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Aboveground Biomass of Slash Pine in a Natural Sawtimber Stand in Southern Alabama

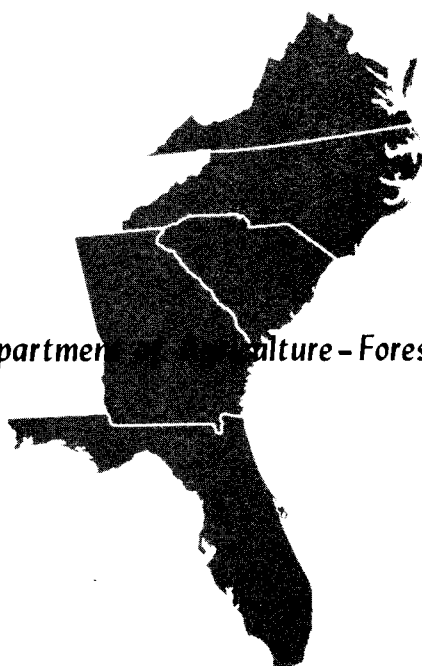
by

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Abstract.--Slash pine trees 6 to 20 inches d.b.h. selected from a natural, uneven-aged sawtimber stand in southern Alabama were sampled for green and dry weight and cubic volume in the total tree and its component parts. On the average, 84 percent of total-tree dry weight was wood, 13 percent was bark, and 3 percent was needles. The average tree sampled had 85 percent of its wood in the stem and 12 percent in the crown. Trends in biomass proportions are discussed. Specific gravity, moisture content, and green weight per cubic foot are presented for the total tree and its components. Yield tables developed from regression equations predict green and dry weights and cubic-foot volumes by d.b.h. and total height classes.

Keywords: Pinus elliotii Englem., weight, volume, prediction equations, component proportions, biomass.

This is the fourth in a series of reports on the aboveground biomass of southern pine sawtimber trees. It contains information on slash pine (Pinus elliotii Engelm.). The first three papers were on loblolly pine (Pinus taeda L.),² shortleaf pine (Pinus echinata Mill.),³ and longleaf pine (Pinus palustris Mill.).⁴

This Paper reports weights and volumes of various tree components (wood, bark, crown, branches, and foliage) and presents regression equations and yield tables for predicting these components. The term "total tree" in this study refers only to the aboveground portion of the tree and does not include stump and roots.

¹ This study was conducted by the Southeastern Forest Experiment Station in cooperation with and through the financial assistance of the Range, Timber, and Wildlife Program Area of Region 3 of the National Forest System. Field personnel were provided by the Conecuh National Forest.

² Taras, Michael A., and Alexander Clark III. 1975. Aboveground biomass of loblolly pine in a natural uneven-aged stand in central Alabama. TAPPI 58(2):103-105.

³ Clark, Alexander, III, and Michael A. Taras. 1976. Biomass of shortleaf pine in a natural sawtimber stand in northern Mississippi. U. S. Dep. Agric. For. Serv., Res. Pap. SE-146, 32 p. Southeast. For. Exp. Stn., Asheville, N. C.

⁴ Taras, Michael A., and Alexander Clark III. 1977. Aboveground biomass of longleaf pine in a natural sawtimber stand in southern Alabama. U.S. Dep. Agric. For. Serv., Res. Pap. SE-162, 32 p. Southeast. For. Exp. Stn., Asheville, N. C.

PROCEDURE

FIELD

A stratified random sample of 43 trees was selected from a natural, uneven-aged slash pine stand on the Conecuh National Forest in southern Alabama. Site index (age 50) averaged 74. Three to six trees from each even-inch d.b.h. class from 6 to 20 inches were selected. The sample trees averaged 12.9 inches d.b.h., 73 feet in total height, and 51 years of age. Means and ranges of the tree measurements by d.b.h. class are shown in table 1.

Table 1.--Means and ranges of measurements of slash pines in each d.b.h. class sampled

D.b.h. class (inches)	Sample trees	D.b.h.		Total height		Merchantable height ¹		Age		Form class	
		Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range	Avg.	Range
	<u>Number</u>	<u>Inches</u>		<u>Feet</u>		<u>Years</u>					
6	5	6.2	6.0- 6.4	56	47-62	2	2- 4	31	28-34	71	63-75
8	5	8.0	7.8- 8.1	58	48-68	21	15-28	39	33-58	75	69-84
10	6	10.1	9.6-10.4	66	52-77	37	30-42	40	32-66	76	69-80
12	6	12.1	11.8-12.3	74	56-85	46	32-52	61	36-68	80	77-86
14	6	14.0	13.6-14.5	75	68-80	48	38-54	48	35-62	79	76-82
16	6	16.3	16.2-16.4	86	72-99	55	46-68	64	54-67	82	79-86
18	6	18.2	18.0-18.5	86	78-94	58	46-66	62	51-68	85	78-94
20	3	20.5	20.0-21.0	81	72-91	51	40-62	61	53-68	87	83-94
All classes	43	12.9	6.0-21.0	73	47-99	40	2-68	51	28-68	79	63-94

¹ Height to 6-inch d.i.b. or merchantable top.

After felling and limbing, the main stem of each tree was bucked into merchantable saw logs and pulpwood. Saw logs 8 to 16 feet long were cut from the main stem to a 6-inch d.i.b. or merchantable top. All material above saw-log merchantability to a 2-inch top was classed as pulpwood. The crown was cut up and segregated into four categories: [1] large branches (≥ 2.0 inches d.o.b.), [2] medium branches (≥ 0.6 and ≤ 1.9 inches d.o.b.), [3] small branches (≤ 0.5 inches d.o.b.), and [4] needles. The tip of the stem (2 inches d.i.b. to top) was included in branch material in this Paper. All crown material and pulpwood were weighed in the woods to the nearest 0.25 pound. Saw logs were weighed individually on electronically operated platform scales.

Moisture content and specific gravity of wood and bark were determined from disks removed from each tree at the butt, at each saw-log bucking point, and at points where d.i.b. measured 4 and 2 inches. Disks were also randomly selected and cut from each branch category. A sample of needles was taken for determining needle moisture content. The disks were weighed and

calipered with and without bark immediately after being sawed. A representative sample of bark and wood was removed from each disk, weighed, and sealed in a polyethylene bag for laboratory analysis.

LABORATORY

Specific gravity was computed from green volume and oven-dry weight. Moisture content samples were dried to a constant weight at 103° C, and moisture content was computed on an oven-dry basis. Bark percentage was determined on a weight basis from cross-sectional samples. Weighted values for moisture content, specific gravity, and bark percentage in the stem, branches, and total tree were calculated by weighting disk values in proportion to the volume of the component each represented. Weighted moisture content values were used to convert component green weights to oven-dry weights.

The following equation was used to calculate green weight per cubic foot separately for wood and bark on the basis of the weighted values for specific gravity and moisture content:

$$\text{Green weight per cubic foot} = 1 + \frac{\text{M.C.}}{100} (\text{S.G.}) (62.4) \quad (1)$$

where: M.C. = weighted tree moisture content in percent

S.G. = weighted tree specific gravity

The green cubic-foot volume of wood and bark was computed by dividing component weight by the component's green weight per cubic foot. Green cubic-foot volume of wood and bark was computed by adding the green volume of wood to the green volume of bark.

ANALYSIS

Simple linear regression analyses were applied to green and dry weight of wood, bark, and needles in the total tree and its component parts. Independent variables examined were d.b.h., total height, merchantable height, crown length, crown ratio, and form class. Regression analyses were also applied to green cubic-foot volume of wood and bark separately and in combination.

The best independent variables examined were d.b.h. and total height. Thus, tree and component weights and volumes were estimated with the equation:

$$Y = b_0 + b_1 D^2 Th + e \quad (2)$$

where: Y = weight or volume of component,

D = d.b.h. in inches,

Th = total-tree height in feet,

e = experimental error, and

b_0, b_1 = constants.

Grouping of the data into D^2Th classes indicated that the variance of Y increased with increasing D^2Th . Thus, a logarithmic transformation was used to make the variance more nearly homogeneous and meet this basic assumption of regression analysis. The final form of the equation used to predict weights and volumes was:

$$\text{Log}_{10} Y = b_0 + b_1 \text{Log}_{10} (D^2Th) \quad (3)$$

RESULTS

TOTAL-TREE BIOMASS

Green and dry weight of the total tree and proportions of tree weight in wood, bark, and needles are shown in table 2. Green weight of the total tree ranged from 357 pounds for a 6-inch tree to 6,676 pounds for a 20-inch tree. On a green-weight basis, the trees averaged 85 percent wood, 11 percent bark, and 4 percent needles; on a dry-weight basis they averaged 84 percent wood, 13 percent bark, and 3 percent needles. The proportion of tree weight in wood increased and the proportion in bark decreased as tree size increased from 6 to 12 inches d.b.h. and then remained almost constant as tree d.b.h. increased from 12 to 20 inches. The proportion of tree weight in needles did not change consistently with tree size and averaged 3 to 4 percent. Proportions of the various tree components computed on a dry-weight basis varied slightly from those computed on a green-weight basis because of differences in component moisture content (table 2).

Table 2.--Average green and dry weight of the total tree and proportion of the tree in wood, bark, and needles for slash pines 6 to 20 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree green weight	Tree component proportions (green)			Total tree dry weight	Tree component proportions (dry)		
				Wood	Bark	Needles		Wood	Bark	Needles
	<u>Feet</u>	<u>Number</u>	<u>Pounds</u>	<u>- - Percent - -</u>			<u>Pounds</u>	<u>- - Percent - -</u>		
6	56	5	357	79	16	5	194	78	18	4
8	58	5	650	79	16	5	360	78	17	5
10	66	6	1,140	81	13	6	622	80	15	5
12	74	6	1,852	85	12	3	1,048	83	14	3
14	75	6	2,648	83	12	5	1,424	81	14	5
16	86	6	3,764	87	10	3	2,113	86	12	2
18	86	6	5,176	87	10	3	2,872	86	11	3
20	81	3	6,676	85	10	5	3,647	84	12	4
Average	--	--	2,617	85	11	4	1,446	84	13	3

When the trees were broken down into stem and crown material, 85 percent of tree dry weight was in the stem and 15 percent was in the crown (branches plus needles) (table 3). The average crown proportion of 15 percent is slightly less than the averages previously reported in this series for loblolly pine (17 percent), shortleaf pine (18 percent), and longleaf pine (17 percent).

Table 3.--Average green and dry weight of the total tree and proportion of the tree in main stem¹ and crown (branches and needles) for slash pines 6 to 20 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree green weight	Tree component proportions (green)			Total tree dry weight	Tree component proportions (dry)		
				Stem	Crown			Stem	Crown	
					Branches	Needles			Branches	Needles
	Feet	Number	Pounds	- - -	Percent	- - -	Pounds	- - -	Percent	- - -
6	56	5	357	86	9	5	194	88	8	4
8	58	5	650	87	8	5	360	88	8	4
10	66	6	1,140	85	9	6	622	86	9	5
12	74	6	1,852	87	10	3	1,048	88	9	3
14	75	6	2,648	82	13	5	1,424	83	12	5
16	86	6	3,764	87	10	3	2,113	88	9	3
18	86	6	5,176	84	13	3	2,872	85	12	3
20	81	3	6,676	78	18	5	3,647	79	17	4
Average	--	--	2,617	83	13	4	1,446	85	12	3

¹ Stem material to 2-inch d.i.b. top.

Proportion of tree dry weight in branches alone ranged from 8 percent in the small trees to 17 percent in the large trees and averaged 12 percent (table 3). As with the other three species, the increase in proportion of crown material was due to an increase in proportion of branch material and not to an increase in the proportion of needles.

The green and dry weight of all wood in the tree and the distribution of wood throughout the tree are presented in table 4. On the average, the trees had 90 percent of their dry wood weight in the main stem (to a 2-inch top) and 10 percent in branches. The proportion of wood in the main stem decreased and that in the branches increased as tree size increased. The increase in proportion of wood in branches was due to an increase in large branch material in larger trees. The proportion of wood in the pulpwood section of a tree decreased and proportion in the saw-log section increased as tree size increased. On the average, the trees contained 80 percent of their dry wood in saw-log material, 10 percent in pulpwood, and 10 percent in branches.

The weight and distribution of bark in the tree are presented in table 5. As tree size increased, the proportion of bark in the main stem decreased and the proportion of bark in the branches increased. This increase in bark percentage in branches was due to an increase in the proportion of large branches in large trees. On the average, 61 percent of all dry bark in the tree was in saw-log material, 12 percent was in pulpwood, and 27 percent was in branches.

CROWN BIOMASS

When the crown was analyzed as a separate entity composed of branchwood, branchbark, and needles, the proportion of crown weight in wood increased, while the proportion in needles and bark decreased with increasing tree size (table 6). On the average, 55 percent of the dry weight of the crown was in wood, 22 percent was in bark, and 23 percent was in needles.

Table 4.--Average green and dry weight of wood in the total tree and distribution of wood in main stem¹ and branches for slash pines 6 to 20 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree wood weight	Proportion of wood in--						
				Main stem			Branches			
				Saw log	Pulpwood	Total stem	Large	Medium	Small	All branches
	<u>Feet</u>	<u>Number</u>	<u>Pounds</u>	<u>Percent</u>						
<u>GREEN</u>										
6	56	5	283	9	84	93	0	5	2	7
8	58	5	515	53	41	94	0	4	2	6
10	66	6	930	78	15	93	1	4	2	7
12	74	6	1,568	81	11	92	4	2	2	8
14	75	6	2,185	81	8	89	6	3	2	11
16	86	6	3,256	81	11	92	5	2	1	8
18	86	6	4,492	82	7	89	8	2	1	11
20	81	3	5,674	76	8	84	12	2	2	16
Average	--	--	2,223	78	11	89	6	3	2	11
<u>DRY</u>										
6	56	5	152	10	84	94	0	4	2	6
8	58	5	282	55	39	94	0	4	2	6
10	66	6	500	80	13	93	1	4	2	7
12	74	6	871	83	10	93	4	2	1	7
14	75	6	1,158	82	7	89	6	3	2	11
16	86	6	1,812	82	10	92	5	2	1	8
18	86	6	2,467	85	5	90	7	2	1	10
20	81	3	3,065	78	7	85	11	3	1	15
Average	--	--	1,214	80	10	90	6	3	1	10

¹ Stem material to 2-inch d.i.b. top.

Table 5.--Average green and dry weight of bark in the total tree and distribution of bark in main stem¹ and branches for slash pines 6 to 20 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Total tree bark weight	Proportion of bark in--						
				Main stem			Branches			
				Saw log	Pulpwood	Total stem	Large	Medium	Small	All branches
<u>Feet</u> <u>Number</u> <u>Pounds</u> - - - - - <u>Percent</u> - - - - -										
<u>GREEN</u>										
6	56	5	56	8	71	79	0	11	10	21
8	58	5	101	42	36	78	0	11	11	22
10	66	6	145	61	14	75	2	11	12	25
12	74	6	226	64	11	75	8	7	10	25
14	75	6	322	59	9	68	11	8	13	32
16	86	6	392	61	12	73	10	7	10	27
18	86	6	509	59	7	66	14	7	13	34
20	81	3	698	54	8	62	18	7	13	38
Average	--	--	289	57	12	69	11	8	12	31
<u>DRY</u>										
6	56	5	34	9	75	84	0	9	7	16
8	58	5	61	45	37	82	0	9	9	18
10	66	6	91	67	13	80	1	9	10	20
12	74	6	150	68	11	79	7	6	8	21
14	75	6	200	62	9	71	11	7	11	29
16	86	6	247	65	12	77	9	6	8	23
18	86	6	321	63	7	70	14	6	10	30
20	81	3	437	58	8	66	17	6	11	34
Average	--	--	182	61	12	73	10	7	10	27

¹ Stem material to 2-inch d.i.b. top.

Table 6.--Average green and dry weight of the crown and proportion of the crown in wood, bark, and needles for slash pines 6 to 20 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Crown weight (green)	Crown proportion in green--			Crown weight (dry)	Crown proportion in dry--		
				Branch- wood	Branch- bark	Needles		Branch- wood	Branch- bark	Needles
	Feet	Number	Pounds	- - - Percent - - -			Pounds	- - - Percent - - -		
6	56	5	51	41	23	36	24	41	24	35
8	58	5	88	36	25	39	44	38	25	37
10	66	6	168	40	21	39	85	41	22	37
12	74	6	238	53	23	24	120	52	26	22
14	75	6	490	50	21	29	246	50	23	27
16	86	6	488	54	22	24	250	55	23	22
18	86	6	849	59	20	21	423	57	23	20
20	81	3	1,496	62	18	20	760	61	20	19
Average	--	--	432	55	21	24	218	55	22	23

When branches (wood and bark) were separated into size classes, on the average 21 percent of branch dry weight was in small branches, 25 percent was in medium branches, and 54 percent was in large branches. Across the range of tree d.b.h. classes from 6 to 20 inches, the percentage of branch material in large branches increased while the percentage in medium and small branches decreased (fig. 1). When branches were separated into wood and bark, large branches averaged 78 percent wood and 22 percent bark, medium branches averaged 73 percent wood and 27 percent bark, and small branches averaged 50 percent wood and 50 percent bark.

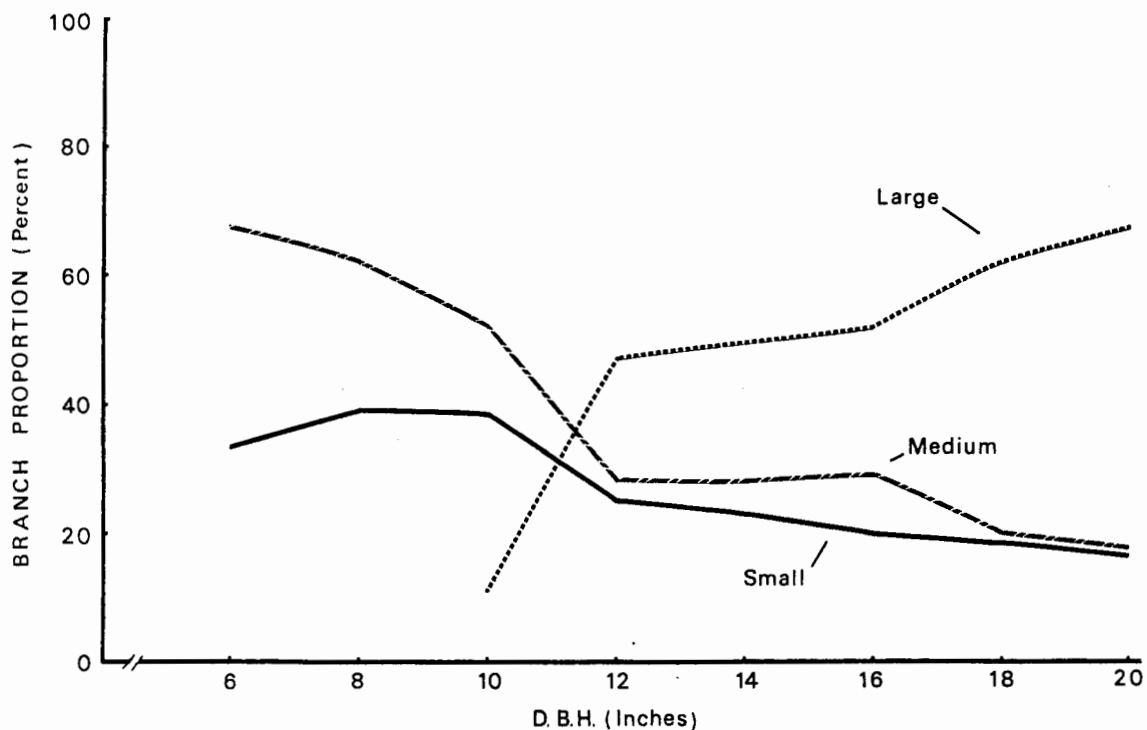


Figure 1.--Proportion of branches in crown by tree size.

MAIN STEM BIOMASS

When the main stem was analyzed separately, the proportion of stem weight in wood increased and the proportion in bark decreased as tree size increased (table 7). On the average, 89 percent of the dry weight of the stem was wood and 11 percent was bark. Similar proportions of wood and bark in the main stem were previously reported in this series for loblolly, shortleaf, and longleaf pine.

Table 7.--Average green and dry weight of the stem¹ and proportion of the stem in wood and bark for slash pines 6 to 20 inches d.b.h.

D.b.h. class (inches)	Average total height	Sample trees	Main stem weight (green)	Stem proportion in green--		Main stem weight (dry)	Stem proportion in dry--	
				Wood	Bark		Wood	Bark
	Feet	Number	Pounds	Percent		Pounds	Percent	
6	56	5	306	86	14	171	83	17
8	58	5	562	86	14	316	84	16
10	66	6	972	89	11	537	86	14
12	74	6	1,614	89	11	927	87	13
14	75	6	2,158	90	10	1,178	88	12
16	86	6	3,276	91	9	1,864	90	10
18	86	6	4,326	92	8	2,449	91	9
20	81	3	5,180	92	8	2,887	90	10
Average	--	--	2,185	91	9	1,228	89	11

¹ Stem material to 2-inch d.i.b. top.

PHYSICAL PROPERTIES

Wood and bark specific gravity, moisture content, and green weight per cubic foot for the total tree and its components are presented in table 8. Wood specific gravity for the total tree averaged 0.509 compared to 0.552 reported for longleaf,⁴ 0.474 for loblolly,² and 0.472 for shortleaf.³ Average wood specific gravity in the main stem was 0.516 or 0.037 units lower than reported by the Forest Products Laboratory.⁵ Bark specific gravity was consistently lower than wood specific gravity, averaging 0.381 for the total tree, 0.373 for the main stem, and 0.402 for branches. Bark specific gravity of all slash pine tree components was higher than that reported in this series for loblolly and shortleaf pine, but lower than that reported for longleaf pine.

Wood moisture content averaged 84 percent for the total tree, 83 percent for the main stem, and 99 percent for the branches (table 8). Wood moisture content was considerably higher for pulpwood (110 percent) than that for saw logs (80 percent).

On a total-tree basis, bark moisture content averaged 59 percent, which was lower than the corresponding value for wood (84 percent) (table 8). Bark

⁵ U.S. Forest Products Laboratory. 1972 (rev. 1975). Properties of major southern pines. Part I - Wood density survey, by H. E. Wahlgren and D. R. Schumann. Part II - Structural properties and specific gravity, by B. A. Bendtsen, R. L. Ethington, and W. L. Galligan. U.S. Dep. Agric. For. Serv., Res. Pap. FPL 176-177, 76 p. U.S. For. Prod. Lab., Madison, Wis.

Table 8.--Average wood and bark specific gravity, moisture content, and green weight per cubic foot for slash pine trees and tree components

Tree component	Average and standard deviation		
	Specific gravity	Moisture content	Green weight per cubic foot
		<u>Percent</u>	<u>Pounds</u>
<u>WOOD</u>			
Total tree	0.509 $\pm$ 0.027	84 $\pm$ 12	58.5 $\pm$ 3.4
Saw log	.524 $\pm$ 0.031	80 $\pm$ 12	58.7 $\pm$ 3.4
Pulpwood	.461 $\pm$ 0.032	110 $\pm$ 19	60.1 $\pm$ 4.2
Main stem	.516 $\pm$ 0.028	83 $\pm$ 12	58.9 $\pm$ 3.5
Branches	.434 $\pm$ 0.024	99 $\pm$ 16	54.1 $\pm$ 4.8
<u>BARK</u>			
Total tree	.381 $\pm$ 0.029	59 $\pm$ 9	37.9 $\pm$ 3.0
Saw log	.370 $\pm$ 0.037	48 $\pm$ 8	34.2 $\pm$ 3.5
Pulpwood	.394 $\pm$ 0.035	69 $\pm$ 20	41.4 $\pm$ 4.9
Main stem	.373 $\pm$ 0.034	52 $\pm$ 9	35.3 $\pm$ 3.6
Branches	.402 $\pm$ 0.039	89 $\pm$ 20	47.2 $\pm$ 4.2

moisture content was also lower for saw logs (48 percent) than for pulpwood (69 percent) or branches (89 percent). The difference in bark moisture content at different levels in the tree is due to the difference in the ratio of inner bark to outer bark with tree height.

Average wood weight per cubic foot did not vary greatly among tree components (table 8). Average green weight per cubic foot was lower for saw logs (58.7 pounds) than for pulpwood (60.1 pounds), but higher than for branchwood (54.1 pounds).

Bark was consistently lower in green weight per cubic foot than wood (table 8). Bark green weight per cubic foot averaged 37.9 pounds for the total tree, 34.2 pounds for saw logs, 41.4 pounds for pulpwood, and 47.2 pounds for branches. Branchbark weighed more per cubic foot than did the stembark because of its higher moisture content and higher specific gravity.

EQUATIONS

Biomass data for the 43 sample trees were used to develop regression equations to predict green and dry weights and cubic volumes for the total tree and its component parts (tables 9 and 10). Green and dry weight equations and associated statistics are given in table 9; green cubic-foot volume equations

Table 9.--Regression equations for estimating green and dry weight of aboveground biomass of natural slash pine trees and tree components with d.b.h. and total height as the independent variables

Weight (Y)	Regression equation ¹	Coefficient of determination (R ²)	Standard error (S _{y·x}) ²
Total tree (including needles) ³			
Green	$\text{Log}_{10} Y = -0.88096 + 1.03014 \text{ Log}_{10}(D^2Th)$	0.99	0.042
Dry	$\text{Log}_{10} Y = -1.16061 + 1.03527 \text{ Log}_{10}(D^2Th)$	.99	.043
Total tree (excluding needles) ³			
Green	$\text{Log}_{10} Y = -0.93767 + 1.03929 \text{ Log}_{10}(D^2Th)$	.99	.041
Dry	$\text{Log}_{10} Y = -1.20931 + 1.04310 \text{ Log}_{10}(D^2Th)$	.99	.043
All wood in tree ³			
Green	$\text{Log}_{10} Y = -1.12148 + 1.06979 \text{ Log}_{10}(D^2Th)$	.99	.043
Dry	$\text{Log}_{10} Y = -1.41487 + 1.07682 \text{ Log}_{10}(D^2Th)$	.99	.045
All bark in tree ³			
Green	$\text{Log}_{10} Y = -1.05327 + 0.84583 \text{ Log}_{10}(D^2Th)$	.96	.070
Dry	$\text{Log}_{10} Y = -1.29370 + 0.85536 \text{ Log}_{10}(D^2Th)$	.96	.072
Wood and bark in stem from stump to 6-inch d.i.b. top for trees >9.5 inches d.b.h. ⁴			
Green	$\text{Log}_{10} Y = -1.15844 + 1.06520 \text{ Log}_{10}(D^2Th)$	.98	.038
Dry	$\text{Log}_{10} Y = -1.44080 + 1.07382 \text{ Log}_{10}(D^2Th)$	.98	.041
Wood in stem from stump to 6-inch d.i.b. top for trees ≥ 9.5 inches d.b.h. ⁴			
Green	$\text{Log}_{10} Y = -1.31474 + 1.09224 \text{ Log}_{10}(D^2Th)$	.98	.040
Dry	$\text{Log}_{10} Y = -1.64257 + 1.10959 \text{ Log}_{10}(D^2Th)$	.98	.045
Bark in stem from stump to 6-inch d.i.b. top for trees >9.5 inches d.b.h. ⁴			
Green	$\text{Log}_{10} Y = -1.12400 + 0.81003 \text{ Log}_{10}(D^2Th)$	.93	.056
Dry	$\text{Log}_{10} Y = -1.24190 + 0.79759 \text{ Log}_{10}(D^2Th)$	.93	.056
Wood & bark in stem from stump to 2-inch d.i.b. top ³			
Green	$\text{Log}_{10} Y = -0.91006 + 1.01913 \text{ Log}_{10}(D^2Th)$	.99	.037
Dry	$\text{Log}_{10} Y = -1.17970 + 1.02348 \text{ Log}_{10}(D^2Th)$	.99	.042

continued

Table 9.--Regression equations for estimating green and dry weight of aboveground biomass of natural slash pine trees and tree components with d.b.h. and total height as the independent variables (continued)

Weight (Y)	Regression equation ¹	Coefficient of determination (R ²)	Standard error (S _{y.x}) ²
Wood in stem from stump to 2-inch d.i.b. top ³			
Green	$\text{Log}_{10} Y = -1.08221 + 1.04952 \text{ Log}_{10}(D^2\text{Th})$	0.99	0.040
Dry	$\text{Log}_{10} Y = -1.38111 + 1.05874 \text{ Log}_{10}(D^2\text{Th})$	.99	.045
Bark in stem from stump to 2-inch d.i.b. top ³			
Green	$\text{Log}_{10} Y = -0.93091 + 0.78051 \text{ Log}_{10}(D^2\text{Th})$	.96	.063
Dry	$\text{Log}_{10} Y = -1.15366 + 0.79118 \text{ Log}_{10}(D^2\text{Th})$	.96	.067
Crown weight (includes branchwood, branchbark, and needles) ³			
Green	$\text{Log}_{10} Y = -1.91514 + 1.08130 \text{ Log}_{10}(D^2\text{Th})$	.89	.149
Dry	$\text{Log}_{10} Y = -2.27828 + 1.09690 \text{ Log}_{10}(D^2\text{Th})$	.90	.148
Needles ³			
Green	$\text{Log}_{10} Y = -1.54455 + 0.84989 \text{ Log}_{10}(D^2\text{Th})$	.76	.190
Dry	$\text{Log}_{10} Y = -1.90538 + 0.85834 \text{ Log}_{10}(D^2\text{Th})$	.75	.195
Wood & bark in all branch material ³			
Green	$\text{Log}_{10} Y = -2.46743 + 1.18093 \text{ Log}_{10}(D^2\text{Th})$	.91	.149
Dry	$\text{Log}_{10} Y = -2.81124 + 1.19396 \text{ Log}_{10}(D^2\text{Th})$	.91	.148
Wood in all branch material ³			
Green	$\text{Log}_{10} Y = -2.93647 + 1.25648 \text{ Log}_{10}(D^2\text{Th})$	.91	.160
Dry	$\text{Log}_{10} Y = -3.23700 + 1.25701 \text{ Log}_{10}(D^2\text{Th})$	.91	.154
Bark in all branch material ³			
Green	$\text{Log}_{10} Y = -2.32184 + 1.01758 \text{ Log}_{10}(D^2\text{Th})$	.90	.136
Dry	$\text{Log}_{10} Y = -2.78541 + 1.06464 \text{ Log}_{10}(D^2\text{Th})$	.89	.150

¹ $\text{Log}_{10} Y = b_0 + b_1 \text{ Log}_{10} D^2\text{Th}$ where:

Y = weight of tree or component in pounds

D = d.b.h. in inches

Th = total height in feet.

² Standard error of estimate in Log_{10} form.

³ Regression equations based on 43 trees 6 to 21 inches d.b.h.

⁴ Regression equations based on 33 trees 10 to 21 inches d.b.h.

Table 10.--Regression equations for estimating green cubic-foot volume of the aboveground biomass of natural slash pine trees and tree components with d.b.h. and total height as independent variables

Cubic-foot volume (Y)	Regression equation ¹	Coefficient of determination (R ²)	Standard error (S _{y.x}) ²
Total tree ³			
Wood	$\text{Log}_{10} Y = -2.96250 + 1.08866 \text{ Log}_{10}(D^2 \text{Th})$	0.99	0.039
Bark	$\text{Log}_{10} Y = -2.80391 + 0.88891 \text{ Log}_{10}(D^2 \text{Th})$	.97	.067
Wood & Bark	$\text{Log}_{10} Y = -2.71839 + 1.05044 \text{ Log}_{10}(D^2 \text{Th})$	.99	.038
Stem from stump to 6 inches d.i.b. for trees > 9.5 inches d.b.h. ⁴			
Wood	$\text{Log}_{10} Y = -3.20017 + 1.12010 \text{ Log}_{10}(D^2 \text{Th})$	.98	.042
Bark	$\text{Log}_{10} Y = -2.81940 + 0.85078 \text{ Log}_{10}(D^2 \text{Th})$	.93	.059
Wood & Bark	$\text{Log}_{10} Y = -2.95191 + 1.07898 \text{ Log}_{10}(D^2 \text{Th})$	.98	.037
Stem from stump to 2-inch d.i.b. top ³			
Wood	$\text{Log}_{10} Y = -2.92607 + 1.06828 \text{ Log}_{10}(D^2 \text{Th})$	.99	.037
Bark	$\text{Log}_{10} Y = -2.69982 + 0.83553 \text{ Log}_{10}(D^2 \text{Th})$	.97	.063
Wood & Bark	$\text{Log}_{10} Y = -2.68740 + 1.02867 \text{ Log}_{10}(D^2 \text{Th})$	.99	.034
All branch material ³			
Wood	$\text{Log}_{10} Y = -4.67578 + 1.25859 \text{ Log}_{10}(D^2 \text{Th})$	.91	.153
Bark	$\text{Log}_{10} Y = -4.20359 + 1.07009 \text{ Log}_{10}(D^2 \text{Th})$	.90	.143
Wood & Bark	$\text{Log}_{10} Y = -4.22890 + 1.19310 \text{ Log}_{10}(D^2 \text{Th})$	.91	.147

¹ $\text{Log}_{10} Y = b_0 + b_1 \text{ Log}_{10} D^2 \text{Th}$ where:

Y = cubic-foot volume of tree or component

D = d.b.h. in inches

Th = total height in feet.

² Standard error of estimate in Log_{10} form.

³ Regression equations based on 43 trees 6 to 21 inches d.b.h.

⁴ Regression equations based on 33 trees 10 to 21 inches d.b.h.

with associated statistics are given in table 10. For most equations, the coefficient of determination indicates a high degree of linear association between the independent variable (D^2Th) and component weight or volume. Poorest associations occurred in equations developed to predict branch weight and volume. Crown components varied more than other tree components.

YIELD TABLES

The equations in tables 9 and 10 were used to develop tables of biomass weight and volume. These tables of predicted yields are presented in the Appendix. Predicted green and dry weights of wood, bark, and needles in the total tree, main stem, and crown are presented in tables 11 through 21 by d.b.h. and total height classes. Predicted green cubic-foot volumes of wood and bark in the total tree, main stem, and branches are presented in tables 22 through 24.

Trees with the same d.b.h. and total height can vary considerably in weight and volume because of differences in crown size, moisture content, specific gravity, and taper. The yield tables presented in the Appendix should not be used indiscriminately over the range of slash pine without testing. Rather, they should be applied only to natural, closed stands which are similar in age, taper rate, and wood properties to the trees sampled.

APPENDIX

Table 11.--Predicted weight of total tree (wood, bark, and needles) for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
----- Pounds -----							
<u>GREEN</u> ³							
6	297	358	420	482	544	606	669
7	408	492	577	662	747	833	919
8	537	648	759	871	984	1,096	1,209
9	684	826	968	1,110	1,254	1,397	1,542
10	850	1,026	1,202	1,380	1,558	1,736	1,915
11	1,035	1,248	1,463	1,679	1,896	2,113	2,331
12	1,238	1,493	1,751	2,009	2,268	2,528	2,789
13	1,460	1,761	2,064	2,369	2,674	2,981	3,288
14	1,700	2,052	2,405	2,760	3,115	3,473	3,831
15	1,960	2,365	2,772	3,181	3,591	4,003	4,416
16	2,239	2,702	3,166	3,633	4,102	4,572	5,044
17	2,537	3,061	3,588	4,117	4,648	5,181	5,715
18	2,854	3,443	4,036	4,631	5,229	5,828	6,429
19	3,190	3,849	4,512	5,177	5,845	6,515	7,187
20	3,546	4,278	5,015	5,754	6,496	7,241	7,988
<u>DRY</u> ⁴							
6	162	196	229	264	298	332	366
7	223	269	316	363	410	457	504
8	294	355	416	478	540	602	665
9	375	453	531	610	689	769	848
10	466	563	661	759	857	956	1,055
11	568	686	805	924	1,044	1,165	1,285
12	680	822	964	1,107	1,250	1,394	1,539
13	803	970	1,138	1,306	1,476	1,646	1,817
14	936	1,131	1,326	1,523	1,721	1,919	2,118
15	1,080	1,304	1,530	1,757	1,985	2,213	2,443
16	1,234	1,491	1,749	2,008	2,268	2,530	2,792
17	1,400	1,690	1,983	2,277	2,572	2,868	3,166
18	1,575	1,903	2,232	2,563	2,895	3,229	3,563
19	1,762	2,128	2,496	2,866	3,238	3,611	3,986
20	1,959	2,366	2,776	3,187	3,601	4,016	4,432

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -0.88096 + 1.03014 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -1.16061 + 1.03527 \log_{10} D^2 Th.$

Table 12.--Predicted weight of all aboveground wood excluding bark for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
----- Pounds -----							
<u>GREEN</u> ³							
6	230	279	329	380	431	482	534
7	319	388	458	528	599	670	742
8	425	516	609	703	797	892	988
9	547	664	784	904	1,025	1,148	1,271
10	685	832	982	1,132	1,284	1,438	1,592
11	840	1,021	1,204	1,389	1,575	1,763	1,952
12	1,012	1,230	1,450	1,673	1,897	2,124	2,352
13	1,201	1,459	1,721	1,985	2,252	2,520	2,791
14	1,407	1,710	2,017	2,326	2,639	2,953	3,270
15	1,631	1,982	2,337	2,696	3,058	3,423	3,791
16	1,872	2,276	2,683	3,096	3,511	3,930	4,352
17	2,132	2,591	3,055	3,524	3,998	4,474	4,955
18	2,409	2,928	3,453	3,983	4,518	5,057	5,599
19	2,704	3,287	3,876	4,471	5,072	5,677	6,286
20	3,018	3,668	4,326	4,990	5,660	6,335	7,015
<u>DRY</u> ⁴							
6	123	150	177	204	232	260	288
7	172	209	247	285	323	362	401
8	229	278	329	380	431	483	535
9	295	359	424	489	555	622	689
10	370	450	532	614	697	781	865
11	454	553	653	754	856	958	1,062
12	548	667	787	909	1,032	1,156	1,281
13	651	792	935	1,080	1,226	1,373	1,522
14	764	929	1,097	1,267	1,438	1,611	1,785
15	886	1,078	1,273	1,470	1,669	1,869	2,071
16	1,018	1,239	1,463	1,689	1,918	2,148	2,380
17	1,160	1,412	1,667	1,925	2,185	2,447	2,712
18	1,312	1,597	1,885	2,177	2,471	2,768	3,067
19	1,474	1,794	2,118	2,446	2,776	3,110	3,446
20	1,647	2,004	2,365	2,731	3,101	3,473	3,848

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -1.12148 + 1.06979 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -1.41487 + 1.07682 \log_{10} D^2 Th.$

Table 13.--Predicted weight of all aboveground bark for slash pine trees
6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

----- Pounds -----

GREEN³

6	50	58	67	75	82	90	98
7	65	76	86	97	107	117	127
8	82	95	108	121	134	147	159
9	100	116	132	148	164	179	194
10	119	139	158	177	196	214	232
11	140	163	186	208	230	251	272
12	162	189	215	241	266	291	316
13	185	216	246	276	305	333	361
14	210	245	279	313	346	378	410
15	236	276	314	352	388	425	460
16	263	307	350	392	433	474	513
17	292	341	388	434	480	525	569
18	322	375	427	479	529	578	626
19	352	411	468	524	579	633	686
20	384	448	511	572	632	691	749

DRY⁴

6	31	36	41	46	51	56	61
7	40	47	54	60	67	73	79
8	51	59	68	76	84	92	99
9	62	72	83	93	102	112	122
10	74	87	99	111	123	134	146
11	87	102	116	131	144	158	171
12	101	118	135	151	168	183	199
13	116	136	155	174	192	210	228
14	132	154	176	197	218	239	259
15	148	173	198	222	245	269	291
16	166	194	221	248	274	300	325
17	184	215	245	275	304	333	361
18	203	237	270	303	335	367	398
19	222	260	297	332	368	402	437
20	243	284	324	363	401	439	477

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -1.05327 + 0.84583 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -1.29370 + 0.85536 \log_{10} D^2 Th.$

Table 14.--Predicted weight of needles for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Pounds - - - - -

GREEN³

6	17	19	22	25	27	30	33
7	22	25	29	32	36	39	42
8	27	32	36	41	45	49	53
9	33	39	44	50	55	60	65
10	40	46	53	59	65	72	78
11	47	55	62	70	77	84	91
12	54	63	72	81	89	98	106
13	62	72	83	93	102	112	121
14	70	82	94	105	116	127	138
15	79	92	105	118	130	143	155
16	88	103	118	132	146	159	173
17	98	114	130	146	161	176	191
18	108	126	144	161	178	194	211
19	118	138	157	176	195	213	231
20	129	151	172	192	213	233	252

DRY⁴

6	8	9	10	12	13	14	15
7	10	12	13	15	17	18	20
8	13	15	17	19	21	23	25
9	16	18	21	23	26	28	31
10	19	22	25	28	31	34	37
11	22	26	29	33	36	40	43
12	25	30	34	38	42	46	50
13	29	34	39	44	48	53	57
14	33	39	44	50	55	60	65
15	37	44	50	56	62	68	73
16	42	49	56	62	69	76	82
17	46	54	62	69	77	84	91
18	51	60	68	76	85	93	100
19	56	65	75	84	93	102	110
20	61	72	82	92	101	111	120

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -1.54455 + 0.84989 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -1.90538 + 0.85834 \log_{10} D^2 Th.$

Table 15.--Predicted weight of wood and bark in main stem to 2-inch d.i.b. top
for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
----- Pounds -----							
<u>GREEN</u> ³							
6	256	308	360	413	465	518	571
7	350	421	493	565	637	709	781
8	459	553	647	742	836	931	1,026
9	584	703	823	943	1,063	1,184	1,304
10	724	872	1,020	1,169	1,318	1,467	1,617
11	879	1,059	1,239	1,419	1,600	1,782	1,963
12	1,050	1,264	1,479	1,695	1,911	2,127	2,344
13	1,236	1,488	1,741	1,995	2,249	2,504	2,760
14	1,437	1,731	2,025	2,320	2,616	2,913	3,210
15	1,654	1,992	2,331	2,671	3,011	3,353	3,695
16	1,887	2,272	2,659	3,046	3,435	3,824	4,214
17	2,135	2,571	3,008	3,447	3,886	4,327	4,768
18	2,399	2,889	3,380	3,873	4,367	4,861	5,357
19	2,678	3,225	3,774	4,324	4,875	5,428	5,982
20	2,973	3,580	4,190	4,800	5,413	6,026	6,641
<u>DRY</u> ⁴							
6	142	171	200	230	259	288	318
7	195	234	275	315	355	395	436
8	256	308	361	414	467	520	573
9	325	392	459	526	594	662	729
10	404	487	570	653	737	821	905
11	491	591	692	794	896	998	1,100
12	586	707	827	949	1,070	1,192	1,314
13	691	833	975	1,118	1,261	1,404	1,548
14	804	969	1,134	1,301	1,467	1,634	1,802
15	926	1,116	1,307	1,498	1,690	1,882	2,075
16	1,057	1,273	1,491	1,709	1,928	2,148	2,368
17	1,196	1,442	1,688	1,935	2,183	2,432	2,681
18	1,345	1,621	1,898	2,176	2,454	2,734	3,014
19	1,502	1,810	2,120	2,430	2,741	3,054	3,366
20	1,668	2,011	2,354	2,699	3,045	3,392	3,739

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -0.91006 + 1.01913 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -1.17970 + 1.02348 \log_{10} D^2 Th.$

Table 17.--Predicted weight of bark in main stem to 2-inch d.i.b. top for slash pine trees 6 to 20 inches d.b.h. ¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Pounds - - - - -

GREEN ³

6	41	47	53	59	64	70	75
7	52	60	67	75	82	89	96
8	64	74	83	92	101	110	118
9	77	88	100	111	121	132	142
10	90	104	118	130	143	155	167
11	105	121	136	151	166	180	194
12	120	139	156	173	190	206	222
13	136	157	177	196	215	234	252
14	153	176	199	221	242	263	283
15	170	196	221	246	269	292	315
16	188	217	245	272	298	323	348
17	207	239	269	299	327	356	383
18	226	261	294	327	358	389	419
19	246	284	320	355	390	423	456
20	267	308	347	385	422	458	494

DRY ⁴

6	26	31	34	38	42	46	49
7	34	39	44	49	54	58	63
8	42	48	54	60	66	72	78
9	50	58	65	73	80	87	94
10	59	68	77	86	94	103	111
11	69	80	90	100	110	119	129
12	79	91	103	115	126	137	148
13	90	104	117	130	143	155	168
14	101	117	132	146	161	175	188
15	113	130	147	163	179	195	210
16	125	144	163	181	199	216	233
17	137	159	179	199	219	238	256
18	150	174	196	218	239	260	280
19	164	189	214	237	261	283	305
20	178	205	232	257	283	307	331

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -0.93091 + 0.78051 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -1.15366 + 0.79118 \log_{10} D^2 Th.$

Table 16.--Predicted weight of wood excluding bark in main stem to 2-inch d.i.b.
top for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
----- Pounds -----							
GREEN ³							
6	216	261	307	354	400	447	494
7	298	361	425	489	553	618	683
8	395	478	562	647	732	817	903
9	506	612	720	828	937	1,047	1,157
10	631	764	898	1,033	1,169	1,306	1,443
11	771	933	1,097	1,262	1,428	1,595	1,763
12	925	1,120	1,317	1,515	1,714	1,915	2,116
13	1,094	1,325	1,558	1,792	2,028	2,265	2,503
14	1,278	1,548	1,820	2,094	2,369	2,646	2,924
15	1,478	1,789	2,103	2,420	2,738	3,058	3,380
16	1,692	2,049	2,409	2,771	3,135	3,502	3,870
17	1,922	2,327	2,735	3,147	3,561	3,977	4,396
18	2,166	2,623	3,084	3,548	4,015	4,484	4,956
19	2,427	2,939	3,455	3,974	4,497	5,023	5,552
20	2,703	3,273	3,847	4,426	5,009	5,594	6,183
DRY ⁴							
6	116	141	166	191	217	242	268
7	161	195	230	265	300	366	371
8	214	259	305	352	398	445	493
9	274	333	392	451	511	571	632
10	343	416	490	564	639	714	790
11	420	509	599	690	782	874	967
12	504	612	720	830	940	1,051	1,162
13	598	725	853	983	1,113	1,245	1,377
14	699	848	998	1,150	1,303	1,456	1,611
15	809	981	1,155	1,331	1,508	1,685	1,864
16	928	1,125	1,325	1,526	1,728	1,932	2,137
17	1,055	1,279	1,506	1,735	1,965	2,197	2,430
18	1,190	1,444	1,700	1,958	2,218	2,480	2,743
19	1,335	1,619	1,906	2,195	2,487	2,780	3,076
20	1,488	1,805	2,125	2,447	2,772	3,099	3,428

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -1.08221 + 1.04952 \log_{10} D^2 \text{Th.}$

⁴ $\log_{10} Y = -1.38111 + 1.05874 \log_{10} D^2 \text{Th.}$

Table 18.--Predicted weight of crown material (branchwood, branchbark, and needles) in slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Pounds - - - - -

GREEN³

6	40	49	58	67	76	85	94
7	56	68	81	93	106	119	132
8	75	91	108	125	142	159	176
9	97	118	139	161	183	205	227
10	121	148	175	202	229	257	285
11	149	182	215	248	282	316	350
12	180	219	259	300	340	381	423
13	214	261	308	356	405	453	503
14	252	306	362	418	475	532	590
15	292	356	420	485	551	618	685
16	336	409	483	558	634	710	787
17	383	466	551	636	723	810	898
18	433	528	623	720	818	916	1,016
19	487	593	700	809	919	1,030	1,142
20	544	662	783	904	1,027	1,151	1,276

DRY⁴

6	20	24	28	33	37	42	47
7	27	34	40	46	52	59	65
8	37	45	53	62	70	79	88
9	48	58	69	80	91	102	113
10	60	73	87	101	115	129	143
11	74	91	107	124	141	159	176
12	90	110	130	150	171	192	213
13	107	131	155	179	204	229	254
14	126	154	182	211	240	269	299
15	146	179	212	245	279	313	348
16	169	206	244	282	321	361	400
17	193	235	279	323	367	412	457
18	218	267	316	366	416	467	518
19	246	300	356	412	468	526	584
20	275	336	398	461	524	588	653

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -1.91514 + 1.08130 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -2.27828 + 1.09690 \log_{10} D^2 Th.$

Table 19.--Predicted weight of wood and bark in branches for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
----- Pounds -----							
GREEN ³							
6	24	30	35	41	48	54	60
7	34	43	51	60	69	78	87
8	47	58	70	82	94	107	119
9	62	77	92	108	124	141	157
10	80	99	118	139	159	180	202
11	100	124	148	174	200	226	253
12	122	152	182	213	245	278	311
13	148	183	220	258	296	335	375
14	176	218	262	307	353	399	447
15	207	257	309	361	415	470	526
16	241	300	359	421	485	548	613
17	279	346	415	485	558	632	707
18	319	396	475	556	639	723	809
19	362	449	539	631	725	822	919
20	409	507	609	713	819	927	1,038
DRY ⁴							
6	12	15	18	21	24	27	30
7	17	21	26	30	35	39	44
8	24	29	35	41	48	54	61
9	31	39	47	55	63	72	80
10	40	50	60	71	81	92	103
11	51	63	76	89	102	116	130
12	62	77	93	109	126	142	160
13	75	94	113	132	152	172	193
14	90	112	134	158	182	206	231
15	106	132	159	186	214	243	272
16	124	154	185	217	260	283	317
17	143	178	214	251	289	327	367
18	164	204	245	287	331	375	420
19	187	232	279	327	376	427	478
20	211	262	315	370	425	482	541

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -2.46743 + 1.18093 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -2.81124 + 1.19396 \log_{10} D^2 Th.$

Table 20.--Predicted weight of branchwood in slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Pounds - - - - -

GREEN³

6	14	18	22	26	30	34	38
7	21	26	32	38	44	50	57
8	29	37	45	53	61	70	79
9	39	50	60	71	83	94	106
10	51	65	78	93	108	123	139
11	65	82	100	118	137	156	176
12	81	102	124	147	170	194	219
13	99	125	152	179	208	238	268
14	120	151	183	216	251	286	323
15	142	179	217	257	298	340	384
16	168	211	256	302	351	400	451
17	195	245	298	352	408	466	525
18	225	283	344	407	471	538	607
19	258	324	394	466	540	617	695
20	294	369	448	530	614	701	791

DRY⁴

6	7	9	11	13	15	17	19
7	11	13	16	19	22	25	28
8	15	19	23	27	31	35	40
9	20	25	30	36	42	47	53
10	26	33	39	47	54	62	70
11	33	41	50	59	69	79	89
12	41	51	62	74	86	98	110
13	50	63	76	90	105	120	135
14	60	76	92	109	126	144	162
15	72	90	109	129	150	171	193
16	84	106	129	152	176	201	227
17	98	123	150	177	206	235	264
18	113	143	173	205	237	271	305
19	130	163	198	234	272	310	350
20	148	186	225	267	309	353	398

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -2.93647 + 1.25648 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -3.23700 + 1.25701 \log_{10} D^2 Th.$

Table 21.--Predicted weight of branchbark in slash pine trees 6 to 20
inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

----- Pounds -----

GREEN³

6	10	12	14	16	18	20	22
7	13	16	19	22	24	27	30
8	18	21	25	28	32	36	39
9	22	27	31	36	41	45	50
10	28	33	39	45	50	56	62
11	34	40	47	54	61	68	75
12	40	48	56	65	73	81	89
13	47	57	66	76	86	96	105
14	55	66	77	89	100	111	122
15	63	76	89	102	115	128	141
16	72	87	101	116	131	146	161
17	81	98	115	131	148	165	182
18	92	110	129	148	167	185	204
19	102	123	144	165	186	207	228
20	113	137	160	183	206	230	253

DRY⁴

6	5	6	7	8	9	10	11
7	7	8	10	11	12	14	15
8	9	11	13	15	17	18	20
9	11	14	16	19	21	24	26
10	14	17	20	23	27	30	33
11	17	21	25	29	33	36	40
12	21	25	30	35	39	44	49
13	25	30	36	41	46	52	58
14	29	35	42	48	54	61	67
15	34	41	48	56	63	70	78
16	39	47	55	64	72	81	90
17	44	53	63	73	82	92	102
18	50	60	71	82	93	104	115
19	56	68	80	92	104	117	129
20	62	75	89	103	116	130	144

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -2.32184 + 1.01758 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -2.78541 + 1.06464 \log_{10} D^2 Th.$

Table 22.--Predicted green volume of wood and bark in total tree for slash pine trees 6 to 20 inches d.b.h. ¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Cubic feet - - - - -

WOOD ³

6	3.8	4.7	5.5	6.4	7.2	8.1	9.0
7	5.3	6.5	7.7	8.9	10.1	11.3	12.6
8	7.1	8.7	10.3	11.9	13.5	15.2	16.8
9	9.2	11.2	13.3	15.4	17.5	19.6	21.8
10	11.6	14.1	16.7	19.3	22.0	24.7	27.4
11	14.3	17.4	20.6	23.8	27.1	30.4	33.7
12	17.3	21.0	24.9	28.8	32.7	36.7	40.7
13	20.5	25.0	29.6	34.3	38.9	43.7	48.4
14	24.1	29.4	34.8	40.3	45.8	51.3	56.9
15	28.0	34.2	40.4	46.8	53.2	59.6	66.2
16	32.3	39.4	46.6	53.8	61.2	68.6	76.1
17	36.8	44.9	53.1	61.4	69.8	78.3	86.9
18	41.7	50.9	60.2	69.6	79.1	88.7	98.4
19	46.9	57.2	67.7	78.3	89.0	99.8	110.7
20	52.5	64.0	75.7	87.5	99.5	111.6	123.8

BARK ⁴

6	1.2	1.4	1.7	1.9	2.1	2.3	2.5
7	1.6	1.9	2.2	2.5	2.7	3.0	3.3
8	2.1	2.4	2.8	3.1	3.5	3.8	4.1
9	2.5	3.0	3.4	3.8	4.3	4.7	5.1
10	3.0	3.6	4.1	4.6	5.1	5.6	6.1
11	3.6	4.2	4.9	5.5	6.1	6.7	7.3
12	4.2	5.0	5.7	6.4	7.1	7.8	8.5
13	4.9	5.7	6.6	7.4	8.2	9.0	9.8
14	5.5	6.5	7.5	8.4	9.4	10.3	11.2
15	6.3	7.4	8.5	9.5	10.6	11.6	12.6
16	7.0	8.3	9.5	10.7	11.9	13.0	14.2
17	7.8	9.2	10.6	11.9	13.2	14.5	15.8
18	8.7	10.2	11.7	13.2	14.6	16.1	17.5
19	9.5	11.2	12.9	14.5	16.1	17.7	19.2
20	10.5	12.3	14.1	15.9	17.6	19.4	21.1

continued

Table 22.--Predicted green volume of wood and bark in total tree for slash pine trees 6 to 20 inches d.b.h.¹ (continued)

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
- - - - - Cubic feet - - - - -							
WOOD AND BARK ⁵							
6	5.0	6.1	7.2	8.2	9.3	10.4	11.5
7	6.9	8.4	9.9	11.4	12.9	14.4	15.9
8	9.2	11.1	13.1	15.1	17.0	19.0	21.1
9	11.8	14.3	16.8	19.3	21.8	24.4	27.0
10	14.7	17.8	20.9	24.1	27.2	30.4	33.6
11	18.0	21.7	25.6	29.4	33.3	37.2	41.1
12	21.6	26.1	30.7	35.3	40.0	44.6	49.3
13	25.5	30.9	36.3	41.8	47.3	52.8	58.4
14	29.8	36.1	42.4	48.8	55.2	61.7	68.2
15	34.4	41.7	49.0	56.4	63.9	71.3	78.8
16	39.4	47.8	56.2	64.6	73.1	81.7	90.3
17	44.8	54.3	63.8	73.4	83.1	92.8	102.6
18	50.5	61.2	71.9	82.8	93.7	104.6	115.7
19	56.6	68.5	80.6	92.7	104.9	117.2	129.6
20	63.0	76.3	89.8	103.3	116.9	130.6	144.3

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -2.96250 + 1.08866 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -2.80391 + 0.88891 \log_{10} D^2 Th.$

⁵ $\log_{10} Y = -2.71839 + 1.05044 \log_{10} D^2 Th.$

Table 23.--Predicted green volume of wood and bark in main stem to 2-inch d.i.b. top for slash pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Cubic feet - - - - -

WOOD³

6	3.6	4.3	5.1	5.9	6.7	7.5	8.3
7	4.9	6.0	7.1	8.2	9.3	10.4	11.5
8	6.6	8.0	9.4	10.9	12.3	13.8	15.3
9	8.5	10.3	12.1	14.0	15.9	17.8	19.7
10	10.6	12.9	15.2	17.5	19.9	22.2	24.6
11	13.0	15.8	18.6	21.5	24.4	27.3	30.2
12	15.7	19.0	22.4	25.9	29.3	32.8	36.3
13	18.6	22.6	26.6	30.7	34.8	38.9	43.1
14	21.8	26.4	31.2	36.0	40.8	45.6	50.5
15	25.2	30.6	36.1	41.7	47.2	52.9	58.5
16	28.9	35.2	41.5	47.8	54.2	60.7	67.2
17	32.9	40.0	47.2	54.4	61.7	69.1	76.5
18	37.2	45.2	53.3	61.5	69.8	78.1	86.4
19	41.8	50.8	59.9	69.0	78.3	87.6	97.0
20	46.6	56.7	66.8	77.0	87.4	97.8	108.3

BARK⁴

6	1.0	1.2	1.4	1.6	1.7	1.9	2.0
7	1.4	1.6	1.8	2.0	2.2	2.4	2.6
8	1.7	2.0	2.2	2.5	2.8	3.0	3.3
9	2.1	2.4	2.7	3.1	3.4	3.7	4.0
10	2.5	2.9	3.3	3.6	4.0	4.4	4.8
11	2.9	3.4	3.8	4.3	4.7	5.1	5.6
12	3.3	3.9	4.4	4.9	5.4	6.0	6.4
13	3.8	4.4	5.0	5.6	6.2	6.8	7.4
14	4.3	5.0	5.7	6.4	7.1	7.7	8.3
15	4.8	5.6	6.4	7.2	7.9	8.6	9.4
16	5.4	6.3	7.1	8.0	8.8	9.6	10.4
17	6.0	7.0	7.9	8.8	9.8	10.7	11.5
18	6.6	7.6	8.7	9.7	10.7	11.7	12.7
19	7.2	8.4	9.5	10.6	11.7	12.8	13.9
20	7.8	9.1	10.4	11.6	12.8	14.0	15.1

continued

Table 23.--Predicted green volume of wood and bark in main stem to 2-inch d.i.b. top for slash pine trees 6 to 20 inches d.b.h.¹ (continued)

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Cubic feet - - - - -

WOOD AND BARK⁵

6	4.6	5.5	6.5	7.4	8.4	9.4	10.3
7	6.3	7.6	8.9	10.2	11.5	12.8	14.2
8	8.3	10.0	11.7	13.4	15.2	16.9	18.6
9	10.6	12.7	14.9	17.1	19.3	21.5	23.8
10	13.1	15.8	18.5	21.3	24.0	26.7	29.5
11	16.0	19.2	22.5	25.9	29.2	32.5	35.9
12	19.1	23.0	27.0	30.9	34.9	38.9	42.9
13	22.5	27.1	31.8	36.5	41.2	45.9	50.6
14	26.2	31.6	37.0	42.5	48.0	53.4	59.0
15	30.2	36.4	42.7	49.0	55.3	61.6	67.9
16	34.5	41.6	48.7	55.9	63.1	70.3	77.6
17	39.1	47.1	55.2	63.3	71.5	79.7	87.9
18	43.9	53.0	62.1	71.2	80.4	89.6	98.9
19	49.1	59.2	69.4	79.6	89.9	100.2	110.5
20	54.6	65.8	77.1	88.5	99.9	111.3	122.8

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -2.92607 + 1.06828 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -2.69982 + 0.83553 \log_{10} D^2 Th.$

⁵ $\log_{10} Y = -2.68740 + 1.02867 \log_{10} D^2 Th.$

Table 24.--Predicted green volume of wood and bark in branches for slash
pine trees 6 to 20 inches d.b.h.¹

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110

- - - - - Cubic feet - - - - -

WOOD³

6	0.3	0.3	0.4	0.5	0.6	0.6	0.7
7	.4	.5	.6	.7	.8	.9	1.0
8	.5	.7	.8	1.0	1.1	1.3	1.5
9	.7	.9	1.1	1.3	1.5	1.8	2.0
10	1.0	1.2	1.5	1.7	2.0	2.3	2.6
11	1.2	1.5	1.9	2.2	2.5	2.9	3.3
12	1.5	1.9	2.3	2.7	3.2	3.6	4.1
13	1.8	2.3	2.8	3.3	3.9	4.4	5.0
14	2.2	2.8	3.4	4.0	4.7	5.3	6.0
15	2.6	3.3	4.0	4.8	5.5	6.3	7.1
16	3.1	3.9	4.8	5.6	6.5	7.5	8.4
17	3.6	4.6	5.5	6.6	7.6	8.7	9.8
18	4.2	5.3	6.4	7.6	8.8	10.0	11.3
19	4.8	6.0	7.3	8.7	10.1	11.5	13.0
20	5.5	6.9	8.3	9.9	11.4	13.1	14.7

BARK⁴

6	0.2	0.2	0.3	0.3	0.4	0.4	0.4
7	.3	.3	.4	.4	.5	.6	.6
8	.4	.4	.5	.6	.7	.7	.8
9	.5	.6	.7	.8	.9	1.0	1.1
10	.6	.7	.8	.9	1.1	1.2	1.3
11	.7	.8	1.0	1.2	1.3	1.5	1.6
12	.8	1.0	1.2	1.4	1.6	1.8	2.0
13	1.0	1.2	1.4	1.6	1.9	2.1	2.3
14	1.2	1.4	1.7	1.9	2.2	2.5	2.7
15	1.4	1.6	1.9	2.2	2.5	2.8	3.1
16	1.6	1.9	2.2	2.6	2.9	3.3	3.6
17	1.8	2.2	2.5	2.9	3.3	3.7	4.1
18	2.0	2.4	2.9	3.3	3.8	4.2	4.6
19	2.2	2.7	3.2	3.7	4.2	4.7	5.2
20	2.5	3.0	3.6	4.1	4.7	5.3	5.8

continued

Table 24.--Predicted green volume of wood and bark in branches for slash pine trees 6 to 20 inches d.b.h.¹ (continued)

D.b.h. (inches)	Total tree height (feet) ²						
	50	60	70	80	90	100	110
----- Cubic feet -----							
WOOD AND BARK ⁵							
6	0.5	0.6	0.7	0.8	0.9	1.0	1.2
7	.7	.8	1.0	1.1	1.3	1.5	1.7
8	.9	1.1	1.3	1.6	1.8	2.1	2.3
9	1.2	1.5	1.8	2.1	2.4	2.7	3.0
10	1.5	1.9	2.3	2.7	3.1	3.5	3.9
11	1.9	2.4	2.9	3.4	3.9	4.4	4.9
12	2.4	2.9	3.5	4.1	4.8	5.4	6.1
13	2.9	3.6	4.3	5.0	5.8	6.5	7.3
14	3.4	4.2	5.1	6.0	6.9	7.8	8.7
15	4.0	5.0	6.0	7.0	8.1	9.2	10.3
16	4.7	5.8	7.0	8.2	9.5	10.7	12.0
17	5.4	6.7	8.1	9.5	10.9	12.4	13.9
18	6.2	7.7	9.3	10.9	12.5	14.2	15.9
19	7.1	8.8	10.6	12.4	14.3	16.2	18.1
20	8.0	9.9	11.9	14.0	16.1	18.3	20.5

¹ Blocked-in area indicates range of data.

² Includes 1-foot stump allowance.

³ $\log_{10} Y = -4.67578 + 1.2859 \log_{10} D^2 Th.$

⁴ $\log_{10} Y = -4.20359 + 1.07009 \log_{10} D^2 Th.$

⁵ $\log_{10} Y = -4.22890 + 1.19310 \log_{10} D^2 Th.$

Taras, Michael A., and Douglas R. Phillips

1978. Aboveground biomass of slash pine in a natural sawtimber stand in southern Alabama. U.S. Dep. Agric. For. Serv., Res. Pap. SE-188, 31 p. Southeast. For. Exp. Stn., Asheville, N. C.

Slash pine trees 6 to 20 inches d.b.h. selected from a natural, uneven-aged sawtimber stand in southern Alabama were sampled for green and dry weight and cubic volume in the total tree and its component parts. Specific gravity, moisture content, and green weight per cubic foot are presented for the total tree and its components. Yield tables developed from regression equations predict green and dry weights and cubic-foot volumes by d.b.h. and total height classes.

Keywords: Pinus elliottii Engelm., weight, volume, prediction equations, component proportions, biomass.

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Slash pine trees 6 to 20 inches d.b.h. selected from a natural, uneven-aged sawtimber stand in southern Alabama were sampled for green and dry weight and cubic volume in the total tree and its component parts. Specific gravity, moisture content, and green weight per cubic foot are presented for the total tree and its components. Yield tables developed from regression equations predict green and dry weights and cubic-foot volumes by d.b.h. and total height classes.

Keywords: Pinus elliottii Engelm., weight, volume, prediction equations, component proportions, biomass.



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