ODC 331:531.2

LOGGING RESIDUE AVAILABLE FOR MINE-TIMBER PRODUCTION

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FOREST SERVICE RESEARCH PAPER NE-415
1978
FOREST SERVICE, U.S. DEPARTMENT OF AGRICULTURE
NORTHEASTERN FOREST EXPERIMENT STATION
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MANUSCRIPT RECEIVED FOR PUBLICATION 27 FEBRUARY 1978

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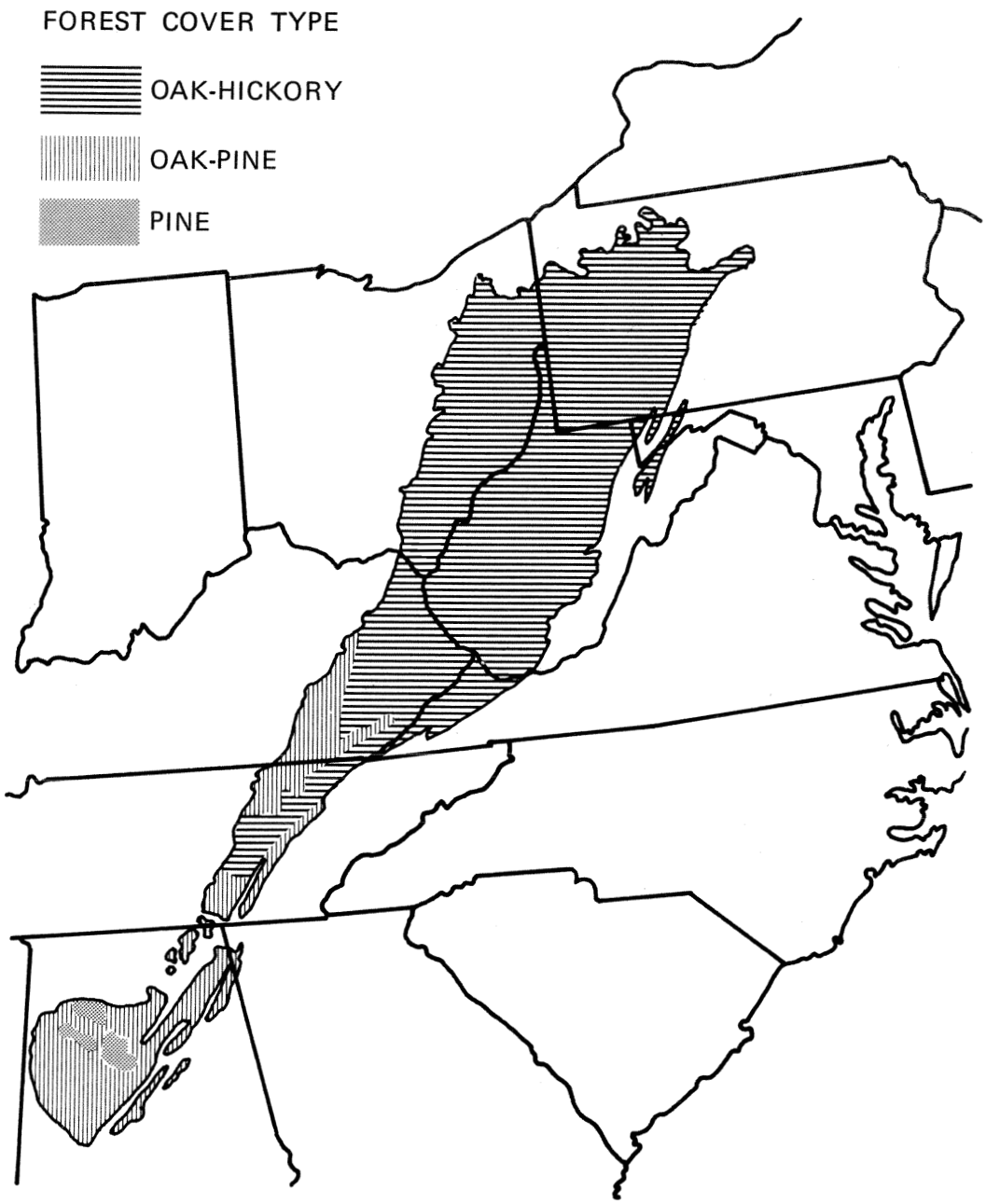
Abstract

Hardwood logging residue was examined as a source of raw material in the manufacture of sawn, split, and round timbers for use in underground coal mines. Forty-four percent of the total logging residue (residue $\geq$ 4 inches in diameter outside bark (dob), small end, and 4 feet long) from sawlog-only harvests was suitable for mine-timber production. Only 26 percent of the limbwood residue was suitable for mine timbers, but 58 percent of the bolewood residue was suitable. Depending on the species, the suitability for bolewood ranged from less than 40 percent (beech and basswood) to 68 percent (cucumbertree).

Figure 1.—Appalachian bituminous coal region [the entire shaded area] (U.S. Department of Interior 1966) and predominant forest cover types of that region (Little 1971).



INTRODUCTION

THE EASTERN HARDWOOD FOREST encompasses the Appalachian bituminous coal region (Fig. 1). In 1965, more than 60 percent of the total coal production in the United States and nearly 78 percent (231 million tons) of the total U.S. production of coal from underground mines came from this large deposit (West Virginia Coal Association 1976). And the eastern hardwood forest accounted for the estimated 300 million board feet (1.3 board feet per ton) of sawn timber and 125 million lineal feet (0.54 lineal foot per ton) of round and split timber used in mining this coal.[1]

There are three principal sources of raw material used in the production of mine timbers: low-quality portions of grade logs; low-grade material harvested specifically for mine-timber manufacturing; and good-quality (but often pole-size) trees harvested specifically for mine timbers.

There is also a fourth possible source: residue from sawlog harvesting. An estimated 80 million cubic feet of residue is produced each year in West Virginia alone (Martin 1975), much of it located near mine-timber markets. After observing that logging residues contain raw material that is suitable for mine-timber production, I determined the proportion of total residue volume that could be used for this purpose.

THE STUDY

Residue was measured on 21 randomly selected areas within the Appalachian bituminous coal region. These sample areas had been cut for sawlogs only, and were located between the Virginia-Tennessee border and north-central West Virginia. Sampling was stratified by three cover types: oak-hickory, northern hardwoods, and cove hardwoods.

Four 1/4-acre circular plots were established in each sample area. The first plot was established randomly by the field crew; each of the remaining plots was established in random direction at a 4-chain interval.

Within each plot, pieces of residue that met the following standards were measured:

- Equal to or greater than 4 feet long
- Equal to or greater than 4 inches in diameter outside bark (dob) at small end
- Lie within plot boundary or pieces that crossed one-half the plot boundary (pieces crossing the remainder of the boundary were ignored).

For each piece of residue, the following was recorded:

- Species
- Position in the tree
  (a) bolewood: main stem to a 4-inch top, or to where the stem breaks up
  (b) limbwood: to 4-inch small diameter
- Large and small end dob (to nearest 1/2 inch)
- Length (to nearest 1/2 foot)
- End diameters and lengths for each portion of the piece suitable for one of the following classes:
  (a) standard sawn mine timbers: 6 to 16 feet long, 7-inch minimum diameter inside bark (dib)
  (b) specialty sawn mine timbers: 30 inches long or multiples thereof, 6-inch minimum dib, or 18 inches long or multiples thereof, 12-inch minimum dib
  (c) mine props: 4-1/2-inch minimum dib; 4-1/2-foot minimum length; 1-inch increase in dib for each 1-foot increase in length.

The material was classified only once in the order given above. However, much of the material in the first class could be used in either of the other classes. The piece size and general characteristics that determine mine-timber classification were developed after inspecting both raw materials and mine-timber products, and from producer's comments on specifications. From this information we developed a set of minimum standards for mine-timber raw material.

After the measurements were obtained, the total cubic-foot volume of each piece was calculated, using Smalian's formula. This information was then summarized and broken down by species into the following classes:

- Suitable for general sawn products (6 to 16 feet long)
  (a) total
  (b) $\leq$10-inch, small dib
  (c) $>$10-inch, small dib
- Suitable for props
  (a) total
  (b) 4.5 through 5.5 feet long
  (c) $>$5.5 feet long

[1] Knutson, Robert G. 1970. Wood use in mines. Unpublished report on file at Forestry Sciences Laboratory, Princeton, W. Va. 35 p.

- Suitable for specialty sawn products
  (a) Total
  (b) < 30 inches long (≥ 12-inch dib, small end)
  (c) ≥ 30 inches long (≥ 6-inch dib, small end)

The preceding breakdown was repeated for each of the three residue categories: all residue, bolewood, and limbwood. All volumes were then converted to percentages.

RESULTS

An analysis of variance showed no differences among the three cover types; therefore, this stratification was discarded. The percentage of usable residue for each class is shown in Tables 1 through 3. Of all residue material remaining after a saw-log-only operation, 44 percent was physically suitable for use in manufacturing mine timbers.

Limbwood accounted for 42 percent of the total residue (Table 4); of this limbwood, only 26 percent could be classified as usable. Bolewood accounted for 58 percent of the total residue (Table 4); of this bolewood, 56 percent could be used for some form of mine timber.

Because only 26 percent of the limbwood would be suitable for the manufacture of mine timbers, a large volume of material would have to be handled for a relatively low-volume return. Therefore, because of the anticipated harvesting problems and relatively low value of material being harvested, it does not seem feasible to consider harvesting limbwood at this time. The remainder of this paper will be concerned with bolewood only.

For all bolewood measured, over one-half was more than 20 feet long and over one-third was more than 10 inches in diameter at the small end. Forty-eight percent of the bolewood residue was in material 7 inches or more in diameter and 6 to 16 feet long; this material is suitable for production of sawn timbers on a standard mine mill (Table 3). The remainder of the usable bolewood residue was suitable for props or for use in specialty mills producing wedges or crib blocking.

In determining the suitability of residue for mine-timber production, the choice of species is important. The choice depends on where the product is to be used, past experience of mine

Table 1.—Percentage of hardwood logging residue usable for the manufacture of mine timbers

ALL RESIDUE

Species	Sawn mine timbers (Standard mill)		Sawn mine timbers (Specialty mill)		Mine props		Total usable residue
	≤10″ diameter	>10″ diameter	18-30″ long	≥30″ long	4.5-5.5′ long	>5.5′ long	
Chestnut oak	16	20	0	6	1	1	44
Red Oak	20	13	0	8	3	0	44
White oak	17	16	0	5	4	1	43
Hickory	22	10	0	8	3	2	46
Basswood	16	3	0	4	0	2	25
Cucumbertree	26	20	0	2	2	0	50
Yellow-poplar	35	8	0	6	2	1	52
Beech	7	24	0	3	1	1	36
Red maple	18	17	0	7	3	0	45
Sugar maple	20	6	0	7	3	0	37
Birch	28	10	0	7	1	0	46
Black cherry	11	6	0	16	1	0	34
Miscellaneous	14	24	0	5	5	1	49
All species	20	14	0	6	3	1	44

Table 2.—Percentage of hardwood logging residue usable for the manufacture of mine timbers

LIMBWOOD

Species	Sawn mine timbers (Standard mill)		Sawn mine timbers (Specialty mill)		Mine props		Total usable limbwood residue
	≤10″ diameter	>10″ diameter	18-30″ long	≥ 30″ long	4.5-5.5′ long	>5.5′ long	
Chestnut oak	6	0	0	6	1	0	13
Red Oak	12	5	0	9	4	0	30
White oak	7	5	0	6	6	0	24
Hickory	13	3	0	9	4	1	29
Basswood	0	0	0	4	2	0	6
Cucumbertree	16	0	0	1	3	0	20
Yellow-poplar	11	0	0	8	4	0	23
Beech	12	8	0	6	3	0	29
Red maple	9	4	0	8	4	0	25
Sugar maple	9	2	0	6	5	0	22
Birch	7	10	0	13	1	0	31
Black cherry	10	0	0	12	1	0	23
Miscellaneous	13	0	0	3	6	0	22
All species	10	4	0	8	4	0	26

Table 3.—Percentage of hardwood logging residue usable for the manufacture of mine timbers

BOLEWOOD

Species	Sawn mine timbers (Standard mill)		Sawn mine timbers (Specialty mill)		Mine props		Total usable bolewood residue
	≤10″ diameter	>10″ diameter	18-30″ long	≥30″ long	4.5-5.5′ long	>5.5′ long	
Chestnut oak	24	35	0	1	0	7	67
Red Oak	32	23	0	6	2	0	63
White oak	25	27	0	5	1	0	60
Hickory	31	18	0	8	2	3	62
Basswood	22	5	0	3	2	0	32
Cucumbertree	32	31	0	3	2	0	68
Yellow-poplar	41	10	0	5	2	1	59
Beech	5	32	0	1	0	1	39
Red maple	24	24	0	6	2	0	56
Sugar maple	29	11	0	8	2	0	50
Birch	37	10	0	4	1	0	52
Black cherry	12	15	0	20	0	0	47
Miscellaneous	15	35	0	16	5	1	62
All species	26	22	0	5	2	1	56

Table 4.—Percentage of bolewood and limbwood in Appalachian logging residue

Species	Bolewood	Limbwood
Chestnut oak	57	43
Red oak	45	59
White oak	52	48
Hickory	51	49
Basswood	71	29
Cucumbertree	65	35
Yellow-poplar	79	21
Beech	64	36
Red maple	63	37
Sugar maple	54	46
Birch	68	32
Black cherry	42	58
Other	68	32
All species	58	42

operation in the use of different speeies, and what is available. In general, hard hardwoods (oaks and hickories), because of their durability and strength, are preferred over soft hardwoods (basswood and yellow-poplar) or softwoods (hemlock and pine). Some mines accept only the preferred species no matter where the wood is to be used. Some mines accept the less preferred species for use in noncritical areas.

Of the species actually used in mines for all purposes (sawn and round), an estimated 55 percent of the sawn timber volume is oak—primarily red oak; 15 percent hickory; 15 percent yellow-poplar, basswood, and cucumbertree; 6 percent beech; 5 percent pine and hemlock; and 4 percent miscellaneous hardwoods. Round and split timber consists primarily of oak, hickory, and beech (Knutson 1970).

Oak-hickory is the most common major forest type in the northern part of the bituminous coal region (Fig. 1). In the coalfield areas (areas of Kentucky, Tennessee, and Alabama), the predominant forest type is oak-hickory and oak-pine. Because of the extent of these forest types, there should be a relatively high portion of residue in the preferred species category.

In considering percent yield of usable residue for individual species (Table 3), the cucumbertree has a slight edge. Sixty-eight percent of the bolewood is usable for manufacturing some form of mine timbers. The cucumbertree, however, usually is used only for such items as wedges, or in noncritical areas, if used at all. Of the preferred species, the oaks and hickories, 60 percent or more of the bolewood residue is in material suitable for mine-timber production. Yellow-poplar, another species used primarily for wedges or in noncritical areas, has almost 60 percent usable bolewood residue. Beech and basswood yield less than 40 percent usable material from residue. However, both species are low on the preference scale.

DISCUSSION

Much of the wood used in soft coal mining could come from salvaging hardwood sawlog residue (Figs. 2A, 2B, 2C). The best opportunity would be to use bolewood residue, since bolewood accounts for most of the usable volume, and would be more economical to harvest.

In West Virginia, for example, and estimated 88,500,000 tons of coal were produced from underground mines in 1975 (West Virginia Coal Association 1976). This required 23,000,000 cubic feet of sawn timbers and 11,179,000 cubic feet of round or split timbers. The 80,000,000 cubic feet of total residue generated each year would yield enough usable bolewood to supply raw material for all the sawn timbers and one-third of the props (based on an average prop of 53 inches in length, a top diameter of 6 inches, and a conversion factor of 5 board feet of sawn product per cubic foot).

FURTHER RESEARCH

Although we estimate that 44 percent of the residue from sawlog cutting is suitable for mine-timber production, very little is considered economically suitable. There should be research on harvesting methods that might yield an adequate return on investment from residue extraction. Also needed are new methods that will minimize damage to the residual stand during residue harvesting operations.

Figure 2A.—"Residue" from a hardwood sawlog cutting operation.

Figure 2B.—A typical Appalachian mine-timber production mill.

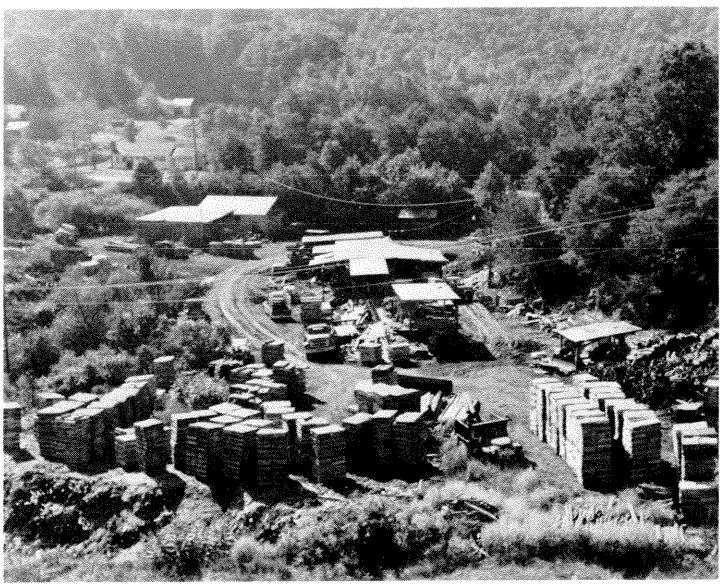


Figure 2C.—Storage yard for coal-mine timbers.

LITERATURE CITED

Knutson, Robert G.
1970. **A look at the mine-timber market in the Appalachian bituminous coal region.** U.S. Dep. Agric. For. Serv. Res. Pap. NE-147. 9 p.

Little, Elbert L., Jr.
1971. **Atlas of United States trees.** U.S. Dep. Argic. For. Serv. Misc. Publ. 1146 (base map overlay 9-E).

Martin, A. Jeff.
1975. **A look at logging residue characteristics in West Virginia.** U.S. Dep. Agric. For. Serv. Res. Note NE-200. 3 p.

U.S. Department of Interior.
1966. **Study of strip and surface mining in Appalachia.** In Interim Rep. Secr. Inter. Appalachian Reg. Comm. U.S. Dep. Inter. Washington, DC. p. 9.

West Virginia Coal Association.
1976. **West Virginia coal facts—1976.** W. Va. Coal Assoc. Charleston. 21 p.

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