

Measuring White Pine Log and Lumber Yields on Paired Harvests in the Adirondacks

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White pine management has largely been haphazard across the Northern Forest, with little investment to perpetuate the species on high quality sites where it can achieve impressive stocking and yields for the landowner. This study suggests that investment in white pine on high quality sites is economically viable, earning internal rates of return of 4-6% over a 110-year rotation.

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<http://www.nsrcforest.org>

Project Summary

White pine is increasingly limited to coarse, sandy soils where it can compete, and even regenerate. These poorer sites, however, do not accommodate growth rates that consistently yield high volumes and quality logs, possibly jeopardizing economic viability. If high quality white pine is to continue to persist as a part of the landscape of the Northeast, it is crucial that forest managers understand the anticipated yields based on site conditions and management actions.

We compared log and lumber yields from two distinct growing sites in the Adirondacks – sandy site with a class 3 white pine site index versus a class 1 white pine site index characterized by more fertile loamy soils. Prior to harvesting operations, forty study trees from each site were measured and marked for inclusion in the yield study. The logs were graded and followed through the sawmill to document lumber yield and grade. A sub-sample of butt logs that were pruned in the 1930s were isolated and the lumber grades recorded in order to quantify the benefits of pruning and thinning. The grade and yields of the butt logs were compared to the grade and yield of the upper logs as well as to the grade and yields of un-pruned butt logs.

As expected, the log yield from the higher site index was much higher with many stems yielding 5 to 6 16-foot logs versus 2 to 3 16-foot logs for the marginal site. The lumber quality, however, was the same for both sites. Due to the high number of black knots and some scattered red rot, the lower lumber grades of standard and industrial represented 60% of the lumber yield for both sites. This was the biggest surprise of the study. As expected, stems with pruned butt logs yielded the highest quality lumber. Using historical management data (costs and revenues) over a 110-year rotation from the high quality site, we calculated positive future present values with an estimated internal rate of return of 6%. This result suggests that it pays to manage and invest in white pine on better sites.

Background & Justification

- Historically, white pine has been a staple of the forest products industry in the Northern Forest region (Abrams 2001).
- Attempts to regenerate white pine after harvests are infrequent, and when regenerated, white pine is relegated to poor sites. In New York, those sites are characterized by sandy soils.
- There has been a gradual decrease in the white pine forest cover type.
 - White pine currently represents less than 5% of forest cover in New York State, down from 10% in 1970 (Ferguson and Mayer 1970).
- Regional loss of white pine has significant consequences for landscape diversity, wildlife habitat, and commodity markets.

Background & Justification

- Due to poor site conditions, the quality of white pine has declined. Sawmills have adjusted their wood procurement practices over the decades and avoid buying low grade logs that they cannot afford to process.
- Sawmills no longer buy timber sales “log run”, but focus on the higher grade select logs.
- White pine stands can grow 300 to 800 board feet/acre/year depending on site and stocking. Potential yields for white pine at maximum stocking (A-line, or 100% relative stand density) have been documented at 67,000 board feet per acre (Frothingham 1914; Lancaster and Leak 1978). The high quality Huntington Forest study site in the Adirondacks supports a 98-year old white pine stand with 60,000 board feet per acre with stocking just above 60%.

Background & Justification

- The Huntington Forest study site volume per acre represents among the highest producing forest stands in the Northern Forest (of any species) and is the inspiration for this study.
- Financial studies of white pine management are limited.
- This study will examine whether it is cost-effective, even profitable, to manage white pine over a long rotation on better quality sites.



Huntington Forest white pine

Methods – Project Area

- Study Sites: Two experimental forests on SUNY ESF properties in the Adirondacks:
 - Huntington Wildlife Forest in Newcomb, NY
 - Charles Lathrop Pack Demonstration Forest in Warrensburg, NY

- Huntington Forest is considered a high quality site.
- Pack Forest is a traditional white pine site with low quality sandy soils.
- Each site was set up with a randomized split-plot design for the purpose of designating various treatments for the silviculture study.



Harvest preparations and implementation at Huntington Forest



Methods – Sawmill Yield Study

- Purpose: Determine quantity and quality of boards produced from the Huntington and Pack forest sites.
- Follow a sample of logs from both sites through the Ward Lumber sawmill in Jay, NY.
- Record the grade and dimension of each board that was processed in the mill.
- Pruned butt logs were processed separately.



Log study at Ward Lumber Company

Methods – Financial Analyses

- Historical stand data was only available for Huntington Forest.
- Using Future Present Value (FPV), we calculated the financial viability of managing white pine over the entire rotation.

Sensitivity analysis was used to test FPV under various interest rates and property tax scenarios.

Year	Harvest b/d/ha	Revenue(\$/Nominal)	Revenue(\$/Real)	Cost(\$/Nominal)	Cost(\$/Real)	FV(R, 2011)	FV(C, 2011)
43 1951		\$ -	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00	\$ 0.00
44 1956		\$ -	\$ 0.00	\$ 3.36	\$ 0.00	\$ 0.00	\$ 0.00
45 1959		\$ -	\$ 0.00	\$ 13.32	\$ 0.00	\$ 0.00	\$ 0.00
46 1960		\$ -	\$ 0.00	\$ 13.49	\$ 0.00	\$ 0.00	\$ 0.00
47 1961	3001	\$ 135.43	\$ 101.23	\$ 13.46	\$ 10.02	\$ 10.02	\$ 10.02
48 1962		\$ -	\$ 0.00	\$ 13.64	\$ 0.00	\$ 0.00	\$ 0.00
49 1963		\$ -	\$ 0.00	\$ 14.03	\$ 0.00	\$ 0.00	\$ 0.00
50 1964		\$ -	\$ 0.00	\$ 14.24	\$ 0.00	\$ 0.00	\$ 0.00
51 1965		\$ -	\$ 0.00	\$ 14.45	\$ 0.00	\$ 0.00	\$ 0.00
52 1966	4192.19	\$ 967.40	\$ 1,012.62	\$ 14.61	\$ 107.26	\$ 107.26	\$ 107.26
53 1967		\$ -	\$ 0.00	\$ 14.90	\$ 0.00	\$ 0.00	\$ 0.00
54 1968		\$ -	\$ 0.00	\$ 15.15	\$ 0.00	\$ 0.00	\$ 0.00
55 1969		\$ -	\$ 0.00	\$ 15.41	\$ 0.00	\$ 0.00	\$ 0.00
56 1970		\$ -	\$ 0.00	\$ 15.69	\$ 0.00	\$ 0.00	\$ 0.00
57 1981		\$ -	\$ 0.00	\$ 15.96	\$ 0.00	\$ 0.00	\$ 0.00
58 1972		\$ -	\$ 0.00	\$ 16.26	\$ 0.00	\$ 0.00	\$ 0.00
59 1973		\$ -	\$ 0.00	\$ 16.57	\$ 0.00	\$ 0.00	\$ 0.00
60 1974		\$ -	\$ 0.00	\$ 16.90	\$ 0.00	\$ 0.00	\$ 0.00
61 1975		\$ -	\$ 0.00	\$ 17.24	\$ 0.00	\$ 0.00	\$ 0.00
62 1976		\$ -	\$ 0.00	\$ 17.61	\$ 0.00	\$ 0.00	\$ 0.00
63 1977		\$ -	\$ 0.00	\$ 17.93	\$ 0.00	\$ 0.00	\$ 0.00
64 1978		\$ -	\$ 0.00	\$ 18.29	\$ 0.00	\$ 0.00	\$ 0.00
65 1979		\$ -	\$ 0.00	\$ 18.60	\$ 0.00	\$ 0.00	\$ 0.00
66 1980		\$ -	\$ 0.00	\$ 18.94	\$ 0.00	\$ 0.00	\$ 0.00
67 1981	12533.1	\$ 731.63	\$ 12,066.43	\$ 19.31	\$ 12,066.43	\$ 12,066.43	\$ 12,066.43
68 1982	353.7	\$ 19.45	\$ 19.30	\$ 19.30	\$ 0.00	\$ 0.00	\$ 0.00
69 1983		\$ -	\$ 0.00	\$ 19.70	\$ 0.00	\$ 0.00	\$ 0.00
70 1984		\$ -	\$ 0.00	\$ 19.24	\$ 0.00	\$ 0.00	\$ 0.00
71 1985		\$ -	\$ 0.00	\$ 19.00	\$ 0.00	\$ 0.00	\$ 0.00
72 1986		\$ -	\$ 0.00	\$ 19.29	\$ 0.00	\$ 0.00	\$ 0.00
73 1987		\$ -	\$ 0.00	\$ 19.01	\$ 0.00	\$ 0.00	\$ 0.00
74 1988		\$ -	\$ 0.00	\$ 19.65	\$ 0.00	\$ 0.00	\$ 0.00
75 1989		\$ -	\$ 0.00	\$ 19.24	\$ 0.00	\$ 0.00	\$ 0.00
76 1990		\$ -	\$ 0.00	\$ 19.05	\$ 0.00	\$ 0.00	\$ 0.00
77 1991		\$ -	\$ 0.00	\$ 19.91	\$ 0.00	\$ 0.00	\$ 0.00
78 1992		\$ -	\$ 0.00	\$ 19.60	\$ 0.00	\$ 0.00	\$ 0.00
79 1993		\$ -	\$ 0.00	\$ 19.43	\$ 0.00	\$ 0.00	\$ 0.00
80 1994		\$ -	\$ 0.00	\$ 19.20	\$ 0.00	\$ 0.00	\$ 0.00
81 1995		\$ -	\$ 0.00	\$ 19.22	\$ 0.00	\$ 0.00	\$ 0.00
82 1996		\$ -	\$ 0.00	\$ 20.16	\$ 0.00	\$ 0.00	\$ 0.00
83 1997		\$ -	\$ 0.00	\$ 19.10	\$ 0.00	\$ 0.00	\$ 0.00
84 1998		\$ -	\$ 0.00	\$ 22.25	\$ 0.00	\$ 0.00	\$ 0.00
85 1999		\$ -	\$ 0.00	\$ 23.35	\$ 0.00	\$ 0.00	\$ 0.00
86 2000		\$ -	\$ 0.00	\$ 24.53	\$ 0.00	\$ 0.00	\$ 0.00
87 2001		\$ -	\$ 0.00	\$ 25.76	\$ 0.00	\$ 0.00	\$ 0.00
88 2002		\$ -	\$ 0.00	\$ 27.04	\$ 0.00	\$ 0.00	\$ 0.00

NPV	LEV
2044.52	2461.04
0.00%	1180.5
0.01%	1182.07
0.02%	1183.64
0.03%	1185.21
0.04%	1186.78
0.05%	1188.35
0.06%	1189.92
0.07%	1191.49
0.08%	1193.06
0.09%	1194.63
0.10%	1196.20
0.11%	1197.77
0.12%	1199.34
0.13%	1200.91
0.14%	1202.48
0.15%	1204.05
0.16%	1205.62
0.17%	1207.19
0.18%	1208.76
0.19%	1210.33
0.20%	1211.90

Results – Grade Recovery

- The two harvest sites yielded surprisingly similar lumber grade recoveries.

	<u>Huntington</u>	<u>Pack</u>
Select:	28%	25%
Finish:	2%	8%
Premium:	9%	6%
Standard:	28%	33%
Industrial:	33%	28%



- We expected the Huntington Forest site to yield a much higher percentage of quality lumber, because of the higher site index and better quality stems, but such was not the case.
- Equally surprising, as well as disappointing, was the high percentage of standard and industrial grade lumber from both sites.
- The pruned butt logs yielded mostly select lumber.

Results: Financial Analysis

- Using FPV methods, we calculated real dollar costs for planting in 1916, timber stand improvement in 1938-39 and pruning in 1940.
- Commercial crown thinnings occurred in 1951, 1955, 1961, 1966 and 1981. Stumpage revenues were based on nominal stumpage rates converted to real dollars.
- The most recent shelterwood cut to 30% relative density occurred in 2012. In addition, we simulated an overstory removal cut to release the regeneration for 2022.
- Timber sale preparation and administration was included as a cost during harvest years.
- At 6% internal rate of return (IRR) revenues = \$195,794; costs = \$142,803; property taxes = \$33,946
- FPV was positive \$19, 045
- At 7% internal rate of return, FPV was negative.

Implications and Applications

- The financial analysis suggests that it pays (IRR of 4-6%) to manage white pine on good sites.
 - Caveat: property taxes in the \$4-6/acre/year range.
- Pruning is Prudent! – Pruning of white pine poles pays off later in the rotation, yielding high quality lumber in the butt log.
- To avoid grade-reducing black knots in the upper logs, crown thinning entries should maintain high live crown ratios by maintaining stand density well below the B-line (Seymour 2007). This strategy will promote more red knots, thus more premium grade lumber.
- The lumber quality would have been much higher had our sites been prescribed fewer, but heavier crown thinnings during the past decades.

Implications and Applications

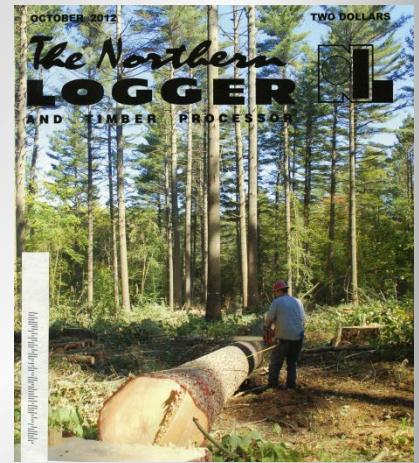
- Monitor red rot during thinning entries and consider reducing rotation age if red rot is a problem.
- A rotation age of approximately 100 years on high quality sites will yield impressive tree specimens and volumes per acre – similar to the Huntington Forest site; however, stems averaging 24-inch diameter-breast-height and over 100 feet in height may not be in synch with sawmill markets. Consequently, stumpage prices will not compensate the landowner for “big wood”.
- Unless there is a market for big timbers for exposed beams, sawmills prefer logs that average 16 – 18 inches on the small end. A 60 – 80 year rotation can serve this market demand and improve financial returns for the landowner.



Future Directions

- The on-going study will test the effectiveness of modified shelterwood regeneration methods with select site preparation techniques (scarification, herbicides) for regenerating white pine on high quality sites.
- We will assess whether the costs of ensuring regeneration on high quality sites is economically justified over the rotation age.
- We will monitor the impact of white pine management on select wildlife communities, including salamanders, small mammals, and songbirds.
- The Huntington Forest site will provide educational opportunities to a wide spectrum of audiences through an interpretive walking trail, supported by booklets, signage, and a kiosk, to foster understanding of wildlife and forest ecology, silviculture and forest management.

List of Products



- Featured in the October 2012 issue of the Northern Logger magazine – “Doing it Right: 100 Years of good forestry pays off . . . ”.
- Plattsburgh (North Country) PBS developed a video segment at the harvest site and the sawmill which featured interviews with René Germain at the site and Sarah Ficken (graduate student) at the sawmill. The video can be viewed at the following link: <http://borderlessnorth.org/videos/huntington-forest-white-pine-harvest/>
- The Huntington harvest site has already hosted several workshops/woods walks, including a delegation from the Menominee Indian Tribe out of Wisconsin, who are passionate about white pine management.
- A manuscript is currently in development.