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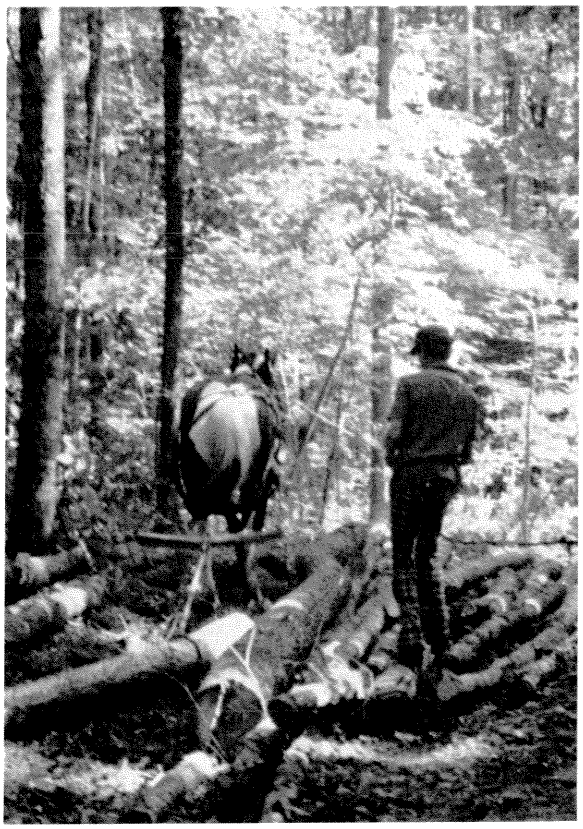
Weight and Volume Yields from Thinning Two Oak-Hickory Stands



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Abstract

Two sample plots in oak-hickory stands of poletimber-small sawtimber were thinned to determine product yields from thinnings. One stand received a light thinning; the other was heavily thinned. Light thinning reduced basal area from 120 ft^2 to 84 ft^2 per acre and removed 22 tons of roundwood per acre, including 2,543 board feet of sawed products and 7 tons of pulpwood and firewood. Heavy thinning reduced basal area from 111 ft^2 to 53 ft^2 per acre and removed 48 tons of roundwood per acre, including 5,319 board feet of sawed products and 16.9 tons of pulpwood and firewood.

INTRODUCTION

AN ESTIMATED 8 million acres of the oak-hickory forest type in the Northeast need thinning or improvement cutting (U.S. Department of Agriculture 1973). Most of this acreage is in poletimber-small sawtimber stands, and about 85 percent is on farms or other private ownerships. Intermediate cuttings in these stands can increase both total yields and the value of the final harvest by concentrating growth in the more desirable trees. More extensive use of thinning material would encourage intensive management by providing landowners with an immediate source of revenue from intermediate cutting.

New or improved harvesting and processing systems will be required before large-scale commercial thinning in poletimber stands can become a reality. Most existing logging and sawmill systems are designed for larger, higher grade timber; thus small trees cannot generally be used efficiently. The development of improved systems will require more information on the types and quantity of products that can be recovered from thinnings. This report provides weight and volume yields of products from thinning two stands in the oak-hickory types.

STUDY AREA

Two sample plots were established in oak-hickory stands on the Jefferson National Forest, Virginia. The first plot, located in Smyth County near Sugar Grove, contained 10.3 acres; the second plot, located in Giles County near Kire, contained 7.5 acres. Both plots were considered to be representative of several thousand acres of overstocked poletimber-small sawtimber stands on the Jefferson National Forest.

The first plot is in a small cove with slopes averaging 25 percent, average elevation is 3,200 feet, stand age is 50 years, and site index is 75 for upland oaks (Hampf 1965). Initial stocking was 120 ft^2 of basal area per acre including 10 percent saplings, 35 percent poletimber, and 55 percent small sawtimber. Species distribution of basal area included 41 percent red oaks (*Quercus rubra*, *Q. coccinea*, and *Q. velutina*), 24 percent white oaks (*Q. alba* and *Q. prinus*), 12 percent yellow-poplar (*Liriodendron tulipifera*), 10 percent soft maple (*Acer* spp.), 3 percent hickory (*Carya* spp.), and 10 percent other hardwood species (Table 1).

The second plot is on a northern exposure averaging less than 10 percent slope. Stand elevation is 2,600 feet, average stand age is 60 years, and site index is 65 for upland oaks. Initial stocking was 111 ft^2 of basal area per acre, including 7 percent saplings, 51 percent poletimber, and 42 percent small sawtimber. Species distribution of basal area was 59 percent white oaks, 7 percent red oaks, 16 percent yellow-poplar, 4 percent magnolia (*Magnolia* spp.), and 14 percent maple and other hardwoods (Table 1).

The oaks were predominant in both plots (65 percent of basal area for Plot 1 and 66 percent for Plot 2). Red oak constituted 63 percent of all oaks in Plot 1 and 11 percent in Plot 2.

PROCEDURE

National Forest personnel marked both stands for thinning to improve crop-tree spacing and reduce stand density. On Plot 1, the thinning reduced the number of trees from 456 to 251 per acre, reduced basal area from 120 ft^2 to 84 ft^2 per acre, and increased the mean stand dbh (diameter breast height) from 6.9 to 7.9 inches. On Plot 2, the thinning reduced the number of trees from 415 to 103 per acre, reduced basal area from 111 ft^2 to 53 ft^2 per acre, and increased the mean dbh from 7.0 to 9.7 inches.

On Plot 1, all trees designated for thinning that were 5.6 inches dbh and larger were felled, topped at a 4-inch minimum dob (diameter outside bark), and skidded to a central landing. On the average, 50 trees per acre were harvested. One hundred fifty five additional trees per acre were designated for removal, but were less than 5.6 inches dbh. Skidding was done by Forest Service personnel with a 34-hp wheeled tractor equipped with a rear mounted winch (Fig. 1).

Each stem was bucked to yield the longest sawable pieces from 4 to 14 feet long as fol-

Table 1.—Stocking by species for two study plots

Species	Basal area per acre			Trees per acre			Mean dbh		
	Initial stand	Designated cut	Designated residual	Initial stand	Designated cut	Designated residual	Initial stand	Designated cut	Designated residual
	Square feet			*Number*			*Inches*		
				PLOT 1					
Red oaks[a]	49	12	37	92	18	74	9.9	11.1	9.6
White oaks[b]	29	11	18	83	43	40	8.0	6.8	9.1
Yellow-poplar	14	2	12	26	2	24	9.9	13.5	9.6
Red maple	12	4	8	53	37	16	6.4	4.4	9.6
Hickory	4	1	3	38	7	31	4.4	5.1	4.2
Others	12	6	6	164	98	66	3.7	3.4	4.1
All species	120	36	84	456	205	251	6.9	5.6	7.9
				PLOT 2					
White oaks[b]	65	32	33	184	118	66	8.0	7.1	9.6
Red oaks[a]	8	4	4	14	11	3	10.2	8.2	15.6
Yellow-poplar	18	8	10	44	25	19	8.7	7.7	9.8
Magnolia spp.	5	4	1	36	34	2	5.0	4.6	9.6
Maple spp.	2	1	1	27	22	5	3.7	2.9	6.1
Others	13	9	4	110	102	8	4.6	4.0	9.6
All species	111	58	53	415	312	103	7.0	5.8	9.7

[a]Includes northern red oak, black oak, and scarlet oak.
[b]Includes white oak and chestnut oak.

Figure 1.—Wheeled tractor with rear-mounted winch on standard three-point hitch used for skidding on Plot 1.

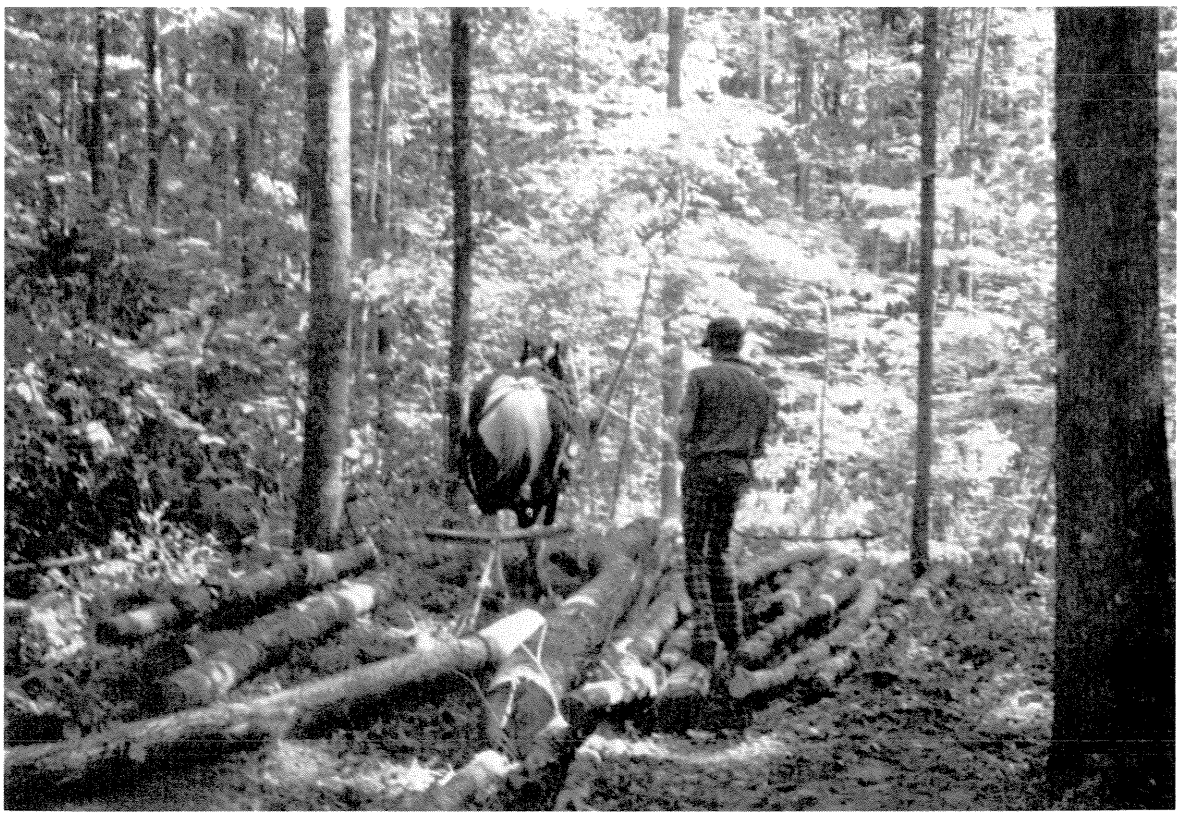
lows: *sawlogs*—pieces at least 7.6 inches dib (diameter inside bark) by 8 feet long that would meet the requirements for Factory Grade 3 or better sawlogs (Rast 1973); *sawbolts*—pieces at least 5.6 inches dib by 4 feet long, straight enough to yield at least one sound square edge 4- by 4-inch cant (NHLA 1974); *poles*—pieces at least 8 feet long and from 5.6 to 7.5 inches dib, straight enough to yield at least one sound square edge 4- by 4-inch cant; *pulpwood*—pieces 4 to 6 inches in diameter by 5 feet long, and larger diameter pieces that were not straight or sound enough to yield a sawbolt; *firewood*—pieces too short for pulpwood or sawbolts.

On Plot 2, all trees designated for thinning that were 5.6 inches dbh and larger were felled, topped at a 4-inch minimum dob, and skidded by a private contractor with horses (Fig. 2). One hundred and eighteen trees per acre were harvested. An additional 194 trees per acre were designated for removal, but were below 5.6 inches dbh and were not considered merchantable by the standards of this study. Stems were bucked as described for Plot 1, with these exceptions: (1) Factory Grade 3 logs less than 13 inches dib were bucked into sawbolts; (2) all sawbolts were cut into 4- or 6-foot lengths; and (3) straight, sound sawbolts 7.5 to 12 inches in diameter by 6 feet long were bucked from the white oak and poplar stems for use as furniture dimension bolts.

Residual stocking on Plot 1 was 84 ft^2 basal area. According to the Upland Hardwoods Stocking Guides published by Roach and Gingrich (1968), this is above the minimum level required for full stocking for this stand.

Plot 2 was thinned more heavily than Plot 1. Residual stocking was 53 ft^2 basal area: this is below the level required for full stocking. On each plot, approximately 80 percent of the trees designated for removal were in the overtopped or intermediate crown classes.

Figure 2.—Horse skidding used on Plot 2.



All roundwood products harvested from both plots were weighed and tallied by product types. Cubic volume and board foot volume (International ¼-inch rule) were determined for each sawlog, sawbolt, and pole. All sawable material was cut into cants, boards, or flitches on the laboratory sawmill. Flitches, 3 and 4 inches thick, were cut from the white oak and yellow-poplar furniture dimension bolts.

The green weight of the aboveground portion of each stand component was estimated using whole-tree weight equations developed by Wartluft (1977).

YIELDS

For Plots 1 and 2 combined, 74 percent of the biomass available for removal was harvested in the form of roundwood products. The unharvested material was in trees less than 5.6 inches dbh, and in the tops of harvested trees. This material did not meet current roundwood merchantability standards and could only be harvested and marketed for whole-tree chips or fuelwood.

Biomass

On Plot 1, an estimated 34 tons per acre of whole-tree biomass[1] was available for harvest; this amounted to 27 percent of total initial stand biomass. The 22 tons per acre of roundwood products harvested accounted for 64 percent of the tonnage available for removal (Table 2).

Estimated biomass available for removal from Plot 2 was 56.7 tons per acre, or 49 percent of the initial stand biomass. The roundwood products harvested weighed 48.3 tons per acre, or 85 percent of available biomass. The increased yield from Plot 2 compared with Plot 1 reflects the heavier thinning (Table 2).

[1]Weight of all material above a *6-inch* stump for trees designated for thinning.

Table 2.—Estimated aboveground green weight of individual stand components (tons per acre)

Stand component	Plot 1	Plot 2
Initial stand	125.4	116.4
Residual trees	91.0	59.7
Trees available for removal[a]	34.4	56.7
Products actually removed	22.0	48.3
Remaining available biomass in trees <5.5″ dbh and residue from cut trees	12.4	8.4

[a]All diameters, including trees less than 5.6 inches dbh—not cut.

Roundwood products

The yield of roundwood from Plot 1 averaged 22 tons or 608 ft³ per acre. Thirty-two percent of this volume was pulpwood and firewood, 40 percent was sawbolts and poles, and 28 percent was sawlogs (Table 3).

The harvest of roundwood from Plot 2 was 48 tons or 1,453 ft³ per acre. Thirty-four percent of this volume was pulpwood and firewood, 44 percent was sawbolts and poles, and 22 percent was sawlogs (Table 3).

For both plots combined, 61 percent of the log scale volume came from sawbolts and poles. The remaining 39 percent was from sawlogs.

Sawed products

Sawable roundwood from Plot 1 yielded 2,543 board feet per acre of sawed products, including 39 percent pallet parts and cants, 12 percent furniture dimension stock, and 49 percent standard lumber. Total green-product yield averaged 23 percent overrun based on International ¼-inch rule (Table 4).

Sawable roundwood on Plot 2 yielded 5,319 board feet per acre of sawed products, including 41 percent pallet parts, 21 percent furniture dimension stock, and 38 percent standard lumber and cants. Total product yield averaged 18 percent overrun on International ¼-inch rule (Table 4).

DISCUSSION

The large differences in available biomass and roundwood for removal between Plots 1 and 2 can be attributed to the intensity of the thinning on each plot. Fifty merchantable trees per acre were cut on Plot 1 compared with 118 per acre on Plot 2. However, the

Table 3.—Roundwood yields per acre by product

Item	Weight	Volume		Proportion of cubic volume
	Tons	*Board feet*[a]	*Cubic feet*	*Percent*
		PLOT 1		
Firewood	1.3		36.9	6.0
Pulpwood	5.7		157.6	26.0
4′ sawbolts	4.3	537	118.0	19.4
5′-8′ sawbolts	3.5	457	95.6	15.7
Poles	1.0	119	28.0	4.6
Sawlogs	6.2	953	172.2	28.3
Total	22.0	2,066	608.3	100.0
		PLOT 2		
Firewood	1.4		42.5	3.0
Pulpwood	15.5		457.0	31.4
4′ sawbolts	6.9	848	199.2	13.7
6′ sawbolts	13.0	1,768	382.4	26.3
Poles	2.0	281	60.0	4.1
Sawlogs	9.5	1,623	312.1	21.5
Total	48.3	4,520	1,453.2	100.0

[a]International ¼-inch rule.

Table 4.—Sawed product yields per acre by roundwood class

Item	Log scale	Yield	Overrun	Proportion of sawed products
	Board feet[a]	*Board feet*[b]		*Percent*
		PLOT 1		
4′ sawbolts	537	694	29	27
5′-8′ sawbolts	457	608	33	24
Poles and sawlogs	1,072	1,241	16	49
Total	2,066	2,543	23 (avg)	100
		PLOT 2		
4′ sawbolts	848	1,136	33	21
6′ sawbolts	1,768	2,184	24	41
Poles and sawlogs	1,904	1,999	5	38
Total	4,520	5,319	18 (avg)	100

[a]International ¼-inch rule.
[b]Lumber measure.

average weight and volume yield per merchantable tree cut were similar on both plots: total weight of products average 0.44 tons on Plot 1, and 0.41 tons on Plot 2; average cubic volume harvested was 12.2 ft^3 on Plot 1 and 12.3 ft^3 on Plot 2; sawable volume was 41.3 board feet on Plot 1 and 38.3 board feet on Plot 2.

More important than the differences between plots, the results from both plots show that close utilization can significantly increase both the volume and the value of the material obtained from thinnings in oak-hickory stands. Full use of all trees available for removal would have yielded an additional 10.4 tons per acre, a 30 percent increase in the weight of products removed from both plots. This additional wood from small trees and cut tree residues can be used for wood fiber or fuel.

Converting small logs into sawed products would significantly increase the value of thinning material. For example, the current value of pallet bolts is about twice that of pulpwood. On both plots combined, 61 percent of the log-scale volume of sawable material (43 percent of the total cubic volume harvested) was in the form of sawbolts and poles (Table 3). Although this material is physically suitable for production of pallet parts or similar products, it is either too small in diameter or too short to make factory grade sawlogs. Without a sawbolt market, this material must be marketed as pulpwood.

In parts of the Appalachians, deep-mining operations provide substantial markets for roundwood 4.5 inches dob and larger (Timson 1978a, 1978b). For other parts of the eastern hardwood region, the only large-volume market for small roundwood is for pulpwood. The use of fuelwood is increasing rapidly, and will probably increase the opportunities for thinning the more accessible stands. Altogether, these markets cannot absorb the large volumes of wood potentially available from thinnings. An expanded sawbolt market would not only increase the value of thinning material, but create additional markets for thinning material as well.

We cannot accurately assess the types and volumes of products available from thinnings in the oak-hickory forest type, having sampled only two stands. However, these preliminary results indicate that a tremendous amount of both fiber and solid wood products are available from this source. We are continuing research to develop preharvest predictors of product yields from thinnings for the region's major forest types, for a range of sites, age classes, and stocking levels. We are also initiatting studies to help develop efficient methods for harvesting small trees from thinnings.

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