



FOREST RESEARCH REPORT

No. 57 March, 1995

REGENERATION FOLLOWING WHITE PINE SHELTERWOOD CUTS IN SHELBURNE CO., N.S.

Introduction

Shelburne County has historically been one of the best white pine (*Pinus strobus* L.) growing areas in Canada, and still maintains one of the highest concentrations of white pine volume in the country (Lowe, 1994).

In recent years, efforts have been made to re-establish white pine by the shelterwood method in the western end of Nova Scotia. This involves the removal of 30 - 50 percent of a stands basal area to create light conditions suitable for regeneration establishment and growth. It has been well documented elsewhere that white pine regenerates successfully under the uniform shelterwood system on coarse, infertile, well drained, shallow soils where hardwood competition is not a problem (Lancaster and Leak, 1978; Corbett, 1994; Heckman et al., 1985). Mechanical scarification to break up the duff

layer and expose some mineral soil also improves white pine regeneration success under a shelterwood overstorey (Lancaster and Leak, 1978; Stiell, 1977; Heckman et al., 1985). Treatments should be made during or immediately after abundant seed years (Lancaster and Leak, 1978).

In 1990, the Nova Scotia Department of Natural Resources initiated a regeneration survey of operational shelterwood cuts in five white pine stands in Shelburne County to determine the success of white pine establishment. Stands were selected that contained a predominantly white pine overstorey, prior to being cut using the uniform shelterwood method. Regeneration was examined for dominant and co-dominant stocking, density, height, species dominance, and non-crop competition.

Methods

Stand Selection and Description

Stands were selected according to the following criteria:

1. Shelterwood harvest was conducted in accordance with the CAFD Manual of Procedures and Standards: Technical (Anonymous, 1994).
2. White pine comprised 70 percent or greater of the original overstorey volume.
3. Stands were located in southwestern Nova Scotia.
4. The final cut, (ie. the removal of all mature trees) had not been completed.

Five stands in Shelburne County on private and Crown land that met these criteria were found by local forestry staff. These stands were located at Middle Ohio, Middle Clyde (2 sites), and Purdy Hill (2 sites), and ranged from 5 to 25 hectares (ha) in size for a total of 62 ha.

Prior to treatment, all sites consisted of pure white pine overstories, except Middle Ohio which had 70 percent white pine. The regeneration survey was conducted 1.5, 1.5, 2.5, 5.5, and 7.5 growing seasons after the shelterwood cut respectively, for the Purdy Hill(1), Purdy Hill(2), Middle Ohio, Middle Clyde(2), and the Middle Clyde(1) sites. All shelterwood harvesting was done using skidders to extract tree-length wood during either winter or early spring. Timing of harvest, harvest method, and ground cover resulted in moderate scarification during treatment (MacMillan, per. comm.

Sept., 1994)¹. Thirty-four to forty-nine percent of the original basal area was removed from these stands and residual basal areas ranged from 18 to 22 m²/ha. All stands surveyed were located on well-drained, coarse textured, moderately fertile, gravelly, sandy loam soils.

Sampling Procedure

Each stand was sampled along pre-determined cruise lines at a sampling intensity of 0.5 percent or a minimum of 4 plots per hectare. Circular 16m² plots with a plot radius of 2.25m were used. These were divided into four, 4m² quadrants, permitting calculation of full stocking at 2,500 trees/ha (2m x 2m spacing).

In each quadrant, the dominant species (by height) was recorded along with its origin (seed, stump sprout, etc.) to determine dominant stocking (all commercial species considered). In addition, if a quadrant contained white pine of any dominance class, a separate tally was taken to determine total white pine stocking. Total stem counts and mean heights by species were recorded in the fourth quadrant of each plot.

At each plot, residual basal area, and sample tree measurements were recorded. The white pine seedling nearest the plot centre was selected as the sample tree and measured for height and age.

Stocking and density, in combination with height data, were analysed to determine the relative dominance of species within the stands surveyed in this report.

Results

Results for each stand are shown in Figures 1 to 5 and include a stand description, photograph, and regeneration data. The photographs depict the status of regeneration and

residual overstorey at each site in 1994, four years after the survey was completed. Average heights of regenerated white pine in the photographs are noted below each picture.

¹ Tom MacMillan, Forester, Nova Scotia Department of Natural Resources

Ownership:	Crown	Original BA (m ²):	35
Area (ha):	5	Residual BA (m ²):	18
Treatment Date:	Dec., 1988	Removal %:	49
Survey Date:	June, 1990		
Growing Seasons:	1.5		
# Plots:	15		

Regeneration Species	Dominant Stocking (%)	Height		Density	
		Dominant (cm)	Average (cm)	Stems/ha	% of Total Density
White Pine	7(33) ¹	5	5	6,607	27
Red Maple	65	31	12	17,857	72
Balsam Fir	5	47	15	178	1
Total	77			24,642	

¹ Total white pine stocking for all heights shown in brackets.



Picture Date: Nov./94

Average White Pine Height: 21 cm

Figure 1. Purdy Hill (1), Shelburne County.

Ownership:	Crown	Original BA (m ²):	32
Area (ha):	8	Residual BA (m ²):	19
Treatment Date:	Dec., 1988	Removal %:	41
Survey Date:	June, 1990		
Growing Seasons:	1.5		
# Plots:	27		

Regeneration Species	Dominant Stocking (%)	Height		Density	
		Dominant (cm)	Average (cm)	Stems/ha	% of Total Density
White Pine	38(80) ¹	6	5	45,300	79
Red Maple	43	17	7	11,700	20
Balsam Fir	10	52	6(97) ²	700	1
Total	91			57,700	

¹ Total white pine stocking for all heights shown in brackets.
² Advanced regeneration shown in brackets.



Picture Date: Nov./94

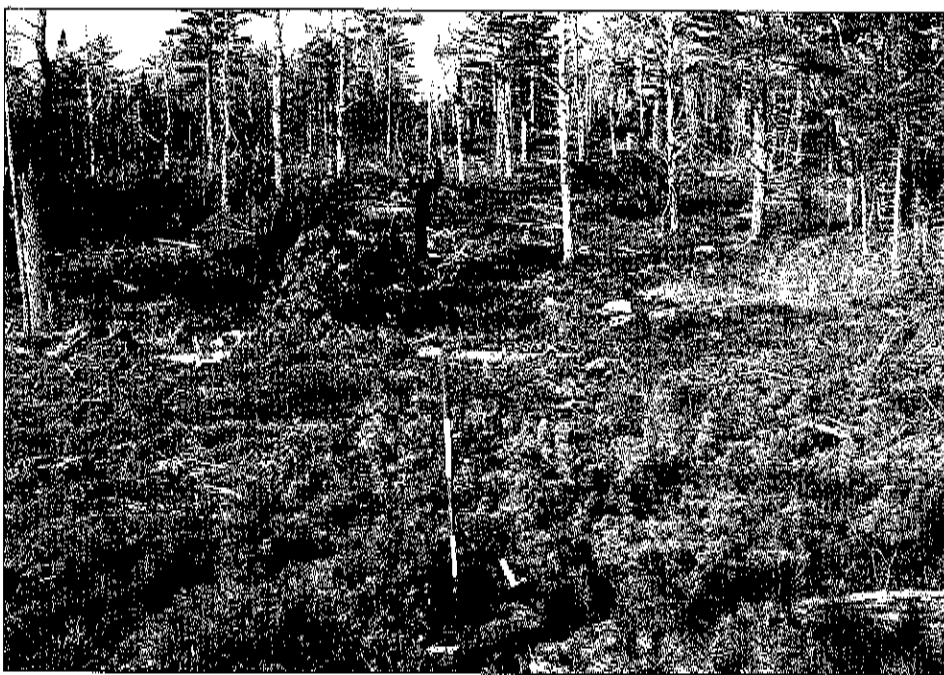
Average White Pine Height: 34 cm

Figure 2. Purdy Hill (2), Shelburne County.

Ownership:	Crown	Original BA (m²):	29
Area (ha):	15	Residual BA (m²):	19
Treatment Date:	Jan., 1988	Removal %:	34
Survey Date:	June, 1990		
Growing Seasons:	2.5		
# Plots:	46		

Regeneration Species	Dominant Stocking (%)	Height		Density	
		Dominant (cm)	Average (cm)	Stems/ha	% of Total Density
White Pine	39(98) ¹	11	7	60,212	81
Red Maple	43	26	12	11,956	16
Balsam Fir	9	61	66	434	-
Spruce	4	42	27	489	1
Others	4	57	53	1,467	2
Total	99			74,558	

¹ Total white pine stocking for all heights shown in brackets.



Picture Date: Dec./94

Average White Pine Height: 53 cm

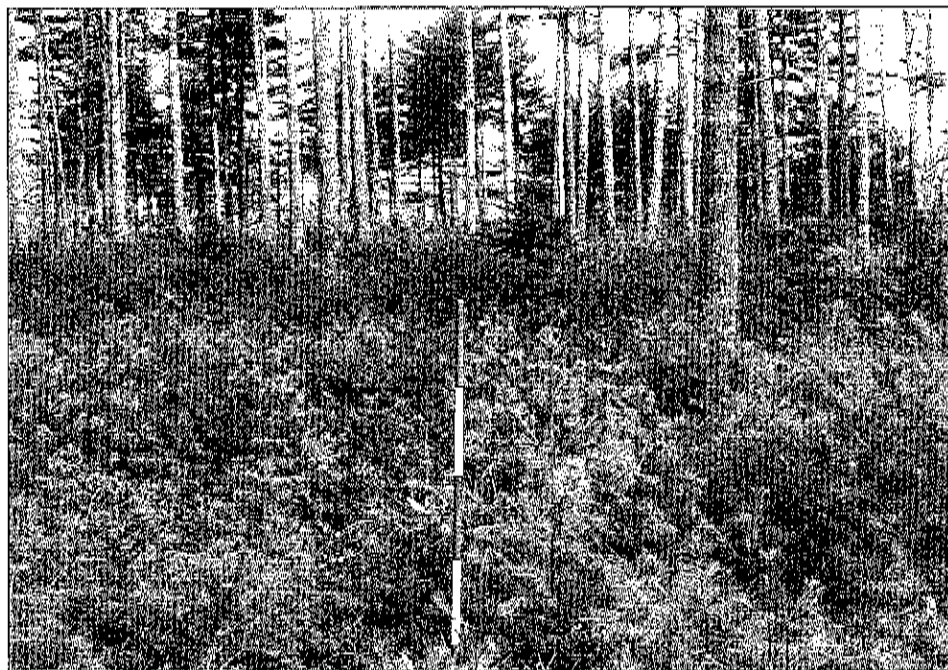
Figure 3. Middle Ohio (2), Shelburne County.

Ownership:	Small Private	Original BA (m ²):	36
Area (ha):	9	Residual BA (m ²):	22
Treatment Date:	May., 1985	Removal %:	39
Survey Date:	June, 1990		
Growing Seasons:	5.5		
# Plots:	28		

Regeneration Species	Dominant Stocking (%)	Height		Density	
		Dominant (cm)	Average (cm)	Stems/ha	% of Total Density
White Pine	57(100) ¹	29	17	91,071	86
Red Maple	18	38	17	6,696	6
Balsam Fir	25	80	15(79) ²	7,142	7
Other				714	1
Total	100			105,623	

¹ Total white pine stocking for all heights shown in brackets.

² Advanced regeneration shown in brackets.



Picture Date: Nov./94

Average White Pine Height: 115 cm

Figure 4. Middle Clyde (2), Shelburne County.

Ownership:	Small Private	Original BA (m ²):	35
Area (ha):	25	Residual BA (m ²):	18
Treatment Date:	Dec., 1982	Removal %:	49
Survey Date:	June, 1990		
Growing Seasons:	7.5		
# Plots:	74		

Regeneration Species	Dominant Stocking (%)	Height		Density	
		Dominant (cm)	Average (cm)	Stems/ha	% of Total Density
White Pine	53(93) ¹	25	11	40,915	75
Red Maple	11	29	14	11,795	22
Balsam Fir	29	103	92	1,585	3
Spruce	1	71	12	35	--
Total	94			54,330	

¹ Total white pine stocking for all heights shown in brackets.

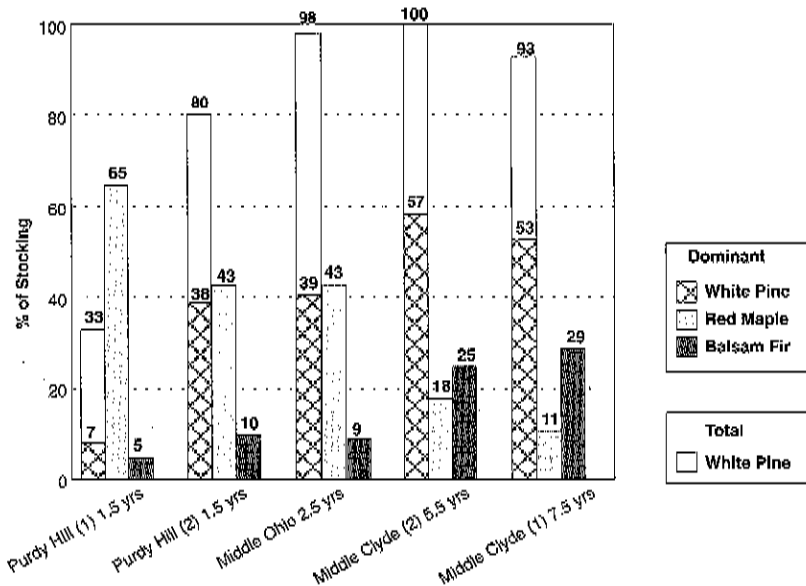


Picture Date: Dec./94

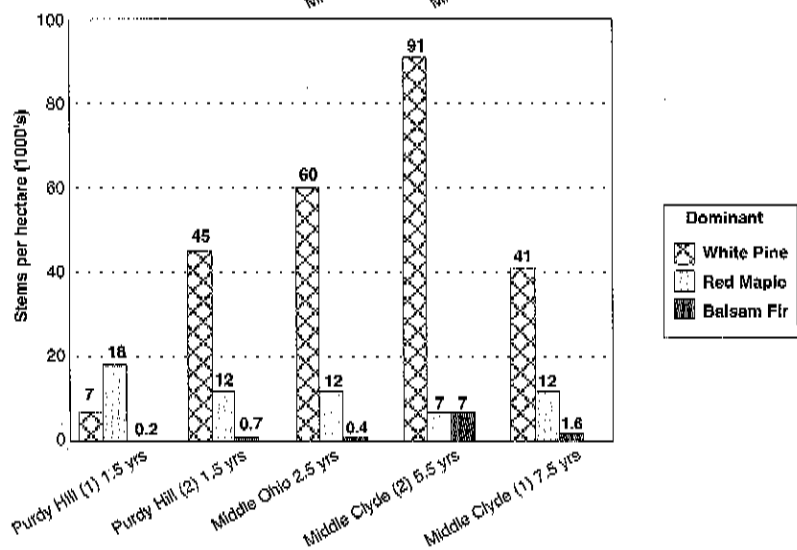
Average White Pine Height: 124 cm

Figure 5. Middle Clyde (1), Shelburne County.

a. Dominant (commercial species) and Total White Pine Stocking



b. Density



c. Dominant Height

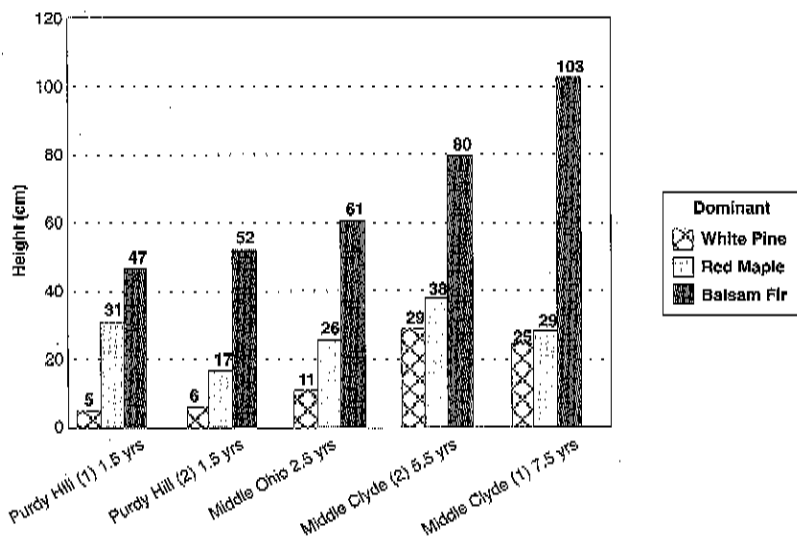


Figure 6. Dominant (to all commercial species) and total (white pine) stocking, dominant height, and density of regeneration by site and species.

Discussion

Stocking

A summary of regeneration results for all stands shows that dominant stocking to commercial species averaged 92 percent, but dominant white pine stocking ranged from 7 to 57 percent (Figure 7a). Red maple dominant stocking ranged from 11 to 65 percent (Figure 7a). White pine stocking exceeded red maple in the Middle Clyde stands, but the reverse was true at Middle Ohio and Purdy Hill (Figure 7a). Total stocking to white pine which included all heights ranged from 33 to 100 percent (Figure 7a), but most were not dominant (Figure 7c). Lower white pine stocking existed in the Purdy Hill stands; but both are still at an early stage of establishment.

Density

In four of five stands, white pine density ranged from 41,000 to 91,071 stems per hectare, confirming that white pine has regenerated in high numbers following treatment (Figure 7b). Density to white pine at Purdy Hill (1) was considerably lower than Purdy Hill (2), despite similar site and shelterwood conditions (Figure 7b).

Height

White pine regeneration was overtopped by balsam fir and red maple in all surveyed stands (Figure 7c). Balsam fir trees are the tallest in all stands (Figure 7c), but density figures are low except for Middle Clyde (1) (Figure 7b). The difference in height between red maple and white pine was greatest for the youngest stands (1.5 - 2.5 years post treatment), and least for the oldest (5.5 - 7.5 years post treatment). At Middle Clyde most of

the red maple and white pine regeneration was in the 11-30cm and 31-100cm height classes (Appendix I).

White Pine Establishment

According to age data from sample trees (Appendix II), 91 percent of the white pine regeneration originated after the shelterwood treatments. The high density and stocking of this regeneration demonstrates that the residual white pine overstorey was effective in providing adequate seed. This regeneration probably occurred as a result of good white pine seed years in 1981, 1984, and 1988 (White, pers. comm. Nov. 1994)¹. It should be noted that most of the white pine regeneration at Middle Ohio and Purdy Hill (1.5-2.5 years after treatment) was less than 10 cm in height. Mean dominant heights of the white pine regeneration found in this survey are similar to average heights reported by Lancaster and Leak (1978), and Fowells (1965) for the same growing periods.

Competition

Red maple was found to be the most serious competitor to white pine regeneration, exceeding white pine stocking on three of five sites, however, densities were generally lower, ranging from 7,000 to 18,000 per hectare (Figure 7b). At the Middle Ohio and Purdy Hill sites (1.5 - 2.5 years post treatment), dominant height of red maple averaged 25 cm compared to 7 cm for white pine, but the height gap between species was considerably less at both Middle Clyde sites (5.5 and 7.5 years post treatment) (Figure 7c). Red maple dominance seems diminished at the Middle Clyde stands, but if it continues to overtop the pine, it could

¹ Brian White, Manager Reforestation, Nova Scotia Department of Natural Resources

be controlled with a herbicide application or pre-commercial thinning (PCT) (Chapsek et al, 1989).

Based on height class distributions, (Appendix I) it is apparent that Balsam fir regeneration originated mostly from advance regeneration present prior to the

shelterwood treatment. Despite the apparent height advantage, balsam fir is a minor component of the regeneration of all stands except Middle Clyde (2), and thus provides limited competition to white pine. If necessary, balsam fir could be controlled through thinning.

Summary

In summary, the following trends are indicated from a survey of five white pine shelterwoods in Shelburne County.

1. Shelterwood treatments in these white pine stands were successful in the natural regeneration of white pine.
2. Stocking to white pine, red maple, and balsam fir averaged 92 percent for all stands. White pine accounted for 42 percent of dominant stocking.
3. Total density of white pine averaged 48,800 stems per hectare and accounted for 77 percent of all regeneration.
4. White pine regeneration was generally overtopped by red maple and balsam fir on all sites at this early stage of development.
5. Successful establishment of white pine regeneration creates the potential to manage these stands for quality sawtimber in the future.

Literature Cited

Anonymous. 1994. *Manual of procedures and standards: Canada - Nova Scotia Agreement for Forestry Development.* Technical Manual, Chapter 5.

Chapeskie, D.J.; Galley, D.F.; Mihell, J.R.; Quinn, N.W.; Struik, H.H. 1989. *A silvicultural guide for the white pine and red pine working groups in Ontario.* OMNR, Sc. and Tech. Series, Vol. 6, 102p.

Corbett, C.M. 1994. *White pine management and conservation in Algonquin Park.* For. Chron. 70(4): 435-436.

Fowells, H.A. 1965. *Silvics of forest trees of the United States.* USDA. For. Serv., Agri. Hdbk No. 271. 761p.

Heckman, S.T.; Pecore, M.T.; Sloan, K.R. 1985. *Natural white pine regeneration: Site requirements.* In *Eastern White Pine: Today and Tomorrow*, Symposium Proc. USDA: For. Serv. GTR WO-51: 57-61.

Lancaster, K.F.; Leak, W.B. 1978. *A silvicultural guide for white pine in the northeast.* USDA: For. Serv. GTR: NE-41. 13p.

Lowe, J.J. 1994. *Volume distribution of eastern white pine in Canada.* For. Chron. 70(4): 369-371.

Stiell, W.M. 1977. *Characteristics of eastern white pine and red pine.* Reprint from Proc. White and Red Pine Symposium. CFS. Chalk River, Ont. Sept. 20-22, 1977. 50p.

Appendix I. Height class distribution of regeneration following Shelterwood cuts in Shelburne Co., N.S.

Stand Location	Years After Shelterwood Cut	Species	Dominant Stocking (%)	Height Class (cm)			
				0-10	11-30	31-100	100 +
				%	%	%	%
Purdy Hill (1)	1.5	WP	7	100	0	0	0
		RM	65	15	49	33	3
		BF	5	33	33	0	34
		OTHER	0	0	0	0	0
Purdy Hill (2)	1.5	WP	38	95	5	0	0
		RM	43	28	59	13	0
		BF	10	36	10	27	27
		OTHER	0	0	0	0	0
Middle Ohio	2.5	WP	39	58	40	1	0
		RM	43	5	70	22	3
		BF	9	10	20	50	20
		OTHER	8	0	20	80	0
Middle Clyde (1)	5.5	WP	57	6	52	42	0
		RM	18	0	35	60	5
		BF	25	2	18	40	40
		OTHER	0	0	0	0	0
Middle Clyde (2)	7.5	WP	53	16	62	20	2
		RM	11	13	61	22	4
		BF	29	0	13	40	47
		OTHER	1	0	50	0	50

Appendix II. Age class distribution of white pine regeneration from sample trees by location.

Location	Years after Shelterwood Cut	Percent of Seedlings by Age (years)							
		1	2	3	4	5	6	7	8
Purdy Hill (1)	1.5		78	11		11			
Purdy Hill (2)	1.5	5	74		16	5			
Middle Ohio	2.5	2	98						
Middle Clyde (2)	5.5		4	18	68	10			
Middle Clyde (1)	7.5		37	28	27	7	1		

Shaded Areas: Seedlings germinated after treatment

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