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

Role of Advance Regeneration on Future Stand Development Along a Gradient of Time since Harvest and Harvest Intensity

September 2015

Technical Note

Silviculture

Introduction

Partial harvesting has been used as a strategy to sustain the production of high quality sawtimber in northern hardwood forests. The recommendation is based on the premise that the quantity of advance regeneration is generally adequate to regenerate stands after harvest. Partial harvesting in northern hardwood forests often uses the responses of important species to determine the intensity and method of harvest. For example, larger gaps are created to regenerate mid-tolerant species while smaller gaps are created to regenerate shade-tolerant species. The application of partial harvesting relies on advance regeneration and new recruitment to regenerate stands after harvest. Our knowledge of the appropriate cover to retain for successful canopy recruitment and the role advance regeneration play in stand development following partial harvest in northwestern New Brunswick is still limited.

Highlights

- ***A harvest entry cycle of less than 20 years can ensure advance regeneration recruitment into merchantable diameter classes.***
- ***Protection of advance regeneration during harvesting will ensure enough recruitment into merchantable diameter classes.***
- ***Maintain at least 20% canopy cover, especially in a two-aged stand, to reduce the risk of regeneration mortality and improve stand quality over time.***

Methodology

The study area comprised of 32 partially cut stands selected from 57 potential sites in northwestern New Brunswick. All live overstory trees and snags having a DBH ≥ 10cm were sampled at each sapling plot with a 3BAF prism and tallied by species. Saplings (trees of or taller than 1.3m and DBH < 10cm) were sampled in 3.57m radius plots. Increment cores were extracted at breast from live overstory trees and saplings to determine diameter at time of harvest. For saplings that were too small to core, disks were extracted at both stump and breast height. The percent basal area (BA) removal was estimated as %BAcut = (BAcut) / BAcut + Residual BA + Mortality BA)*100.

DBH at the time of harvest for all overstory trees in each plot was reconstructed using the method described by Bakker (2005). We used DBH-crown width equations to reconstruct the percent cover opening for each plot.

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Results

1. Composition of pre-existing advance regeneration immediately after harvest.

Pre-existing advance regeneration density (% density)		Current overstory trees (trees/ha)		Stand Type	
Hard-wood	Soft-wood	Hard-wood	Soft-wood	Residual stand	Current overstory
60	40	279	114	H	H
50	50	524	268	H	HS
43	57	293	374	H	HS
75	25	193	0	H	H
38	62	347	470	HS	SH
89	11	504	33	H	H
76	24	728	90	H	H
100	0	672	23	H	H
83	17	727	375	H	H
83	17	380	97	H	H
93	7	635	44	H	H
80	20	258	61	H	H
91	9	286	27	H	H
100	0	243	14	H	H
75	25	435	29	H	H
78	22	682	58	H	H
93	7	226	169	H	H
94	6	439	20	H	H
52	48	1198	96	H	H
75	25	493	71	H	H
75	25	152	31	H	H
100	0	582	27	H	H
94	6	222	0	H	H
83	17	239	34	H	H
86	14	194	13	H	H
84	16	321	144	H	H
57	43	405	0	H	H

Hardwood advance regeneration immediately after harvest dominated 82% of all stands, while 7% of the stands was dominated by softwood advance regeneration.

Table 1: Composition (% density) of pre-existing advance regeneration (for a trees ≥ 1.3m and DBH > 10cm) immediately after harvest, density of current overstory (DBH ≥ 10cm), residual and current overstory type for 27 partial harvest stands.

H = Stand with ≥70 % of basal area composed of hardwood tree species

S = Stand with ≥70 % of basal area composed of softwood tree species

HS = Stand with 50-69% of basal area composed of hardwood tree species.

SH = Stand with 50-69% of basal area composed of softwood tree species.

2. Diameter distribution by cohort class in advance regeneration stands.

Pre-existing advance regeneration density increased gradually from stands harvested 10 years before sampling date and peaked at 22 years after the harvest. The pre-existing advance regeneration accounted for most of the small diameter trees (10-19cm) in stands harvested between 10 and 20 years before sampling date. Pre-existing advance regeneration diameter increased into the medium classes (20-30cm) in stands with more than 20 years since the last harvest.

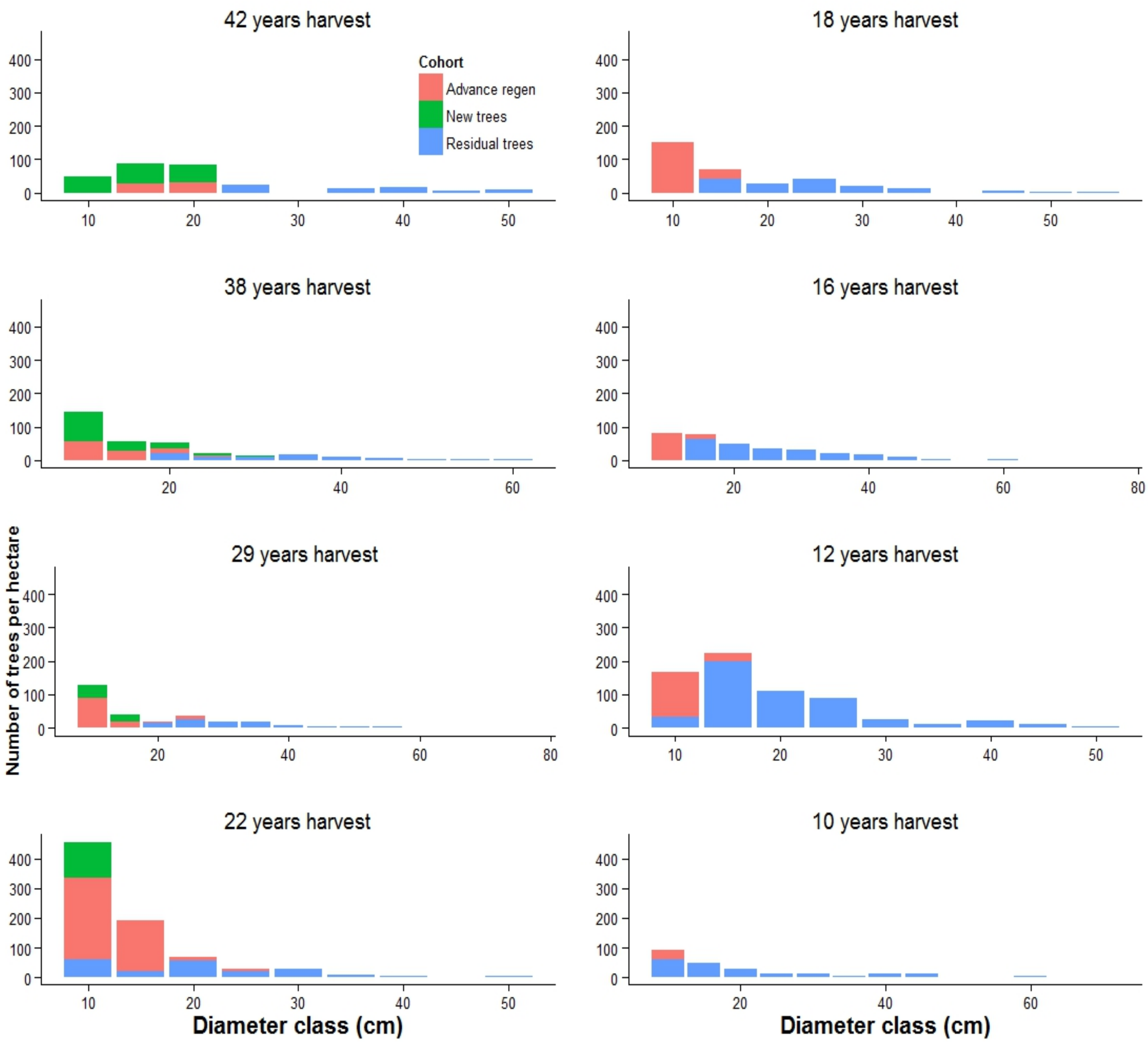

Figure 1: Diameter distribution of trees (DBH ≥ 10cm) by cohort class and years since the last harvest (Advance regen = Pre-existing advance regeneration; RT = Residual trees; New trees = new recruitment after harvest). Each graph represents a separate stand.

3. Overstory and basal area growth proportions.

The proportion of tolerant hardwoods regeneration (TOHW-regeneration, such as yellow birch, sugar maple, and red maple) in the current overstory density significantly increased with time since harvest, and tended to increase as %BA removal increased, but the trend was not significant (Fig. 2A and 2C). The proportion of TOHW-regeneration in the current overstory density increased as percent canopy opening increased, up to about 80-82% canopy opening, and then declined thereafter (Fig. 2B).

The proportion of current overstory BA comprised of TOHW-regeneration showed a positively linear trend with increasing time harvest, percent canopy opening and BA removal (Fig. 2A-C). However, the trend was not statistically significant with percent canopy opening.

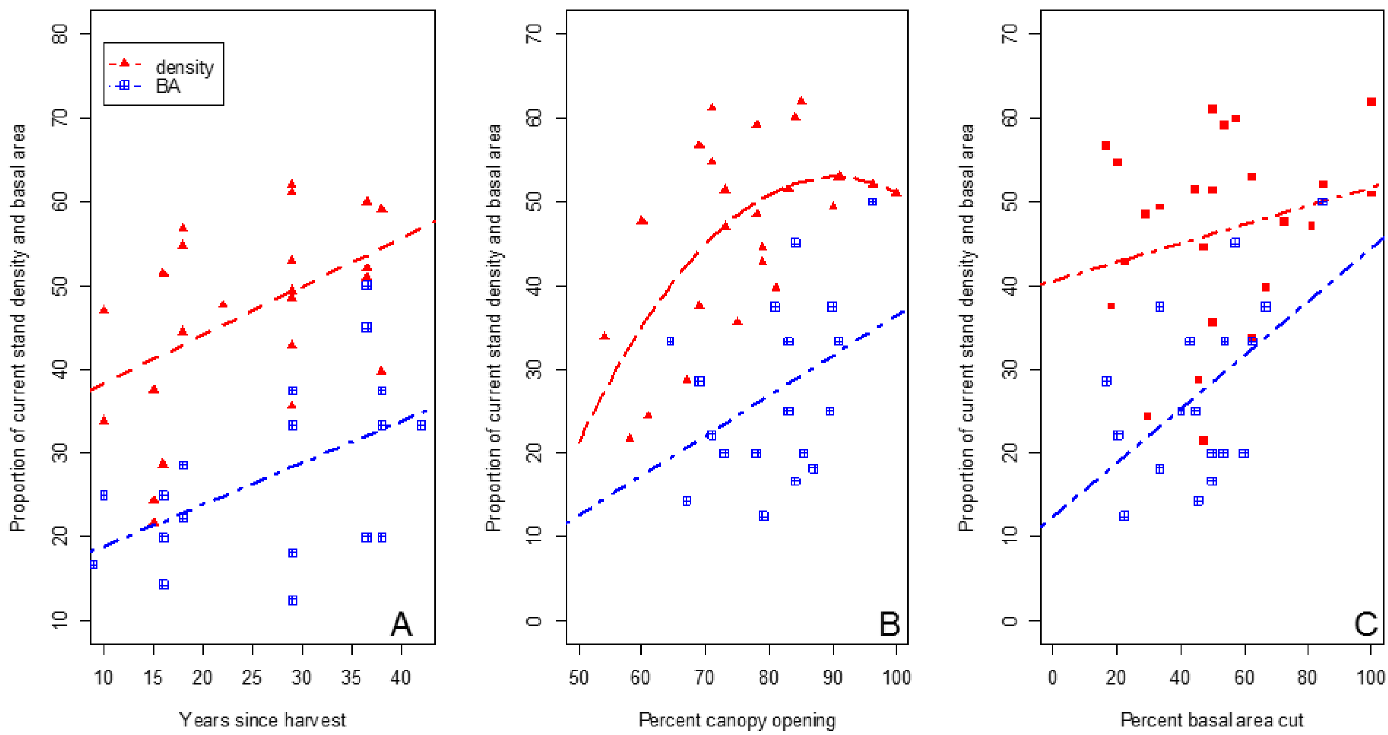

Figure 2: The proportion of seedlings and saplings of yellow birch, sugar maple and red maple (referred to as TOHW-regeneration) in the current overstory density and basal area, as functions of years since harvest (A), percent canopy opening (B) and percent basal area removal (C).

Conclusion

The proportion of regeneration basal area in the current stand was positively and linearly related to time since harvest, percent canopy opening and BA removal. The regeneration density increased as percent canopy opening increased, up to about 75%, and then plateaued. The proportion or regeneration remained relatively constant from 75-85%, decreasing thereafter as percent canopy opening increased. The proportion of regeneration density tended to increase with increasing percent canopy opening, but the trend was not statistically significant. The current stand density and basal area are made up of about 60% new and advance yellow birch, sugar maple, and red maple regeneration at the time of harvest. The results show greater importance of canopy openness in regeneration abundance while higher percentage basal area cut promotes regeneration, diameter and basal area growth.

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