United States
Department of
Agriculture

Forest Service

**Northern
Research Station**

Research Note
NRS-170

Effects of Low-Density Thinning in a Declining White Pine Stand in Maine

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ABSTRACT:

Low-density (32 ft^2/acre residual basal area) and medium-low density (60 ft^2/acre residual basal area) thinnings were studied over a 4-year period in a declining white pine stand on the Massabesic Experimental Forest in southern Maine. Gross basal area growth at 60 ft^2 was about three-fourths the rate of the control and more than twice as much as the 32 ft^2 thinning, while diameter growth at 60 ft^2 was twice that of the control and about the same as the low-density treatment. Regeneration under the thinning treatments was abundant. Declining white pine stands apparently respond quickly to low-density thinnings and the optimum level, among the treatments studied, is about 60 ft^2 residual basal area.

Citation: Leak, William B.; Yamasaki, Mariko. 2013. **Effects of low-density thinning in a declining white pine stand in Maine.** Res. Note NRS-170. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 6 p.

KEY WORDS: low-density thinning, white pine, decline

INTRODUCTION

Low-density thinning of white pine (*Pinus strobus*) stands is a system based on wide spacing between trees (low stand density) to encourage rapid growth and early returns from harvesting. The system usually includes some level of pruning to provide clean boles with minimal dead limbs (black knots). The system has been applied successfully since the early 1960s (Guiterman et al. 2011, Hunt and Mader 1970, Seymour and Smith 1987, Seymour 2007). In addition to rapid growth rates of the individual trees, the Hunt and Mader study showed increased soil water availability due to reduced area-wide transpiration.

In 2008, numerous white pine stands on the Massabesic Experimental Forest in Lyman, Maine showed signs of severe decline including dead tops and widespread mortality. These stands, now about 65 years old,

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developed naturally, or were planted, following the severe fires in October 1947. The decline symptoms were similar to those described by Livingston (2005), who attributed the decline to moisture stress, coupled with secondary pests and pathogens, from several years of drought on soils with a shallow, firm plow layer (compacted by early agricultural activity), which limited root development. Although the Massabesic stands did not have an obvious plow layer, it seemed quite possible that moisture stress could be a contributing factor to the decline. So, a large-scale thinning study was established to see if this approach would mitigate the decline symptoms.

METHODS

In a ~90 acre stand, two thinning treatments were applied in the growing season of 2008: a low-density treatment resulting in 32 ft^2/acre residual basal area (Fig. 1) and a medium-low density treatment resulting in 60 ft^2/acre residual basal area (Fig. 2). Due to the advanced decline, it was difficult for the marking crew to find sufficient well-spaced residual trees.

In a portion of an adjacent stand, which exhibited moderate decline (Fig. 3), a control was established with a residual of 148 ft^2 (trees 4.5 inches diameter at breast height (d.b.h.) and larger). In each treatment, the effects were monitored in five prism plots (10-factor in the thinnings, 20-factor in the control), coupled with four sample trees for d.b.h. and crown-width measurements. Basal-area growth was estimated by projecting tree diameters in the prism-plot tallies using d.b.h. growth measurements from the sample trees. Four-year results are reported here; because of concerns over the decline, early responses to the treatments were of particular interest.

Figure 1.—Low density thinning after four growing seasons, Massabesic Experimental Forest, Maine. Note the extensive white pine regeneration. Photo by Mariko Yamasaki, U.S. Forest Service.

Figure 2.—Medium-low density thinning after four growing seasons, Massabesic Experimental Forest, Maine. Note the extensive white pine regeneration. Photo by Mariko Yamasaki, U.S. Forest Service.

Figure 3.—Control area, Massabesic Experimental Forest, Maine. Photo by Mariko Yamasaki, U.S. Forest Service.

For comparison with the latest stocking charts for white pine (Leak and Lamson 1999), basal areas of the thinning treatments were below the managed B-line basal area of about 100 ft^2/acre and managed C-line of about 75 ft^2, based on the mean diameters in Table 1. The control was below the A-line of about 200 ft^2.

RESULTS

Estimated gross annual basal area growth per acre was 1.08, 2.74, and 3.49 ft^2/acre for the low, medium-low, and control treatments, respectively, and the corresponding d.b.h. growth rates were 0.21, 0.25, and 0.10 inches per year (Table 1). Similar to other low-density studies, the treatments produced a significant increase in diameter growth but a decline, especially under the 32-ft^2 treatment, in basal area growth per acre due to the understocking. Accurate mortality estimates are not yet available, but appear to be insignificant in the thinned areas.

Using the measured crown widths, and assuming round crowns, the estimated percent crown coverage for the low and medium-low thinnings were 27 and 56 percent, respectively. Changes in crown width were not evident; however, crown density and vigor (unmeasured) appeared better after the thinnings.

Diameter growth was not well related to tree d.b.h. in the thinning treatments (Fig. 4A and 4B) but were related slightly better to d.b.h. in the control, due mostly to low growth rates of the smaller trees (Fig. 4C). In calculating basal area growth rates, the average d.b.h. growth rates were used, applied to the trees per acre calculated from the prism cruises.

During the last (fourth) year, the average d.b.h. growth rates were 0.36 inches for the low and medium-low thinnings, and 0.1 inches for the control. Apparently, the residual trees in the thinnings continued to respond with increasing rates of growth.

As an aside, the low and medium-low thinnings acted as shelterwood harvests. Regeneration of white pine, oak (*Quercus* spp.), and other species, sometimes under short-lived grey birch (*Betula populifolia*), was visibly very abundant. A small sample of 20 milacres in the medium-low thinning, assessed by recording the dominant stem and dominant commercial stem, showed 40 percent oak or pine, 20 percent grey birch over oak or pine, 25 percent other species (red maple [*Acer rubrum*], balsam fir [*Abies balsamea*], aspen [*Populus* spp.]), and 15 percent (nonstocked or no commercial species). This influx of regeneration was the result of a good white pine seed year, a heavy harvest to thoroughly scarify the seedbed, and wildlife activity to plant acorns under the overhead white pine cover.

Table 1.—Annual basal area and d.b.h. growth over 4 years and initial crown widths by thinning treatment.

Thinning Treatment	Post-cut basal area per acre	Initial mean d.b.h.	Annual gross basal area growth/acre	Annual average d.b.h. growth	Initial average crown width
	ft^2	*in*	*ft^2*	*in*	*ft*
Low	32	12.7	1.08	0.21	20.4
Medium-Low	60	11.1	2.74	0.25	18.7
Control	148	7.7	3.49	0.10	18.8

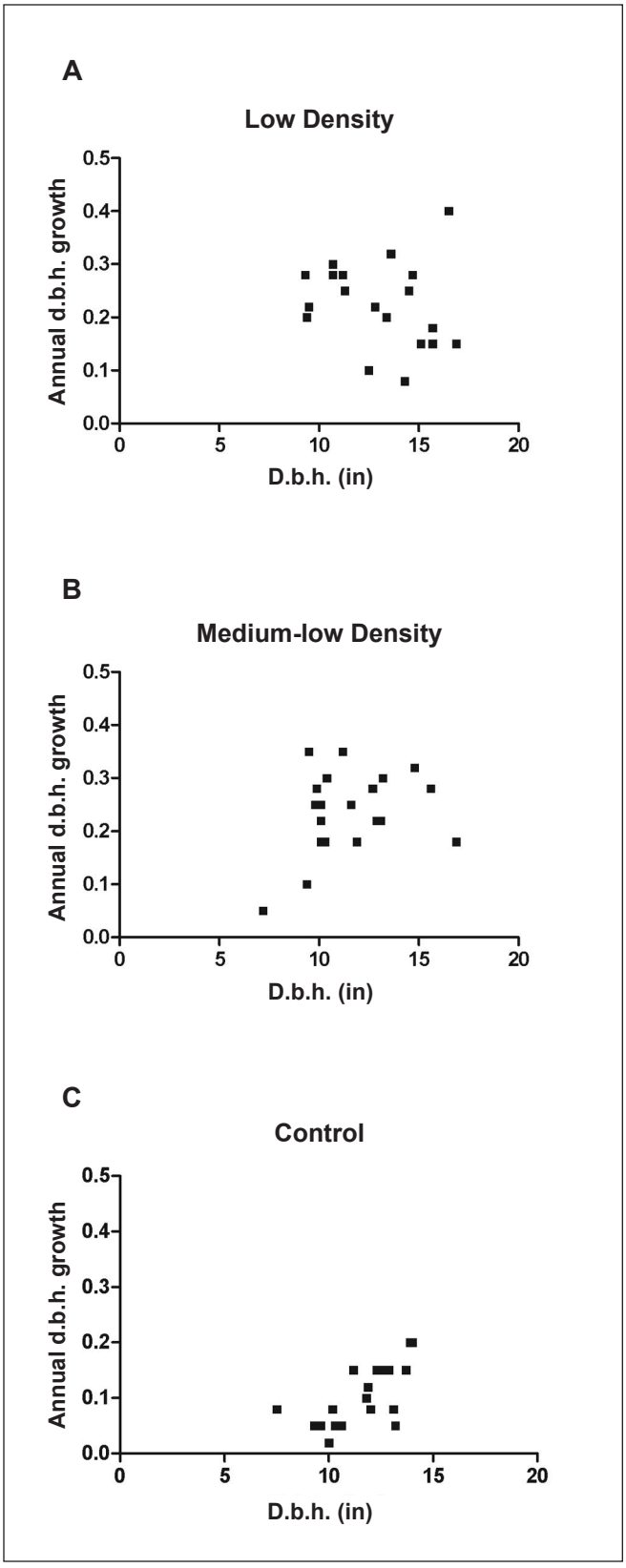

Figure 4.—Annual d.b.h. growth over the 4-year period for the A) low density, B) medium-low density, and C) control plots.

DISCUSSION

This short-term study showed a rapid response of declining white pine to low and medium-low density thinning. Diameter growth in both treatments was twice that of the control. Based on the last year's rate, the trees are growing at about 1 inch in diameter in 3 years. At this rate, the trees will grow about 10 inches in 30 years, and will average over 20 inches in d.b.h. Similar to other studies, basal area growth was about one-third (low density) to three-fourths (medium-low) of that in the control. However, over time, as the crowns close, the per-acre growth will approach that of a fully stocked stand—especially under the medium-low thinning. Considering both diameter growth and basal area growth per acre, the 60-ft^2 treatment (medium-low) was better than the low-density thinning. Low-density management is best applied with repeated pruning of the lower dead branches, beginning when the stand is of poletimber size. Without pruning, as in this study, a longer time period will be needed to develop large trees with a component of quality sawtimber.

One common concern over low-density thinning is the abundant understory development, which could limit desirable regeneration or require substantial investments during the regeneration phase. However, this study shows that with preparation and foresight, a low-density thinning can be the start of an effective shelterwood harvest.

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Manuscript received for publication December 2012

Published by:

USDA FOREST SERVICE
11 CAMPUS BLVD., SUITE 200
NEWTOWN SQUARE, PA 19073-3294

July 2013

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