FIELD NOTE

Influence of Species on Site Selection and Timber Removal: A Case Study for West Virginia

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ABSTRACT

Over the last 40 years the composition of West Virginia forests has been changing as selective cutting practices have removed larger-diameter timber of specific species and partial canopy removal has fostered the regeneration of shade-tolerant species such as red maple. However, since the mid-1990s there has been considerable change in the number of markets accepting lower-quality and smaller-diameter roundwood, especially yellow-poplar. These changes have increased the number of roundwood markets and thus have increased the potential for harvesting based on silvicultural objectives or clearcuts. An examination of harvesting and merchandising practices for 28 harvest sites in West Virginia found an average of four merchandising separations or markets per site. Although the presence of new markets may have increased the section of sites containing yellow-poplar and the removal of this species from these sites, the continuation of diameter-limit cutting seems to have the greatest effect on which trees are removed. This pattern of partial harvests continues to favor the regeneration of shade-tolerant species such as red and sugar maple.

Keywords: hardwood markets, forest composition, harvesting, yellow-poplar

Changes in land use and harvesting practices have influenced the composition and structure of forests in West Virginia (Carvell 1986). In turn, relative species prices influence which stands are harvested and the harvesting criteria (e.g., timber management or diameter-limit cutting [DLC]) used to determine which trees are removed. Since the early 1970s this process has tended to remove larger-diameter trees of higher value species, with the red oak species accounting for greater than 30% of sawlog production (Bones and Glover 1977, Widmann and Murriner 1990, Widmann et al. 1998).

Past changes in forest composition can be examined by analyzing relative changes in growing stock volume by species group and the direction of future compositional changes can be projected by analyzing relative changes in growing stock volume by diameter class (Table 1). Table 1 indicates that the relative volume of select and other red oak species have declined in West Virginia during the past 40 years by 30 and 27%. Much of the red oak growing stock harvested during this period regenerated before the Great Depression and matured during the 1960s and 1970s. In contrast, the volume of yellow-poplar growing stock has increased by 50% as this species regenerated on farmlands abandoned before and after the Great Depression and matured in the 1980s and 1990s. However, the species group that has shown the greatest surge in growing stock volume was soft maple (primarily red maple) increasing by greater than 86% between 1961 and 2000.

An examination of relative changes in volume by diameter class indicates that soft maple has increased in all size categories over the last 40 years, whereas the red oak groups have decreased in all classes during this period. Most notable is the 129% decrease in relative select red oak volume for trees less than 13 in. when compared with the 87% increase in soft maple volume (Table 1). When examining trees less than 9 in., all midtolerant and intolerant species groups have decreased in relative volume while the shade-tolerant maples have increased. This change generally has been attributed to partial canopy removal during harvesting in the last 40 years.

Since the early 1990s there has been an increased demand for yellow-poplar and other low-density hardwood species in West Virginia with the construction of two oriented strandboard (OSB) mills and two peeler mills (West Virginia Bureau of Commission 1997). During this period there also has been an increased demand for higher-density lower-grade roundwood with a 137% increase in hardwood pulpwood production (Widmann 1992, Baker et al. 2005). The development of these markets in combination with the existing sawmilling industry has provided markets for all species and qualities of hardwood roundwood. To investigate how this market situation affects harvesting method and timber removal, we examined 28 harvest sites during 2001.

Data Collection

We initially selected 30 harvest sites distributed over all geographic regions of West Virginia. We focused on logging initiated by larger mills because small and part-time mills have limited markets and tend to purchase logs rather than stumpage.

On each harvest site, five standard ⅕-ac plots were selected randomly from a grid drawn from the area expected to be harvested and merchandized the next day. Before harvest, the diameter and height of all trees 5 in. or more in dbh were measured, and current and potential future tree grades were determined. Trees that did not meet criteria for grades 1, 2, or 3 were classified as grade 4. Loggers were questioned as to the harvesting criteria they used (e.g., management plan, diameter-limit, and others) as well as the type and number of markets in which they sold roundwood. Each plot was revisited immediately after harvest to classify trees harvested, not harvested, or destroyed during harvest. Because it was difficult to estimate cubic volume for all species without detailed information of cull trees and cull portions of trees, we examined the surveyed sites in terms of basal area (BA). The final usable sample was 28 because one

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Table 1. Changes in growing stock composition for major species groups by diameter class for hardwoods in West Virginia between the 1961[a] and 2000[b] forest surveys.

Species Yr	Total volume	5–8.9 in.	9–12.9 in.	13–16.9 in.	Greater than 16.9 in.
Select red oaks[c]					
1961	12.1	11.1	11.0	12.3	14.2
2000	8.4	2.9	4.9	7.6	15.1
Other red oaks[d]					
1961	10.3	6.0	8.9	13.1	14.1
2000	7.5	4.7	7.2	8.4	8.3
Select white oaks[e]					
1961	8.9	8.6	9.6	8.7	8.6
2000	9.8	7.7	10.3	10.3	10.0
Other white oaks[f]					
1961	11.1	11.1	11.3	10.0	11.8
2000	9.1	8.0	10.0	9.4	8.7
Yellow-poplar					
1961	10.3	8.5	11.2	12.4	7.6
2000	15.2	7.6	11.9	18.4	19.1
Hard maple[g]					
1961	5.7	7.3	4.6	4.0	6.8
2000	7.0	10.4	4.5	6.0	6.1
Soft maple[h]					
1961	5.1	8.6	5.5	3.6	3.4
2000	9.5	14.7	11.8	8.7	5.6

[a] Source: Ferguson 1964.
[b] Source: USDA Forest Service 2005.
[c] Primarily northern red oak.
[d] Primarily black and scarlet oaks.
[e] Primarily white oak.
[f] Primarily chestnut oak.
[g] Primarily sugar maple.
[h] Primarily red maple.

site was excluded from the analysis because entrance restrictions prevented a full postharvest observation and a second site also was excluded because it was a pine pulpwood harvest.

Markets and Site Section

For the 28 sites included in the final sample, the survey found 10 different roundwood markets with an average of 4 markets per site. The most commonly listed products merchandized were sawlogs (100%), peeler logs (82%), OSB roundwood (75%), and pulpwood (54%). In addition, 39% of the loggers reported that both sawlogs and peeler and sawlogs were primary products. The great number of sites at which peeler logs and OSB roundwood were merchandized suggested a large market for yellow-poplar products.

In general, the composition of the selected sites was not statistically different from the overall composition in West Virginia, except for yellow-poplar and chestnut oak. More than 21% of the BA on the sampled sites was yellow-poplar or nearly twice the proportion of BA statewide (11.2%).[1] We surmise that the relative volume of yellow-poplar on the survey sites apparently is the result of multiple markets for this species.

BA Removed

The harvesting criteria used, BA removed, and average number of markets for the 28 sites examined are presented in Table 2. DLC was the most commonly observed harvesting method. However, the data indicated several instances in which large-diameter beech were left uncut even though they exceeded the target diameter-limit. Also noted were several instances in which black cherry and sugar maple were cut even though they did not meet the target diameter-limit. During 2001 these two species were highly valued for lumber production.

Table 2. Number of sites harvested by harvesting criteria and average change in BA, average number of markets, and average number of low-grade markets associated with these sites.

Harvest criteria	Number of sites	Average percentage removal of BA	Average number of markets[a]
Diameter-limit cutting[b]	14	51.9	4.0
Unspecified	6	51.8	3.7
Managed	5	45.5	4.0
Clearcut	3	100	4.3

[a] Includes sawlogs, peeler logs, tie logs, low-grade sawlogs, fence materials, pulpwood, OSB roundwood, alloy chips, and firewood.
[b] Includes one site that was an apparent 18-in. diameter-limit cut.

The use of DLC is motivated by operational efficiency and profitability goals of both sawmills and logging operations. Hardwood lumber grades are based on long, wide, and clear board sections (Smith 1967) that usually result from large-diameter timber. Larger-diameter logs also require less sawing time per board foot of lumber produced (Rast 1974). Loggers are paid for the volume of timber produced and can make more money by harvesting larger trees. These economic realities will continue to dictate what trees will be removed and what trees will be left standing.

Loggers at six sites did not specify logging criteria but a combination DLC and cutting for value apparently was used. The five stands that were harvested with stated management criteria had lower BA removed, but we could not determine whether this decreased removal rate was significant because of the limited number of observations. We expected that an increase in the number of markets could be a reason for managed harvests but only in one case did current market conditions (management for yellow-poplar) seem to play a role in timber management.

In Table 3, the number of sites on which specific species were found are listed and the average percentage of BA harvested of specific species is compared with the BA of all trees removed from those sites. The oaks and other midtolerant or shade-intolerant species generally were harvested at greater levels, but only yellow-poplar and black cherry had significantly greater removal rates (Table 3). Because shade-intolerant and midtolerant species tend to be larger in diameter, a greater volume of these species usually would be removed by DLC. The relatively high BA of yellow-poplar harvested appears to be influenced by the multiple markets for this species. This increased rate of cherry harvest is consistent with the higher value, quality, and yield of that species.

By contrast, the maples, American beech, and hickory were harvested at significantly lower levels. The small average diameter of the maple species on most sites examined contributed to the low BA harvested. In contrast, the average diameter of the American beech tallied on the survey sites was fairly large but the low quality of beech timber and low value of beech lumber probably caused loggers to ignore this species.

Hickory species were the least harvested with less than 3% of the BA removed on 13 sites containing these hickories. The diameter of the hickory species was only slightly greater than that of the maples. The relatively high volume of small-diameter hickory on the measured sites probably was a factor that influenced the reduced harvest levels; however, hickory also is difficult to process because of its high specific gravity or density. Mills that process this species are midsize and smaller circle mills that may not have been adequately accounted for in the survey because of our focus on larger operations.

Table 3. Number of sites where specific species were found, average BA cut of specific species vs all species on sites containing these species and average diameter of focus species vs all trees on sites containing these species.

Focus species	Number of sites where specific species were found[a]	Average BS cut of (%)		Average DBH of trees of (in.)	
		Specific species	Sites containing these species	Specific species	Sites containing these species
Yellow-poplar	19	57.4[c]	44.7	14.5[d]	11.3
Chestnut oak	7	55.4	47.4	13.8[c]	11.8
Red maple	16	27.8[d]	51.8	8.9[d]	11.3
White oak	13	46.9	41.3	14.3[d]	11.1
Nor. Red oak	16	58.8	44.9	15.2[d]	11.2
Sugar maple	19	27.3[d]	46.9	9.3[d]	11.3
Hickory	13	2.9[d]	46.2	9.8[c]	11.0
Beech	10	20.6[c]	45.9	13.3	11.6
Black oak	9	63.8	43.5	17.2[d]	11.2
Black cherry	4	84.8[b]	54.1	13.0	12.1

[a] On sites where focus species accounted for at least 5% of the total BA.
[b] Significantly different from site average at 0.1 probability level for a *t-test: paired two sample for means.*
[c] Significantly different from site average at 0.05 probability level for a *t*-test: paired two sample for means.
[d] Significantly different from site average at 0.01 probability level for a *t*-test: paired two sample for means.

Conclusion

Our objective was to investigate how multiple markets influence the selection of harvest sites and the characteristics of trees removed from these sites. The results of our analysis did not indicate a strong relationship between multiple markets and increased timber management. Although the addition of multiple markets for yellow-poplar roundwood seems to have influenced site selection and the removal of this species; DLC and/or a combination of DLC and value cutting appears to dominate the type of timber harvested. This resulting pattern of partial harvests will continue to favor the regeneration of shade-tolerant species such as red and sugar maple.

Endnote

[1] Because the average estimates of BA were developed from estimates of number of trees of various diameters, it is impossible to develop an accurate variance estimate for BA. Thus, we treat this estimate as a constant in our analysis.

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