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TOTAL TREE AND PRODUCT WEIGHT OF BEETLE-KILLED LOBLOLLY PINES IN NORTHEAST GEORGIA

BY

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COVER

These loblolly pines were recently killed by southern pine beetles and are still merchantable for a variety of products, including saw logs, pulpwood, and total tree fuelwood chips. Note particularly the low-value understory hardwoods, which have been released from competition and may soon dominate this pine site.

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TOTAL TREE AND PRODUCT WEIGHT OF BEETLE-KILLED LOBLOLLY PINES IN NORTHEAST GEORGIA

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INTRODUCTION

Utilization of beetle-killed trees not only helps control the spread of southern pine beetles, but is a good management practice to increase profits. Recently killed trees are usually merchantable with little loss of quality and lower stumpage value. However, during severe outbreaks of southern pine beetles, immediate utilization of dead trees may not be possible because of oversupply at the mill.

Standing dead trees will deteriorate rapidly in the warm, humid climate of the South. Barron (1971) found that within several months of their death, beetle-killed trees lose little wood substance but over half of their moisture content. Since half of the total weight of live loblolly pines consists of water (Taras and Clark 1975), this loss of water results in a major reduction of tree weight, especially if beetle-killed trees are marketed on a weight basis.

The yield of harvested southern pine timber is commonly measured on a weight basis for convenience and, with proper factors, is converted to conventional volume units by the buyer. Conversion factors are available for live pine sawlog and pulpwood timber (Saucier and others 1981) but they should not be applied to beetle-killed trees because of the lower moisture content of dead trees. Reported here are the results of a study to develop prediction equations and tables for estimating the weight of trees killed by southern pine beetles.

PROCEDURE

Loblolly pine trees killed by southern pine beetles during 1980 and 1981 were selected from natural upland stands at four locations in northeast Georgia (Figure 1). Sixty trees, ranging from 5 to 18 inches d.b.h., were sampled and grouped in two classes according to crown appearance (Table 1). Trees in class A were estimated to have been dead from 5 to 7 months, and still had fine twigs attached to the larger branches (Figure 2). Those in class B had lost some of their small branches and had been dead from 10 to more than 18 months (Figure 3).

The amount of bark remaining on the trees varied widely, particularly between classes. Levi (1981) found that the presence or absence of bark is not a reliable indicator of wood quality. Generally, all stem bark was still attached on trees in class A and was present on the lower half of trees in class B. All trees sampled had bark present at 4.5 feet. The 13 sawtimber-size trees sampled in class A averaged 12.9 inches d.b.h. and contained an average of 2.5 to 3.0 saw logs 16.3 feet in length.

Trees were felled with a chain saw, limbed, and the main stem was bucked into major products of saw logs and pulpwood, depending on tree class and size. In class A, saw logs to a 7-inch d.o.b. or merchantable top were cut from trees greater than 9 inches d.b.h. Pulpwood was cut to a 4-inch d.o.b. top from the stem above the saw-log top, and from smaller trees. No saw logs were cut from trees in class B because of probable low grade and loss of strength resulting from blue stain, decay, or insect damage (Levi 1981).

The crown, consisting of stem wood above the 4-inch top and all branches, was weighed separately to the nearest pound. Broken branches and topwood were included in the weighing when they could be found and identified according to the proper tree. Samples of stem and branch wood were collected and returned to the laboratory for determination of moisture content.

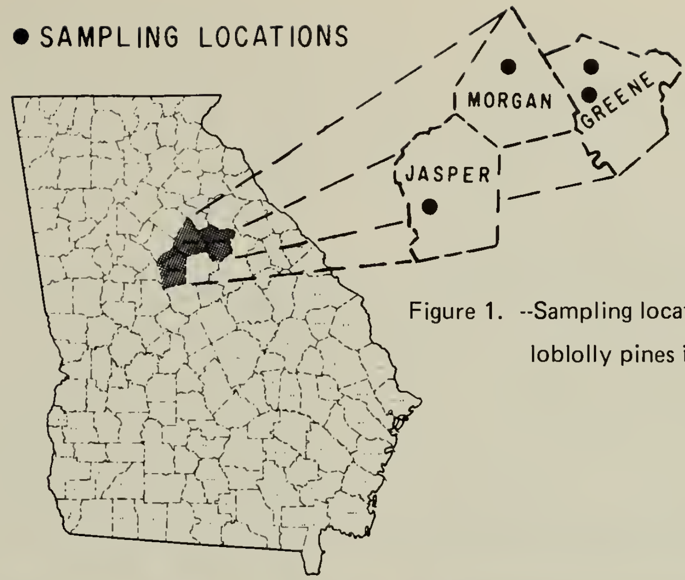


Figure 1. --Sampling locations of beetle-killed loblolly pines in northeast Georgia.

Figure 2. --Class A beetle-killed loblolly pines still have fine twigs attached to the main branches.

Figure 3. --Class B beetle-killed loblolly pines have broken branches and lack fine branch twigs.

RESULTS AND DISCUSSION

Preliminary analysis of the weight data showed no practical difference in total tree or product weight between the two tree classes. Wood moisture content was also similar between the two classes of trees:

Tree Class	Main Stem	Branches
	- - - - - - - Percent- - - - - - -	
A	62	24
B	45	26

Except for the saw-log weights, total tree and pulpwood weight data from both classes were combined into a single group for further analysis.

Total Tree Weight

The relationship of average total tree green weight by d.b.h. class is shown in Figure 4. Results are presented for tree wood content only, and do not include bark. Even though bark was present on most of the bole on trees in class A, it was loosely attached and would probably be lost during felling and skidding operations.

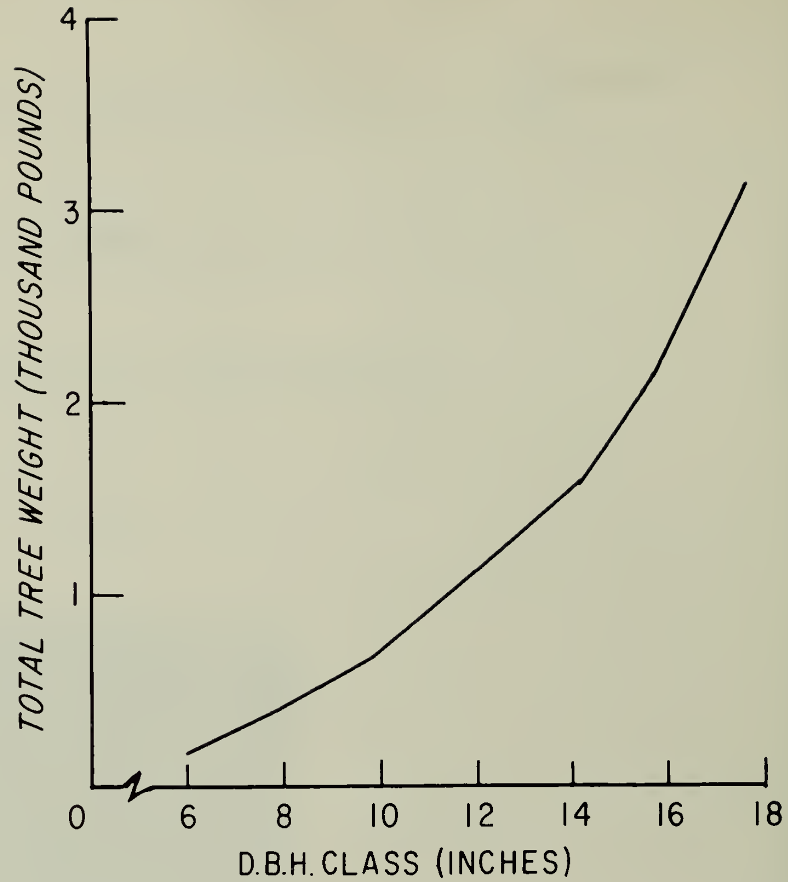
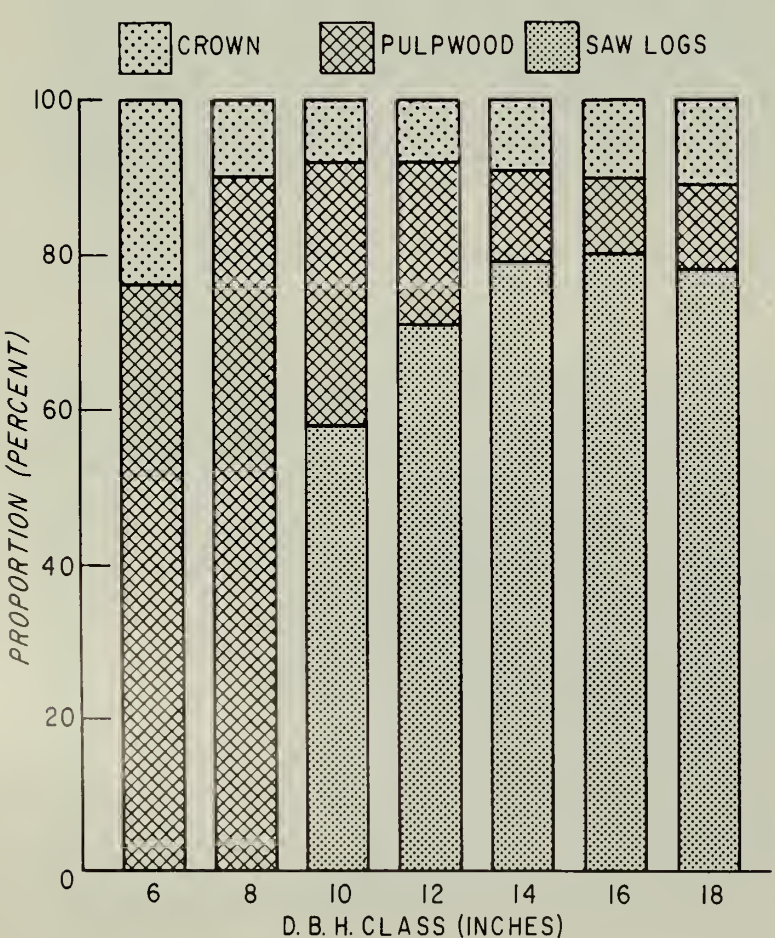


Figure 4. --Relationship of total-tree green weight to d.b.h. class of beetle-killed loblolly pines in northeast Georgia.



A considerable amount of crown material was often broken from trees in class B during felling. On the average, about 15 percent of the total tree weight in branches and top wood was broken and probably would not be recovered for utilization. Larger trees appeared to lose a higher proportion of crown wood than small trees.

Product Weight

The distribution of pulpwood and saw-log product weight as a percentage of total tree weight is shown in Figure 5. A large proporation of total tree weight consists of pulpwood in the bole to a 4-inch d.o.b. top, indicating that recoverable crown weight is relatively small. A similar trend occurs between the bole weight to a 4-inch top and saw-log weight. The proportion of weight in saw logs increased until tree d.b.h. reached 14 inches, where it leveled off at about 83 percent.

Figure 5. --Proportion of total-tree green weight in crown, pulpwood, and saw logs for beetle-killed loblolly pines.

Predicition Equations

Prediction equations were developed from common cruise variables to estimate total tree and product weight. A prediction equation for pulpwood weight was developed by using d.b.h. and height to a 4-inch d.o.b. top. Total tree weight was estimated by developing a prediction equation for the crown separately, and adding it to the predicted weight of pulpwood. An equation using d.b.h. and merchantable height was developed to allow estimation of saw-log weight. All equations were sufficiently accurate to account for over 95 percent of the variation associated with total tree or product weight.

Weight Scale Factors

Factors for converting weight to units of volume were calculated from field weights and published volume tables (Knight and McClure 1974 Mesavage and Girard 1956). An average of 2,996 pounds of wood from 8-inch d.b.h., beetle-killed trees was required for a stacked cord containing 68 cubic feet of wood. For sawtimber in our study, the average weight per thousand board feet (Scribner log rule, form class 78) was about 10,600 pounds. Saw-log conversion factors were also calculated from d.b.h. class and estimated weights (Table 2).

Weight Tables

Prediction equations were used to construct Tables 3, 4, and 5 for estimating saw-log, pulpwood, and total tree green weight. Other components may also be estimated by using values from these tables. For example, pulpwood above the saw-log merchantable top can be determined by subtracting saw-log weight from weight to a 4-inch top. Likewise, crown weight can be estimated by subtracting pulpwood weight from total tree weight. As with any table of this type, predicted weights are most accurate near the center of the "blocked-in" area and, where possible, predicted weights should be verified for accuracy.

SUMMARY AND CONCLUSIONS

Pines killed by beetles are merchantable for various products if harvested soon after attack. In the South, however, significant weight loss occurs quickly, especially during the summer months, and will affect accurate conversion of weight to volumes if factors for live trees are used. For example, the main stem and branch wood moisture content of live loblolly pines is slightly over 100 percent (Taras and Clark 1974), almost double the amount measured in beetle-killed trees. Tables for estimating the weight of the total tree and products, and weight-scaling factors were developed for beetle-killed loblolly pines.

If markets are not available or if excessive deterioration lowers qood quality for conventional products, beetle-killed trees can be harvested for fuelwood chips.

Table 1.--Means and ranges in dimensions of beetle-killed loblolly pines sampled in northeast Georgia

Tree class	Trees sampled	D.b.h. Mean	D.b.h. Range	Height to 4-inch top Mean	Height to 4-inch top Range
	Number	- - -*Inches*- - -		- - -*Feet*- - - -	
A	26	9.8	5.1-15.3	46	14-72
B	34	11.6	5.2-18.8	56	14-82
All	60	10.8	5.1-18.8	52	14-82

Table 2.--Estimated green weight of pulpwood and saw logs per unit volume for beetle-killed loblolly pines in northeast Georgia

D.b.h. class (inches)	Pulpwood 1/	Saw log 2/ Merchantable height	Saw log 2/ Weight
	Lb/cord	*Feet*	*Lb/MBF*
6	2,745	--	--
8	3,064	--	--
10	3,290	1.5	12,700
12	3,452	2.0	11,200
14	3,573	2.5	10,300
16	3,672	3.0	9,600
18	3,748	3/	9,100

1/ Cubic feet of wood per cord from Knight and McClure 1974. Average field weight of wood and bark per cubic foot of wood was about 45 pounds for the main stem.

2/ Scribner log rule; form class 78.

3/ No trees measured in this d.b.h. class; weight extrapolated.

Table 3.--Predicted green weight of wood to a saw-log merchantable height for beetle-killed loblolly pines in northeast Georgia

D.b.h. class (inches)	Merchantable saw-log top (16-foot logs)[1/]					
	1.0	1.5	2.0	2.5	3.0	3.5
	Pounds[2/]					
9	288	379	461	537	608	
10	359	472	573	668	756	
11	437	574	698	813	921	1023
12	523	688	836	973	1102	1225
13	617	811	987	1149	1301	1446
14	719	946	1150	1339	1516	1685
15		1091	1326	1544	1749	1943
16		1247	1516	1765	1999	2221
17			1718	2000	2266	2518
18			1934	2252	2550	2833
19				2518	2852	3169
20				2800	3171	3523

1/ Blocked-in area indicates range of data.

2/ $Y = 0.37790(D^2)^{1.03409}(Mh)^{0.68894}$.

where:

Y = saw-log weight in pounds,
D = d.b.h. in inches,
Mh = saw-log merchantable height in 16-foot logs.

Table 4.--Predicted green weight of wood to a 4-inch d.o.b. top for beetle-killed loblolly pines in northeast Georgia

D.b.h. class (inches)	Height to 4-inch top (feet)[1]							
	10	20	30	40	50	60	70	80
	Pounds[2]							
5	37	70	103	134	166	197		
6	52	99	144	189	233	277		
7	69	132	193	253	311	369	427	
8	88	169	248	324	400	475	548	
9	110	211	309	405	499	592	684	755
10	134	257	377	493	608	721	833	944
11		308	450	590	727	862	996	1129
12		362	530	694	856	1015	1173	1329
13			616	806	994	1180	1363	1545
14			708	927	1142	1355	1566	1775
15				1055	1300	1543	1782	2020
16				1190	1467	1741	2012	2280
17					1644	1951	2254	2555
18					1830	2171	2509	2844
19						2403	2777	3147
20						2646	3057	3465

1/ Blocked-in area indicates range of data.

2/ $Y = 0.20679(D^2H4)^{0.93763}$.

where:

Y = stem weight to 4-inch d.o.b. top,
D = d.b.h. in inches,
H4 = height to 4-inch top.

Table 5.--Predicted green weight of total tree wood for beetle-killed loblolly pines in northeast Georgia

D.b.h. class (inches)	Height to 4-inch top (feet)[1/]							
	10	20	30	40	50	60	70	80
	Pounds[2/]							
5	56	97	135	172	208	242		
6	74	131	184	234	283	331		
7	95	169	238	305	370	433	495	
8	119	212	299	384	466	547	626	
9	144	259	367	471	573	673	771	869
10	172	310	441	567	690	811	930	1048
11		366	521	671	817	961	1103	1243
12		425	607	782	954	1123	1289	1453
13			699	902	1101	1296	1488	1678
14			797	1029	1257	1480	1701	1919
15				1164	1422	1676	1926	2174
16				1307	1598	1883	2165	2444
17					1782	2102	2417	2728
18					1976	2331	2681	3027
19						2571	2958	3341
20						2822	3248	3668

1/ Blocked-in area indicates range of data.

2/ $Y = 0.20679(D^2H4)^{0.93763} + 1.30503(D^2H4)^{0.4866}$

where:

Y = total tree weight in pounds,
D = d.b.h. in inches,
H4 = height to 4-inch top.

LITERATURE CITED

Barron, Edwin H. 1971. Deterioration of southern pine beetle-killed trees. For. Prod. J. 21(3): 57-59.

Knight, H. A.; McClure, J. P. 1974. Georgia's timber, 1972. Resour. Bull. SE-27. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southeastern Forest Experiment Station; 19 p.

Levi, Michael P. 1981. A guide for using beetle-killed southern pine based on tree appearance. Agric. Handb. 572. Washington, DC: U.S. Department of Agriculture; 19 p.

Mesavage, Clement; Girard, J. W. 1956. Tables for estimating board-foot volume of timber. Washington, DC: U. S. Department of Agriculture, Forest Service; 94 p.

Saucier, J. R.; Phillips, D. R.; Williams, J. G. 1981. Green weight, volume, board-foot, and cord tables for the major southern pine species. Ga. For. Res. Pap. 19. Macon, GA: Georgia Forestry Commission; 63 p.

Taras, M. A.; Clark, A. 1975. Aboveground biomass of loblolly pine in a natural uneven-aged sawtimber stand in central Alabama. Tappi 58(2): 103-105.

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