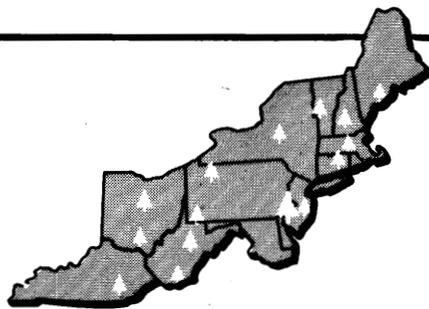


# Northeastern Forest Experiment Station



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## UTILIZING HARDWOOD LOGGING RESIDUE: A CASE STUDY IN THE APPALACHIANS

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*Abstract.*—An Appalachian hardwood timber stand that contained 6,700 board feet per acre of sawtimber was harvested by clearcutting. After the merchantable sawlogs were removed, this stand contained 69.3 tons per acre of green wood residue. Thirty-three and one-third tons of residue were from tops of merchantable sawtimber; 36 tons were from residual trees. Treetop residue yielded 1,800 board feet of marketable sawed products and 26 tons of chippable wood. The residual trees yielded 3,000 board feet of sawed products and 25.6 tons of chippable wood. The overall weight of residue was about 1.8 times greater than the weight of sawtimber removed.

**Keywords:** Utilization, logging residues, clearcuts, Appalachian hardwoods, treetops, residual trees, sawed products, chips.

Researchers at the Forest Products Marketing Laboratory are evaluating opportunities for commercial use of hardwood logging residues in the Appalachians. The initial phase of this research includes determining the amounts and characteristics of residues, after harvesting, for a variety of timber-stand conditions, logging methods, and product objectives. As a part of this phase, we are investigating the amount and types of marketable products that could be manufactured from residue that results from clearcutting sawtimber stands in the oak-

hickory type. This report provides a summary of residue weights and sawed-product volumes for the initial sample area.

### The Study

My objective was to determine (a) the total weight of residue that was on the study area after commercial harvest of merchantable sawlogs; and (b) the amount of residue that was suitable for sawing into cants, blocking, and other marketable sawed products.

A merchantable tree was defined as a sound tree of an acceptable species that was at least 12 inches in diameter at breast height (dbh). A merchantable log was defined as a log from a merchantable tree with a minimum scaling diameter of 10 inches and a minimum length of 8 feet. Merchantable species included yellow-poplar, hickory, chestnut oak, black oak, white oak, red oak, sugar maple, red maple, and beech.

Logging residue was defined as all unused parts above the stumps of the harvested trees (topwood residue); and all parts above the stumps of live standing or down trees (residual trees) that were on the site after logging.

All residue except decayed wood was considered chippable. All sound residue pieces at least 6 inches in diameter inside bark (dib) on the small end and at least 4 feet long were considered sawable, provided they were straight enough to yield at least a 4-inch by 4-inch by 4-foot cant.

### The Site

In cooperation with the forest supervisor and staff, I selected an 18-acre unit of a commercial timber sale on the Monongahela National Forest near Richwood in Nicholas County, West Virginia. The stand contained 6,144 board feet per acre (International ¼-inch tree scale) of merchantable sawtimber 12 inches dbh or larger. Average tree dbh was 16 inches. Seventy-two percent of the sawtimber volume was oak, 14 percent was yellow-poplar, 8 percent was beech, 3 percent was hickory, and 2 percent was maple. The average slope was about 25 percent and had a generally southern exposure; the site index is 80 for red oak.

The stand was harvested by clearcutting. The logging contractor felled all merchantable trees 12 inches dbh or larger and removed all logs to a 10-inch top scaling diameter. Actual yield of sawlogs was 6,667 board feet per acre, International ¼-inch log scale. Skidding was done with a rubber-tired skidder; all logs were skidded uphill over grades of 15 to 35 percent.

Since there were no local commercial markets for round pulpwood, mine props,

or similar products, the remaining trees that were 2 inches dbh or larger were felled and left on the site to assist regeneration.

### Procedure

After the merchantable timber was felled and removed, a typical acre within the 18-acre unit was selected for study (fig. 1). The first treatment was the removal of all topwood residue (fig. 2). All sound material that would yield a straight or nearly straight piece at least 6 inches in diameter by 4 feet 3 inches long or longer was decked for sawing into cants and lumber. The remaining material was stored for chipping. A 5-ton crane with a dial scale in line with the lifting cable was used to weigh both groups of residue (fig. 3).

The second treatment was the felling and skidding of all residual trees that were 6 inches dbh or larger. These trees were bucked, weighed, and separated into the same two categories that were used for topwood residue. Final treatment of the plot was the felling and skidding of all trees below 6 inches dbh (fig. 4). This residue was weighed and piled for chipping.

Sample disks were taken from each category of residue for determining moisture contents. Because several months elapsed between logging and the study, there was some drying of logging residue. Therefore all residue weights were adjusted to the equivalent of 61 percent moisture content, the actual average moisture content of standing unmerchantable trees.

A three-man crew used one chain saw and a 35-horsepower farm tractor with a rear-mounted winch to recover the residue. The average bunching distance to the tractor was about 60 feet. Average skidding distance to the landing was 300 yards. All material was moved up a 30- to 35-percent grade over a logging skidroad to the landing (fig. 5).

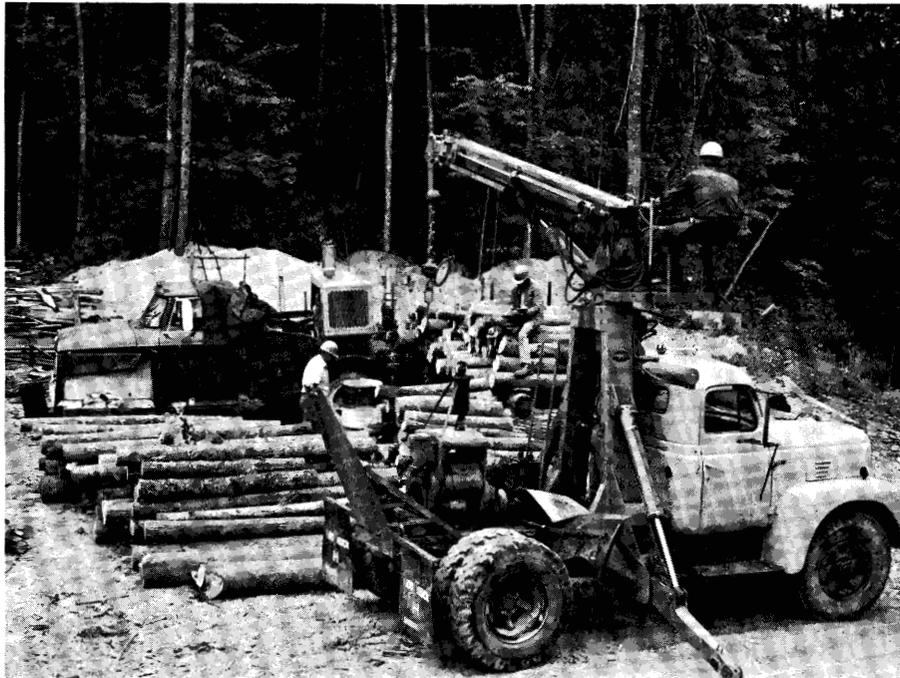
Sawable material was bucked so that each piece would yield the largest cant possible. Because of the small diameters, sweep and crook had a strong influence on the maximum size for cants. Bucking out



**Figure 1.—One-acre plot after commercial logging.**



**Figure 2.—One-acre plot after all topwood residue was removed.**



**Figure 3.—Weighing and decking sawable bolts from residual trees.**



**Figure 4.—One-acre plot after all residue was removed.**



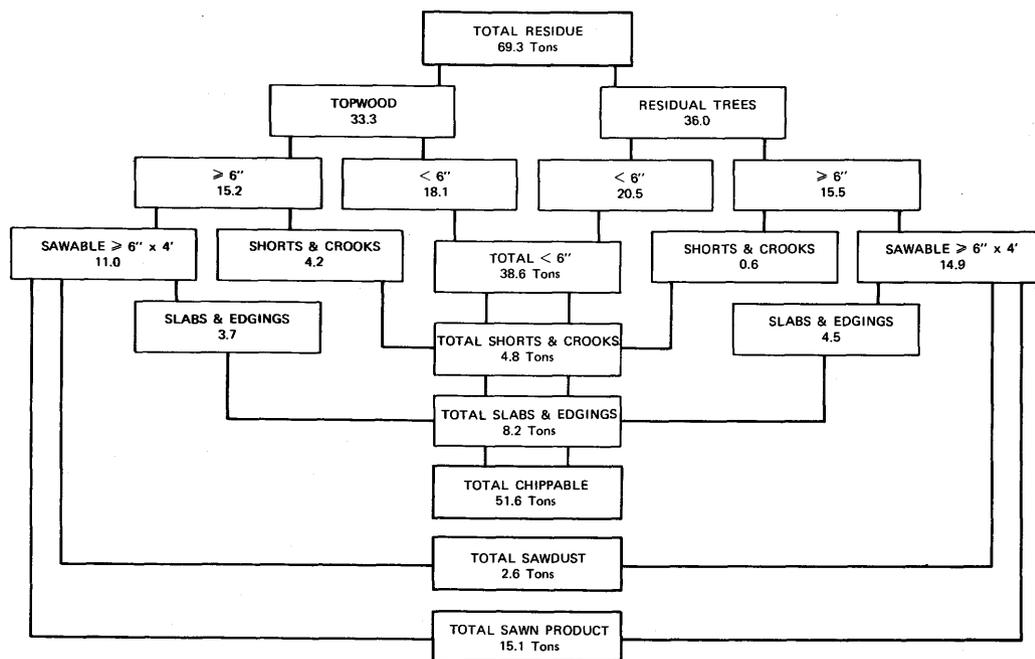
**Figure 5.—Farm tractor with rear winch used for skidding residue.**

sweep and crook resulted in a 9-foot maximum length for sawable bolts.

Sawable bolts were then processed into cants and lumber on a mobile sawmill and a trailer-mounted edger. The manually-operated mill is equipped with a 50-inch diameter, 7- to 8-gauge saw with forty-four 17/64-inch kerf bits; it is powered by a 68-horsepower diesel engine. The engine is mounted on a 2-ton short-wheel-base truck that also serves as the towing unit for the mill (fig. 3).

## Results

*Residue weight.*—The total weight of all residues recovered from the 1-acre plot was 69.3 tons: 33.3 tons from topwood residue, and 36 tons from the residual trees. The topwood residue yielded 11.0 tons (1,363 board feet, International ¼-inch log scale) of sawable bolts; residual trees yielded 14.9 tons (2,312 board feet, International ¼-inch log scale) of sawable bolts (fig. 6). Assuming an average weight of 6.0 tons per M board foot, the weight of merchantable logs harvested from the 18-acre unit was about 40 tons per



**Figure 6.—Residue weights from 1-acre sample plot, (green weights at 61 percent moisture content, oven-dry basis).**

**Table 1.—Distribution of sawable pieces, by diameter class and length, in percent**

Diameter small end (inches)	Type of residue a, b	Length (feet)							Total	
		4	5	6	7	8	9	T	R	
6	T	22	5	3	3	7	3	43	—	
	R	20	5	8	3	4	8	—	48	
7	T	12	3	3	1	3	—	22	—	
	R	12	1	6	1	2	4	—	26	
8	T	7	3	1	—	2	—	13	—	
	R	5	1	3	—	3	4	—	16	
9	T	5	1	—	—	1	—	7	—	
	R	2	—	2	—	1	4	—	9	
10	T	1	3	1	—	1	—	6	—	
	R	—	—	—	—	1	—	—	1	
11	T	1	—	1	—	1	—	3	—	
	R	—	—	—	—	—	—	—	—	
12	T	—	—	1	—	—	—	1	—	
	R	—	—	—	—	—	—	—	—	
13	T	1	—	1	1	—	—	3	—	
	R	—	—	—	—	—	—	—	—	
14	T	1	—	1	—	—	—	2	—	
	R	—	—	—	—	—	—	—	—	
Total	T	50	15	12	5	15	3	100	—	
	R	39	7	19	4	11	20	—	100	

a T = Topwood.

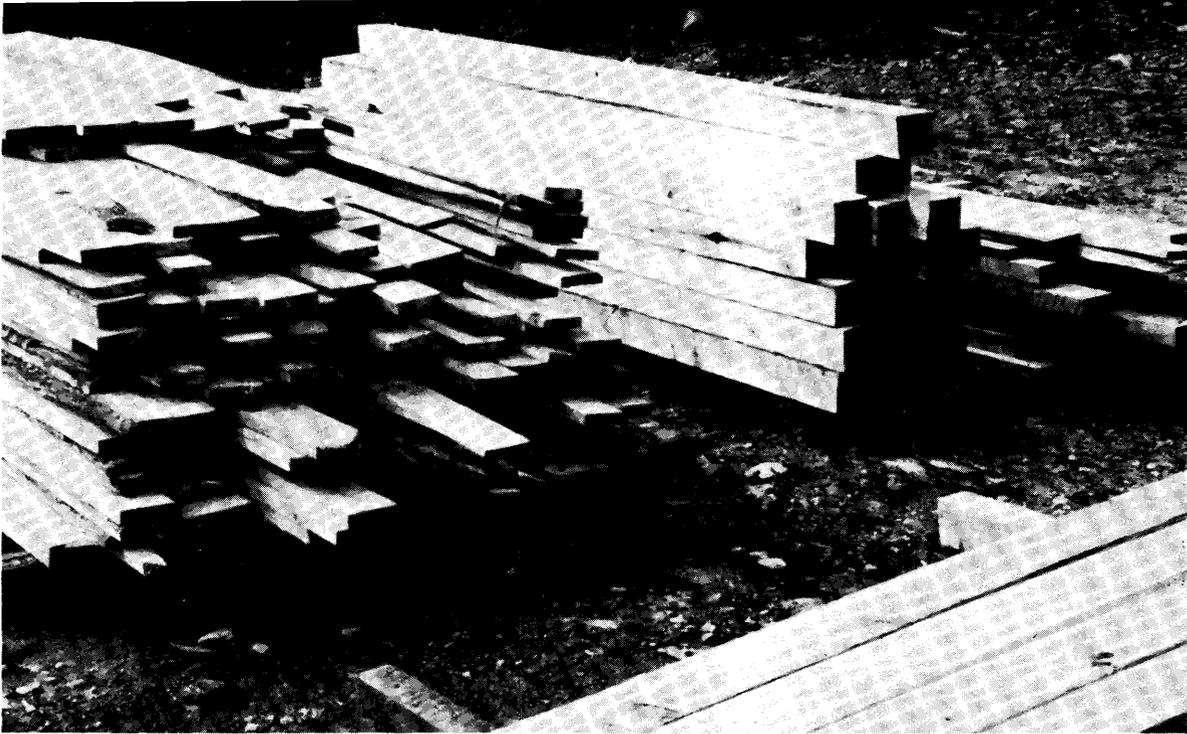
b R = Residual trees.

**Table 2.—Distribution of sawable volume (International 1/4-inch rule), by diameter class and length, in percent**

Diameter small end (inches)	Type of residue a, b	Length (feet)							Total	
		4	5	6	7	8	9	T	R	
6	T	7	2	2	2	7	2	22	—	
	R	7	2	5	2	4	8	—	28	
7	T	7	2	2	1	3	—	15	—	
	R	6	1	5	1	3	6	—	22	
8	T	7	2	2	—	3	—	14	—	
	R	5	4	4	—	4	9	—	26	
9	T	6	2	—	—	3	—	11	—	
	R	3	1	3	—	3	10	—	20	
10	T	1	5	3	—	2	4	15	—	
	R	1	—	—	—	—	3	—	4	
11	T	1	—	2	—	3	—	6	—	
	R	—	—	—	—	—	—	—	—	
12	T	—	—	2	—	—	—	2	—	
	R	—	—	—	—	—	—	—	—	
13	T	4	—	3	3	—	—	10	—	
	R	—	—	—	—	—	—	—	—	
14	T	2	—	3	—	—	—	5	—	
	R	—	—	—	—	—	—	—	—	
Total	T	35	13	19	6	21	6	100	—	
	R	22	8	17	3	14	36	—	100	

a T = Topwood.

b R = Residual trees.



**Figure 7.—Some of the products sawed from residue bolts.**

acre. Thus for every ton of merchantable logs harvested, about 1.8 tons of residue remained.

*Sawable bolts.*—Sawable bolts from top-wood residue ranged from 6 to 14 inches in diameter and 4 to 9 feet in length. Sawable bolts from the residual trees ranged from 6 to 10 inches in diameter and 4 to 9 feet in length. The average bolt size was 7 inches in diameter by 6 feet in length for both groups. All bolts and logs were cut to the nearest foot length, with a 3-inch trim allowance. Complete bolt size distribution is shown in tables 1 and 2.

Thirty-eight percent of the sawable volume was yellow-poplar, 34 percent was oak, and the remaining 28 percent was distributed among six other hardwood species.

*Saw products.*—Total yield of sawed products from the 1-acre plot was 4,719 board feet of which 3,057 were in cant products, and 1,662 board feet were in 4/4 and 8/4 lumber (fig. 7). Total sawed volume overran the International 1/4-inch log scale by 28 percent. Ninety-five percent of the cants ranged from 4-inch by 4-inch pieces to 8-

inch by 8-inch pieces. Five percent of the cant pieces were less than 4-inch by 4-inch size because of errors in estimating sweep in some of the small diameter bolts. The sawing operation produced 8.2 tons of chip-pable slabs and edgings and 2.6 tons of sawdust (fig. 6).

All the cants met National Hardwood Lumber Association standards for sound, square-edge quality and were suitable for use as pallet material, blocking, mine timbers, and other marketable sawed products. The sawed material was used for maintenance and construction of recreation structures on the Monongahela National Forest, and for lumber package separators at the Forest Products Marketing Laboratory.

### **Further Research**

We plan similar research on at least two other clearcut areas in the oak-hickory type. This will be followed by research for developing economical systems for harvesting and processing residue.