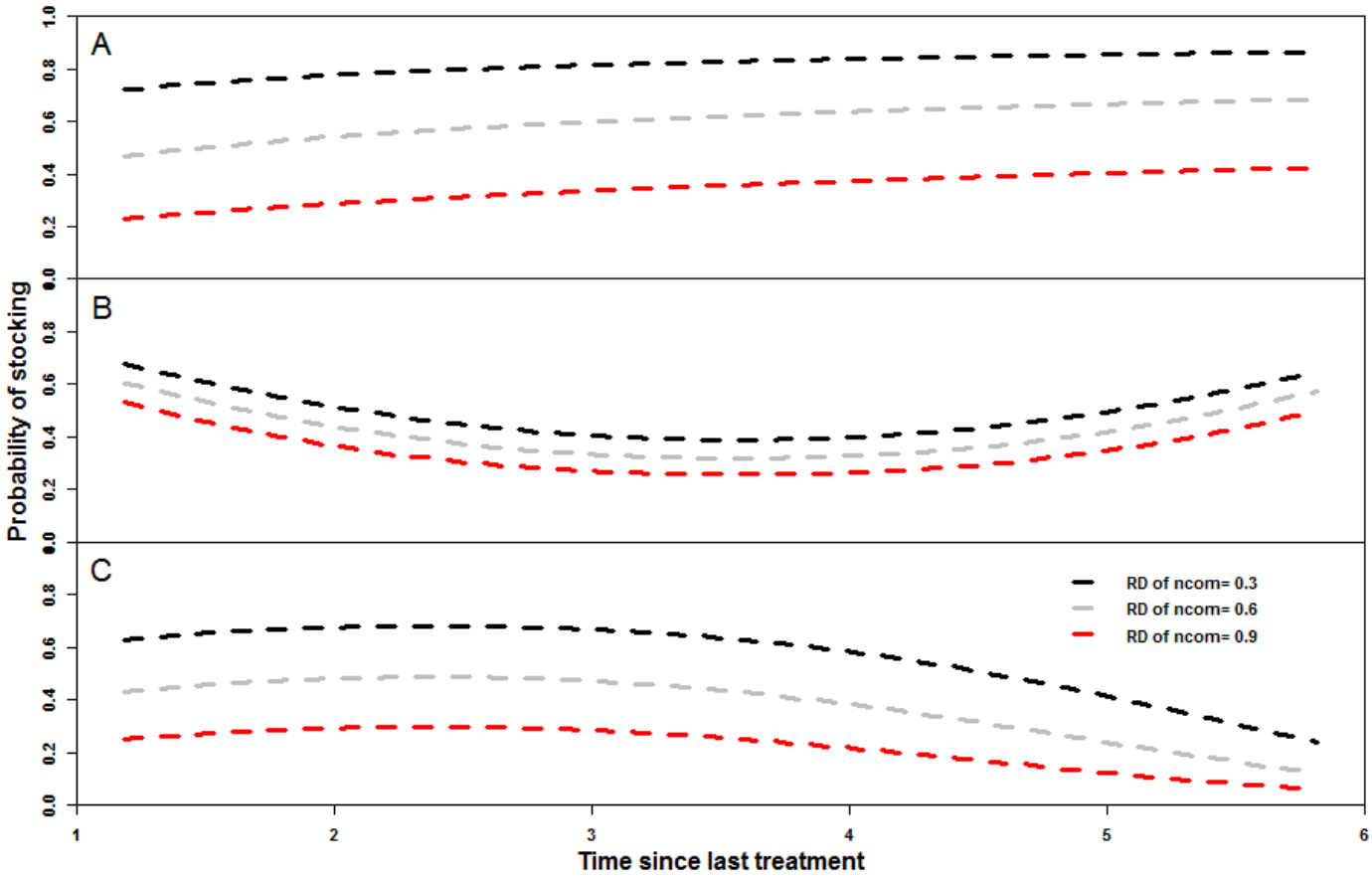

Figure 2. The predicted probability of stocking (at least one seedling of desired species present in a plot) for yellow birch (A) and red maple (B) as a function of time since the last cut and competition from non-commercial tree species.

Table 2: Parameter estimates for best model for yellow birch, and red maple stocking (probability of finding at least one yellow birch or red maple within a 6.7 m^2 plot .

Variables	Yellow birch	Red maple
Intercept	1.9315	0.97988
Time since last harvest (years)	0.5692	0.92218
Time since last harvest poly(2)	—	-0.19382
—	—	—
—	—	—
Relative density of non-commercial species	-3.5967	-2.54283

Conclusion

Our analysis confirmed that the proportion of yellow birch seedlings was generally increased up to 40m away from a seed-tree and declined thereafter (Fig. 1). The optimum distance between seed trees for yellow birch seedling recruitment ranges from 30m to 40m. However, relative density of yellow birch seedlings was negatively influenced by competition from non-commercial tree species within each plot (Fig. 1). The model (equation 1) to predict yellow birch seedling proportion is a function of a distance to seed-tree and the relative abundance of non-commercial species. Some of the unexplained variation in yellow birch seedling proportion could be related to other factors unaccounted for in the model such as seedbed type, climate and seed-tree characteristics. It should be noted that the model exposed in this technical note (referred to as Equation 1) is not calibrated for sugar maple, red maple, nor any other tree. Use of the equation for other species than yellow birch, although not advised, is risky and has to be made with the user's experience and knowledge.

The probability of obtaining at least one yellow birch seedling in the stand increased with increasing time since the last harvest (Fig. 2A). Sugar maple stocking probability generally declined with time since the last harvest (Fig. 2B) while red maple remained flat up to three years after harvest and declined thereafter (Fig. 2C).

This study demonstrates that important implications for tolerant hardwood management under seed-tree silvicultural system, in northwestern New Brunswick. While only a modest number of seed-trees might be required for yellow birch under this system, the rate of success might be limited by competition from non-commercial tree vegetation and other factors such as climate and seedbed type. To ensure adequate regeneration and recruitment of yellow birch, management efforts should focus on limiting competition and interference to yellow birch regeneration and recruitment.

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