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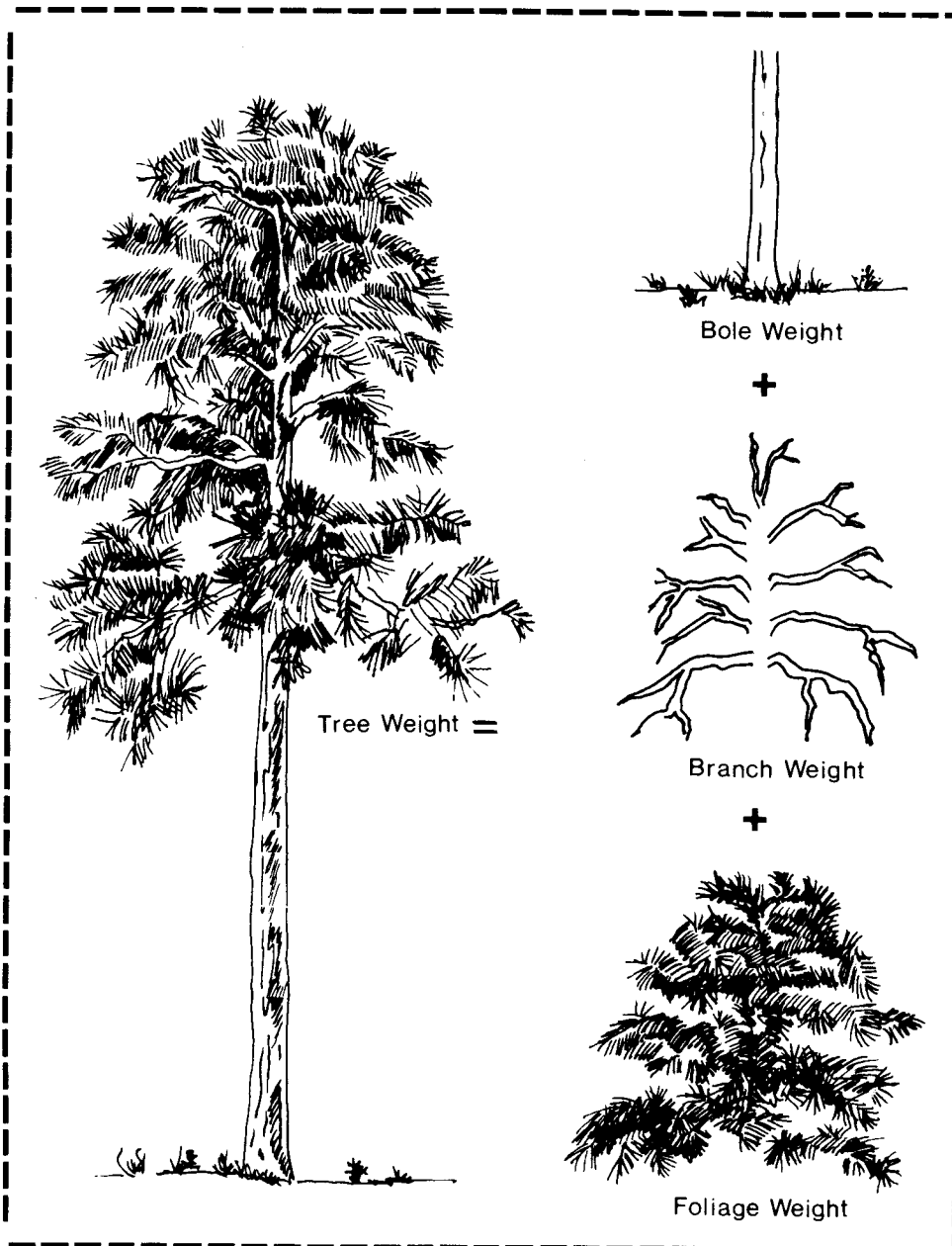
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# Aboveground Weight and Volume of Unthinned, Planted Longleaf Pine on West Gulf Forest Sites

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### **SUMMARY**

Volume (cubic foot) and weight predictions (green and dry) are presented in equations and tables for aboveground total tree and tree components of unthinned, planted longleaf pine trees. The 111 sample trees, from 10 stands in Louisiana and Texas, were 10 to 44 years old and ranged from 1 to 21 inches dbh. The data for saplings (dbh < 5 inches) were analyzed separately from that of commercial sized trees (dbh  $\geq$  5 inches). The linearized allometric model utilizes the variable  $D^2H$  (squared diameter at breast height multiplied by total tree height) to predict volumes and weights of tree components in two size classes.

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## INTRODUCTION

Increased demand for wood fiber and developing markets for wood fuel have prompted interest in utilization of the total tree, not only the "merchantable" bole. Accurate estimates of the weight and volume of trees and tree components are needed for various species to provide forest managers with silvicultural and utilization possibilities.

This paper presents equations to predict aboveground weight and volume of longleaf pine (*Pinus palustris* Mill.) trees and tree components in unthinned plantations within the West Gulf region. Preliminary weight and volume equations based on the data used for the model developments discussed herein were published earlier (Baldwin and Saucier 1982). These data were also used to develop bole taper equations (Baldwin and Polmer 1981). Biomass prediction equations have been developed for sawtimber-sized longleaf pine in uneven-aged natural stands (Taras and Clark 1977) and for saplings from young even-aged stands (Edwards and McNab 1979, 1981).

## Data

Stand-characteristic information collected from 111 trees located in 10 unthinned plantations in Louisiana and Texas appears in tables 1 and 2. Trees were selectively chosen over a 1- to 21-inch dbh range, placed in one of three height classes,<sup>1</sup> and finally into one of three crown ratio classes.<sup>2</sup> The dis-

<sup>1</sup>Discrete total height distributions were determined prior to sampling, based on the trees previously measured from all 10 study plantations combined. The height range in each diameter class was divided into three classes designated as short, medium, and tall. Thus the heights and range of heights varied within each diameter class, with each height class representing a particular one-third of the available range of heights.

<sup>2</sup>Crown ratio (in percent) is defined as (100) (length of full live crown)/(total height of tree). The crown ratio (CR) classes were: CR < 36 percent, 36 percent ≤ CR ≤ 50 percent, CR > 50 percent.

tribution of the sample trees by dbh, crown ratio, height, and age is presented in table 3. Sample trees were free from forking, excessive sweep, and any observable effects of disease or mechanical damage causing atypical characteristics.

Total height, dbh, height to base of live crown, and vertical crown width projection were measured for each tree. The trees were then felled. Crowns were divided into thirds lengthwise and one branch was cut from each section. Branches were chosen to represent average foliage appearance for each crown position class. After removal, foliage, wood and bark subsamples from these branches were bagged for subsequent analysis. The remaining limbs were removed from the bole, and segregated into six branch categories: extra large (≥ 4.0 inches dob), large (≥ 2.0 inches and < 4.0 inches dob), medium (≥ 0.5 inches and < 2.0 inches dob), small (< 0.5 inch dob), foliage, and dead branches.

Measurements of dib and dob were taken at 1-inch taper steps along the bole of each tree to the 1-inch top. Boles with dbh ≥ 5 inches were cut at right angles to the stem axis into at least seven sections, with cuts always made at dbh, at 1/4, 1/2, and 3/4 of the length to the 4-inch dob top, and at the points where dob was 4 inches and 2 inches. Boles of trees with dbh < 5 inches were cut into at least five sections. Cuts were made at dbh and at points 1/4, 1/2, and 3/4 of the total length of the tree. The stem tip in either case was considered to be part of the bole.

After sectioning, each section of the tree was weighed in the field to the nearest 0.1 pound. Following weighing, disks to be analyzed for subsequent moisture content, specific gravity, and bark percent determinations were removed from the butt, from each bucking point as discussed above, and from each of the three sample branches. A sample of needles was also selected for determination of needle moisture content. These samples were individually placed in marked polyethylene bags and stored in a cooler for later laboratory analysis.

The laboratory and volume estimating procedures described by Taras and Clark (1977) were used.

Table 1.—Distribution of sample trees with respect to site index (base age 50), age, and planting density of the stands from which the trees were cut

	Site index					
	60-69	70-79	80-89	90-99	100-109	110-119
Age at cut						
years	-----number of trees-----					
10-20	10	0	0	0	0	0
21-30	0	0	0	11	14	22
31-40	0	0	21	0	8	9
41-50	0	0	16	0	0	0
Planting density						
trees/acre						
0-500	0	0	16	0	0	0
501-1000	10	0	0	0	0	9
1001-1500	0	0	21	11	22	12
1501-2000	0	0	0	0	0	10

Table 2.—Distribution of sample trees with respect to age, planting density, and density at time of cutting

Age at cut	Planting density				
	0-500	501-1000	1001-1500	1501-2000	
years	-----number of trees-----				
10-20	0	10	0	0	
21-30	0	0	37	10	
31-40	0	9	29	0	
41-50	16	0	0	0	
	Density at cut				
	0-200	201-400	401-600	601-800	801-1000
	-----number of trees-----				
10-20	0	10	0	0	0
21-30	0	0	25	12	10
31-40	21	17	0	0	0
41-50	16	0	0	0	0

## Analysis

Tree and individual tree component weights and volumes were fitted to the linearized form of the allometric model:

$$\log Y = b_0 + b_1 \log (D^2H) \quad (1)$$

where Y = the weight or volume variable of interest,

D = tree dbh in inches

H = total height in feet

log = base 10 logarithm

$b_0, b_1$  = coefficients estimated from the data.

The  $b_0$  coefficient of the various component equations was corrected for bias occurring when transforming  $\log Y$  to  $Y$  (Finney 1941, Baskerville 1972, Flewelling and Pienaar 1981) by using the procedure given in Yandle and Wiant (1981). For simplicity, model (1) was used to predict all tree components

and to provide direct comparability of our equations with some of those published earlier for natural long-leaf pine (Taras and Clark 1977).

Also, the following supporting statistics, most of which were suggested by Schlaegel (1982), were calculated for all model (1) equations and are provided in this paper to make our results suitable for comparison with other published results which may utilize different weight and volume prediction models:

- Coefficient of determination ( $r^2$ ) for logarithmic equation
- Fit index (FI)<sup>3</sup>

<sup>3</sup>FI =  $1 - [\sum (Y_i - \hat{Y}_i)^2 / \sum (Y_i - \bar{Y})^2]$ . The fit index which is calculated in actual units is similar to  $r^2$  and is used to judge linear equation efficiency when the dependent variable has been transformed (Farrar 1978).

Table 3.—Distribution of the sample trees by diameter, live crown ratio, height and age

Dbh class	Age		Total height		Total trees	Distribution by height class*			Distribution by crown ratio class		
	Mean	Range	Mean	Range		Short	Medium	Tall	CR < 36%	36% ≤ CR ≤ 50%	CR > 50%
<i>in</i>	---- yrs ----		---- ft ----		----- number of trees -----						
1	26	25-27	13	12-14	3	0	1	2	1	2	0
2	23	10-40	19	15-23	8	3	2	3	2	3	3
3	27	23-40	34	20-46	7	2	2	3	2	2	3
4	24	22-25	44	33-54	6	1	3	2	2	2	2
5	24	22-27	47	36-58	6	2	3	1	2	1	3
6	28	22-40	51	33-66	6	2	3	1	3	0	3
7	26	22-40	60	44-70	7	1	4	2	1	3	3
8	30	22-40	70	58-79	6	0	3	3	2	3	1
9	28	22-40	69	57-83	8	3	1	4	1	6	1
10	33	23-40	77	73-85	8	1	2	5	3	5	0
11	35	22-44	76	62-87	8	1	4	3	2	3	3
12	30	22-40	79	65-86	5	1	1	3	0	2	3
13	33	23-40	79	71-87	6	1	2	3	1	3	2
14	39	23-44	81	74-90	6	0	2	4	0	3	3
15	37	23-44	82	76-85	5	0	1	4	0	4	1
16	42	40-44	77	69-88	5	2	1	2	0	3	2
17	44	40-44	78	70-90	5	1	3	1	0	1	4
18	43	40-44	83	79-86	2	0	1	1	0	0	2
19	43	40-44	75	72-78	3	1	2	0	0	0	3
20	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
21	44	44	83	83	1	0	0	1	0	0	1
Totals					111	22	41	48	22	46	43

\*Short trees: lower one-third of the height range of all measured trees in a given dbh class within the study plantations. Medium trees: middle one-third of the height range. Tall trees: upper one-third of the height range.

- Standard errors of estimate ( $S_{y.x}$ ) based on residuals both before and after transformation to actual (arithmetic) units
- Coefficient of Variation (CV) of predictions in actual units
- Mean percent standard error ( $\bar{S}(\%)$ )<sup>4</sup> of predictions in actual units
- Component means and sample sizes, and
- Means and corrected sums of squares for log  $D^2H$ .

The data for saplings (dbh < 5 inches) were analyzed separately from those of commercial sized trees (dbh ≥ 5 inches) to provide more precise equations in each class and to make the results more comparable with existing published equations. Results are presented for each size class.

Bole equations were developed to predict green and dry weight and cubic foot volume for the total bole from stump to 0-inch top. Bole weight or volume from stump to any top diameter limit between seven and zero inches is estimated for commercial sized

trees using a ratio model similar to one proposed by Burkhardt (1977) and recently utilized for biomass prediction by Taras (1980):

$$R = 1 + \beta_1 [D_t^{\beta_2}/D^2H]^{\beta_3} \quad (2)$$

where D = dbh in inches

H = total height in feet

$D_t$  = top diameter (outside bark) in inches

R = weight or volume, to top diameter  $D_t$ , divided by total bole weight or volume, respectively

$\beta_i$  = constants estimated from the data

The  $\beta_i$  were estimated using nonlinear regression techniques.

## RESULTS

Biomass characteristics of the sample trees and their components, summarized below, are presented in detail in Appendix Tables 39 through 43.

For the sapling sized trees, the proportions of total green weight in wood, bark, and foliage averaged 69, 20, and 11 percent, respectively, while on a dry weight basis the proportions were 68, 23, and 9 percent. For commercial sized trees (dbh ≥ 5 inches), these proportions were 83, 12, and 5 percent on a

<sup>4</sup> $\bar{S}(\%) = \frac{100}{n} \sum [Y_i - \hat{Y}_i / \hat{Y}_i]$  when  $Y_i$  and  $\hat{Y}_i$  are measured and predicted quantities in actual units and n is the number of observations (Meyer 1938).

green weight basis, and 82, 14, and 4 percent on a dry weight basis.

When commercial sized trees are considered composed of merchantable bole (stump to 4-inch top) and crown (bole 4-inch to tip plus branches and foliage), the proportions of the bole and the crown were 77 and 23 percent, respectively, on a green basis and the dry weight proportions were 78 and 22 percent.

Considering the crown as a whole in commercial sized trees, the proportion of green weight in branchwood (including bole tip), branchbark (including bole tip bark), and foliage was 57, 21, and 22 percent, respectively. The respective proportions of the crown on a dry weight basis were 58, 23, and 19 percent.

The proportion of the bole biomass in commercial-sized trees, to the 8-inch dob top was 63 percent of the green weight and 74 percent of the dry weight. The pulpwood proportions (8-inch to 4-inch top) were 18 percent of the total bole green weight and 8 percent of the bole dry weight.

Of the total bole weight to the 4-inch top of commercial size trees, wood represented 74 percent of the total weight in both the green and dry condition.

Average wood and bark specific gravity, moisture content, and green weight per cubic foot (green density) in the total commercial and sapling sized trees are summarized below and presented in more detail in appendix table 38:

	Mean	Range
Commercial tree wood specific gravity	.500	.437-.561
Commercial tree bark specific gravity	.389	.324-.461
Sapling tree wood specific gravity	.479	.407-.547
Sapling tree bark specific gravity	.353	.263-.421
Commercial tree wood moisture content	110	76- 142
Commercial tree bark moisture content	90	63- 124
Sapling tree wood moisture content	126	100- 166
Sapling tree bark moisture content	99	71- 156
Commercial tree wood green density	65.27	59.30- 68.64
Commercial tree bark green density	45.99	36.35- 54.62
Sapling tree wood green density	67.21	64.18- 70.22
Sapling tree bark green density	43.30	36.89- 51.10

Estimates of the coefficients  $b_0$  and  $b_1$  for model (1) are presented in table 4 for predicting green and dry weight and cubic foot volume of the total tree, total bole, and total crown; and of wood only, wood plus bark, and foliage subcomponents for sapling and commercial sized trees. Selected tables, prepared

Table 4.—Regression coefficient's for predicting weight and volume<sup>1</sup> of longleaf pine tree components;  $\log Y = b_0 + b_1 \log D^2H$ :

Component	Trees $\geq$ 5 inches dbh					
	Green weight (pounds)		Dry weight (pounds)		Volume (cubic feet)	
	$b_0$	$b_1$	$b_0$	$b_1$	$b_0$	$b_1$
Total tree wood, bark and foliage	-0.64745	0.98442	-1.06186	1.00853	.....	.....
Total tree wood and bark	-0.75522	1.00514	-1.15588	1.02700	-2.52214	0.99928
Total tree wood	-0.92239	1.03167	-1.33916	1.05605	-2.77009	1.04013
Total bole wood and bark	-0.66098	0.96407	-1.07630	0.98996	-2.44693	0.96225
Total bole wood	-0.81664	0.99139	-1.24531	1.01912	-2.67764	1.00313
Crown <sup>2</sup> wood, bark and foliage	-0.81900	0.86637	-1.26878	0.89268	.....	.....
Crown wood and bark	-1.09334	0.90495	-1.52243	0.93058	-2.80386	0.88844
Crown wood	-1.28969	0.91829	-1.74083	0.94746	-3.07359	0.91122
	Trees $<$ 5 inches dbh					
Total tree wood, bark and foliage	-0.24556	0.85263	-0.65729	0.88019	.....	.....
Total tree wood and bark	-0.31359	0.85584	-0.71944	0.88503	-2.04397	0.83908
Total tree wood	-0.57024	0.91174	-1.00303	0.94609	-2.39317	0.91019
Total bole wood and bark	-0.35931	0.85567	-0.76622	0.88506	-2.09552	0.83821
Total bole wood	-0.59626	0.91007	-1.02731	0.94468	-2.42121	0.90837

<sup>1</sup>Average stump height for the data trees was 0.4 ft for trees  $\geq$  5.0 inches dbh and 0.1 ft for the smaller trees.

<sup>2</sup>The crown consists of all lateral branches and the bole from 4-inch dob to the tip.

Table 5.—Supporting statistics for the fitted longleaf pine volume and weight prediction equations based on  $\log Y = b_0 + b_1 \log D^2H^1$

Tree component (Y)	Y	$S_{y,x}^2$	$r^2$ <sup>3</sup>	$S^*_{y,x}$ <sup>4</sup>	FI <sup>5</sup>	CV <sup>6</sup>	S(%) <sup>7</sup>
	Mean						
	lbs			lbs		-----%	
<b>Trees ≥ 5.0 inches dbh</b>							
Total tree wood, bark, foliage green weight	2222.7	.05796	.98	273.2	.97	12.3	-.020
Total tree wood, bark, foliage dry weight	1077.9	.04895	.98	110.9	.98	10.3	-.014
Total tree wood and bark green weight	2111.6	.05146	.98	239.1	.98	11.3	-.021
Total tree wood and bark dry weight	1034.4	.04596	.98	99.7	.98	9.6	-.014
Total tree wood green weight	1846.8	.04591	.98	199.5	.98	10.8	-.029
Total tree wood dry weight	892.1	.04655	.98	86.2	.98	9.7	-.023
Total bole wood and bark green weight	1749.5	.04511	.98	148.3	.98	8.5	-.023
Total bole wood and bark dry weight	860.1	.04796	.98	81.1	.98	9.4	-.023
Total bole wood green weight	1583.6	.04745	.98	153.1	.98	9.7	-.035
Total bole wood dry weight	767.7	.05164	.98	85.1	.97	11.1	-.035
Crown <sup>8</sup> wood, bark, foliage green weight	509.8	.18371	.76	277.2	.69	54.4	.045
Crown wood, bark, foliage dry weight	233.5	.18340	.77	128.8	.69	55.2	.007
Crown wood and bark green weight	398.7	.19854	.74	250.3	.65	62.8	-.164
Crown wood and bark dry weight	190.1	.19882	.75	119.3	.66	62.8	-.187
Crown wood green weight	291.7	.21277	.72	202.8	.62	69.5	.183
Crown wood dry weight	136.6	.21569	.73	94.3	.63	69.1	-.243
	cu ft			cu ft			
Total tree wood and bark cubic foot volume	34.15	.04836	.98	3.45	.98	10.1	-.017
Total tree wood cubic foot volume	28.40	.04627	.98	2.77	.98	9.7	-.031
Total bole wood and bark cubic foot volume	28.16	.04282	.98	2.34	.98	8.3	-.019
Total bole wood cubic foot volume	24.37	.04710	.98	2.49	.98	10.2	-.034
Crown wood and bark cubic foot volume	6.59	.19185	.75	3.92	.67	59.5	-.177
Crown wood cubic foot volume	4.47	.20774	.73	3.01	.63	67.5	-.159
<b>Trees &lt; 5.0 inches dbh</b>							
	lbs			lbs			
Total tree wood, bark, foliage green weight	95.3	.08619	.97	20.57	.94	21.6	-.085
Total tree wood, bark, foliage dry weight	44.5	.07436	.98	8.69	.95	19.5	-.052
Total tree wood and bark green weight	84.7	.05735	.98	13.08	.97	15.4	-.059
Total tree wood and bark dry weight	40.4	.05961	.98	6.71	.97	16.6	-.058
Total tree wood green weight	67.7	.05490	.99	10.75	.97	15.9	-.056
Total tree wood dry weight	31.5	.06142	.99	5.65	.97	17.9	-.084
Total bole wood and bark green weight	76.9	.04822	.99	11.17	.97	14.5	-.035
Total bole wood and bark dry weight	36.7	.05783	.98	6.47	.96	17.6	-.036
Total bole wood green weight	63.6	.05388	.99	10.12	.97	15.9	-.040
Total bole wood dry weight	29.7	.06351	.98	5.75	.96	19.4	-.077
	cu ft			cu ft			
Total tree wood and bark cubic foot volume	1.4	.06439	.98	.232	.97	16.5	-.075
Total tree wood cubic foot volume	1.0	.05451	.99	.154	.97	15.3	-.056
Total bole wood and bark cubic foot volume	1.3	.05090	.99	.172	.98	13.7	-.047
Total bole wood cubic foot volume	0.9	.05365	.99	.142	.98	15.2	-.044

<sup>1</sup>Equations for trees ≥ 5.0 inches dbh based on 83 trees with mean  $\log D^2H = 3.92709$  and corrected sums of squares of  $\log D^2H = 11.32132$ ; equations for trees < 5.0 inches dbh based on 28 trees with mean  $\log D^2H = 2.35059$  and corrected sums of squares of  $\log D^2H = 9.68978$ ;  $\log =$  common logarithm to the base 10, D = dbh in inches, H = total height in feet.

<sup>2</sup> $S_{y,x}$  = standard error of the estimate for the log form of the equation.

<sup>3</sup> $r^2$  = Coefficient of determination for the log form of the equation.

<sup>4</sup> $S^*_{y,x}$  = Standard error of the estimate in actual units.

<sup>5</sup>FI =  $1 - [\sum(Y_i - \hat{Y}_i)^2 / \sum(Y_i - \bar{Y})^2]$  = Fit index where  $Y_i$  (observation),  $\hat{Y}_i$  (predicted observation) and  $\bar{Y}$  (mean of the observations) are in actual units.

<sup>6</sup>CV = Coefficient of variation (in percent) expressed in actual units.

<sup>7</sup>S(%) =  $(100/n) \sum[(Y_i - \hat{Y}_i) / \hat{Y}_i]$  = Percent standard error where  $Y_i$  and  $\hat{Y}_i$  are in actual units.

<sup>8</sup>The crown consists of all lateral branches plus the bole from 4-inch dbh top to the tip.

Table 6.—*Longleaf pine ratio parameter estimates for calculating the proportion of weight or volume of the merchantable bole to total bole:  $R = 1 + \beta_1 [D_t^{.62} / (D^2H)^{.63}]^*$*

Ratio	$\beta_1$	$\beta_2$	$\beta_3$	$S_{y,x}^{**}$	S(%) <sup>†</sup>
Green weight wood and bark	-6.80342	2.97184	1.04751	.03922	.283
Dry weight wood and bark	-7.96452	2.85319	1.05874	.03816	.307
Green weight wood	-7.11931	3.13434	1.09043	.03938	.291
Dry weight wood	-8.51870	3.01905	1.10385	.03845	.319
Cubic foot volume wood and bark	-7.19490	2.89957	1.04094	.03977	.298
Cubic foot volume wood	-7.72150	3.10152	1.09346	.04031	.312

\*R = (merchantable bole to any outside bark diameter less than or equal to 7 inches)/(total bole).

\*\*Standard error of estimate based on nonlinear regression analysis.

†Mean percent standard error.

using the appropriate transformed equations from table 4, are presented in appendix tables 7 to 37.

The coefficients required for application of model (2) to estimate merchantable bole weight or volume for commercial sized trees are given in table 6. Green weight, dry weight, or volume (wood only or wood plus bark) is found by multiplying the appropriate ratio estimate obtained from model (2) with the corresponding total bole weight or volume estimate obtained from model (1). For example, the green weight of the wood from stump to 4-inch top for a tree 70 feet tall with dbh of 15 inches is obtained by first predicting the total bole green weight by using model (1) and the proper coefficients from table 4 or by reading directly from table 15:

$$\log Y = -.81664 + 0.99139 \log (15 \times 15 \times 70) = 3.344502$$

$$Y = 10^{\log Y} = 10^{3.344502} = 2211 \text{ pounds}$$

Then the ratio factor is obtained from model (2) using the appropriate coefficient estimates from table 6:

$$R = 1 - 7.11931 [4^{3.13434} / (15 \times 15 \times 70)^{1.09043}] = .98546$$

Finally, the predicted green weight of the merchantable bole from stump to 4-inch top is the product

$$(R)(Y) = .98546(2211) = 2179 \text{ pounds}$$

Note that the answer of 2178 pounds is given directly in table 17. The one pound discrepancy in the estimates is due to the rounding up to the nearest pound of the total bole green weight.

Further examples of equation and table use are given in the appendix.

The supporting statistics for the coefficient estimates for model (1) are contained in table 5. They indicate an overall excellent fit of the data to the allometric model, utilizing  $D^2H$  as predictors, except for the crown components. Better crown component weight and volume prediction models have been reported (e.g., Brown 1978, Ek 1979), but they require additional measurements of the crown or upper bole

and their utilization would have negated our previously stated objectives of simplicity and comparability with other published work with longleaf pine.

Most of the "goodness of fit" statistics commonly used with linear models are not appropriate for nonlinear models. Thus table 6 only presents standard error and mean percent standard error statistics for the fitted equations utilizing model (2). These statistics, and a graphical analysis of measured versus predicted ratios for the six different prediction equations, indicated good fits were obtained over the range of ratios used in the fitting process (from 7-inch to 0-inch outside bark top diameters). The reader is cautioned against making estimates for bole weights or volumes to merchantable top diameters much greater than 7 inches outside bark.

Although evidence was presented earlier (Baldwin and Saucier 1982) that some of the weight and volume estimates presented herein might not differ greatly from estimates for natural longleaf pine grown under an uneven-aged management system in southern Alabama, indiscriminate application of these equations in stands other than unthinned plantations in the West Gulf Region is not recommended. Components of trees with the same dbh and total height (especially the crown components) may vary considerably in weight and volume because of variation in physical and morphological characteristics.

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## APPENDIX

### EXAMPLES OF EQUATION AND TABLE USE

In this section, a few examples are given to illustrate use of Equations 1 and 2 and the tables presented. Assume an unthinned planted longleaf pine with diameter at breast height (D) equal to 17.7 inches and total height (H) equal to 86 feet.

To calculate, for example, total green weight of the wood, bark and foliage using Equation 1 and the coefficients from table 4:

$$\begin{aligned} \log Y &= b_0 + b_1 \log D^2 H \\ &= -0.64745 + 0.98442 \log (17.7 \times 17.7 \times \\ &\quad 86) \end{aligned}$$

$$\begin{aligned} &= -0.64745 + 0.98442 \log (26942.94) \\ &= -0.64745 + 0.98442 (4.43044) \\ &= -0.64745 + 4.36142 \\ &= 3.71397 \end{aligned}$$

$$Y = 10^{3.71397} = 5,176 \text{ pounds}$$

To calculate total green weight of the foliage, for example, we must first calculate total green weight of the wood and bark and then obtain the foliage weight estimate by subtracting the green wood and bark estimate from the green wood, bark and foliage estimate already obtained:

$$\begin{aligned} \log Y &= b_0 + b_1 \log D^2 H \\ &= -0.75522 + 1.00514 \log (17.7 \times 17.7 \times \\ &\quad 86) \end{aligned}$$

$$\begin{aligned}
&= -0.75522 + 1.00514 \log (26942.94) \\
&= -0.75522 + 1.00514 (4.43044) \\
&= -0.75522 + 4.45322 \\
&= 3.69800 \\
Y &= 10^{3.69800} = 4,989 \text{ pounds}
\end{aligned}$$

Therefore, estimated green foliage weight is 5176 - 4989 = 187 pounds.

Merchantable bole wood and bark volume to a 7-inch dob top, for example, is obtained by first calculating the total bole wood and bark volume from model (1) using the appropriate coefficients from table 4:

$$\begin{aligned}
\log Y &= b_0 + b_1 \log D^2H \\
&= -2.44693 + 0.96225 \log (17.7 \times 17.7 \times 86) \\
&= -2.44693 + 0.96225 \log (26942.94) \\
&= -2.44693 + 0.96225 (4.43044) \\
&= -2.44693 + 4.26319
\end{aligned}$$

$$= 1.81626$$

$$Y = 10^{1.81626} = 65.5 \text{ cubic feet.}$$

Then the ratio factor is obtained from model (2) using the appropriate coefficient estimates from table 6:

$$\begin{aligned}
R &= 1 + \beta_1 [D_i^{\beta_2} / (D^2H)^{\beta_3}] \\
&= 1 - 7.19490 [7^{2.89957} / 26,942.94^{1.04094}] \\
&= 1 - 7.19490 [282.11159 / 40,909.80427] \\
&= 1 - 7.19490 [.00690] \\
&= 1 - .04962 \\
&= .95038
\end{aligned}$$

Lastly, the predicted cubic foot volume of the merchantable bole wood and bark from stump to 7-inch dob top is:

$$(R)(Y) = .95038 (65.5) = 62.3 \text{ cubic feet}$$

The prediction for the wood and bark cubic foot volume to a 7-inch dob top for the same tree using table 31 (18-inch dbh class and 90 foot height class) is 67.4 cubic feet.

Table 7.—Predicted green weight of total tree wood, bark and foliage of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
6	218	200	361	432	502	573		
7	295	392	489	585	680	776	871	
8		510	635	760	885	1009	1133	
9			801	959	1116	1273	1429	
10			986	1180	1373	1566	1759	1951
11			1190	1423	1657	1889	2122	2354
12			1412	1689	1966	2242	2518	2793
13				1978	2302	2625	2948	3270
14				2288	2663	3038	3411	3784
15				2621	3051	3480	3907	4334
16				2977	3464	3951	4437	4922
17				3354	3904	4452	4999	5546
18				3753	4368	4982	5595	6206
19				4175	4859	5542	6223	6903
20				4619	5376	6131	6884	
21					5918	6749	7578	
22					6485	7396	8305	

Table values computed from equation:  $\log Y = -0.64745 + 0.98442 \log (D^2H)$

Table 8.—Predicted dry weight of total tree wood, bark and foliage of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
6	99	133	166	200	234	267		
7	136	181	227	273	319	365	411	
8		237	297	357	417	478	538	
9			377	453	529	606	682	
10			466	561	655	749	844	938
11			565	679	794	908	1023	1137
12			674	810	946	1082	1219	1355
13				952	1112	1272	1432	1593
14				1105	1291	1477	1663	1850
15				1270	1484	1697	1912	2126
16				1447	1690	1933	2177	2421
17				1635	1910	2185	2460	2736
18				1834	2143	2452	2761	3071
19				2046	2390	2734	3079	3425
20				2269	2650	3032	3415	
21					2925	3346	3768	
22					3212	3675	4139	

Table values computed from equation:  $\log Y = -1.06186 + 1.00853 \log (D^2H)$

Table 9.—Predicted green weight of total bole wood and bark of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
6	183	242	300	358	415	472		
7	247	326	404	482	559	636	712	
8		421	523	623	723	822	921	
9			656	782	907	1032	1156	
10			804	958	1112	1264	1416	1568
11			966	1151	1336	1519	1702	1884
12			1142	1362	1580	1797	2013	2228
13				1589	1844	2097	2349	2600
14				1833	2127	2419	2710	3000
15				2094	2429	2763	3095	3426
16				2371	2751	3129	3506	3880
17				2665	3092	3517	3940	4361
18				2976	3453	3927	4399	4870
19				3303	3832	4359	4883	5405
20				3646	4230	4812	5390	
21					4648	5286	5922	
22					5084	5782	6478	

Table values computed from equation:  $\log Y = -0.75522 + 1.00514 \log (D^2H)$

Table 10.—Predicted dry weight of total bole wood and bark of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
6	84	112	140	168	195	223		
7	115	152	190	228	265	303	340	
8		198	248	297	345	394	443	
9			313	374	436	498	559	
10			385	461	537	613	689	765
11			465	557	649	741	832	924
12			552	662	771	880	989	1097
13				775	903	1031	1158	1286
14				898	1046	1194	1341	1489
15				1029	1199	1369	1538	1707
16				1170	1363	1555	1747	1940
17				1319	1536	1753	1970	2187
18				1477	1720	1964	2206	2449
19				1644	1915	2185	2456	2726
20				1819	2119	2419	2718	
21					2334	2664	2994	
22					2560	2921	3283	

Table values computed from equation:  $\log Y = -1.15588 + 1.02700 \log (D^2H)$

Table 11.—Predicted green weight of bole wood and bark to a 4-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
6	132	192	251	310	368	425		
7	197	277	356	435	512	590	667	
8		374	476	577	678	777	877	
9			610	737	863	988	1112	
10			759	914	1068	1221	1374	1525
11			922	1108	1293	1477	1660	1842
12			1099	1319	1538	1755	1972	2187
13				1547	1802	2056	2308	2560
14				1791	2085	2378	2669	2959
15				2053	2389	2723	3055	3387
16				2330	2711	3089	3466	3841
17				2625	3052	3478	3901	4323
18				2936	3413	3888	4361	4831
19				3263	3793	4320	4844	5367
20				3607	4192	4773	5352	
21					4609	5248	5884	
22					5046	5744	6440	

Table values computed from equations:  $\log Y = -0.66098 + 0.96407 \log (D^2H)$

$$R = 1 - 6.80322 [4.0^{2.97184} / (D^2H)^{1.04751}]$$

Table 12.—Predicted dry weight of bole wood and bark to a 4-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
6	63	91	119	147	175	203		
7	93	132	170	207	245	283	320	
8		178	228	277	326	375	424	
9			293	355	417	479	540	
10			366	442	518	594	670	746
11			446	538	630	722	814	905
12			534	643	752	861	970	1079
13				757	885	1013	1140	1268
14				880	1028	1176	1324	1471
15				1011	1181	1351	1520	1689
16				1152	1345	1537	1730	1922
17				1301	1519	1736	1953	2170
18				1459	1703	1946	2189	2432
19				1626	1897	2168	2439	2709
20				1802	2102	2402	2701	
21					2317	2647	2977	
22					2543	2904	3266	

Table values computed from equations:  $\log Y = -1.07630 + 0.98996 \log (D^2H)$   
 $R = 1 - 7.96452 [4.02^{.85319} / (D^2H)^{1.05874}]$

Table 13.—Predicted green weight of bole wood and bark to a 7-inch top of west gulf plantation long-leaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
8			277	381	484	586	687	
9			415	544	673	800	926	
10			567	725	881	1037	1191	1344
11			733	922	1109	1295	1480	1664
12			912	1135	1356	1576	1794	2011
13				1366	1623	1879	2133	2386
14				1612	1909	2204	2497	2788
15				1876	2214	2550	2885	3217
16				2156	2538	2919	3297	3674
17				2452	2882	3309	3734	4157
18				2764	3244	3721	4195	4667
19				3093	3625	4154	4680	5204
20				3438	4025	4609	5189	
21					4444	5085	5723	
22					4882	5583	6280	

Table values computed from equations:  $\log Y = -0.66098 + 0.96407 \log (D^2H)$   
 $R = 6.80342 [7.02^{.97184} / (D^2H)^{1.04751}]$

Table 14.—Predicted dry weight of bole wood and bark to a 7-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
8			149	199	249	299	348	
9			215	278	341	404	466	
10			289	367	444	520	597	673
11			370	464	556	649	741	833
12			459	569	680	789	899	1008
13				684	813	941	1070	1198
14				808	957	1105	1254	1402
15				940	1110	1281	1451	1620
16				1081	1275	1468	1661	1854
17				1231	1449	1667	1885	2102
18				1390	1634	1878	2121	2365
19				1557	1829	2100	2371	2642
20				1733	2034	2335	2634	
21					2250	2580	2911	
22					2476	2838	3200	

Table values computed from equations:  $\log Y = -1.07630 + 0.98996 \log (D^2H)$   
 $R = 1 - 7.96452 [7.0^{2.85319}/(D^2H)^{1.05874}]$

Table 15.—Predicted green weight of total bole wood of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
6	155	206	257	308	359	410		
7	211	280	349	419	488	557	626	
8		365	455	546	636	726	815	
9			575	689	803	916	1030	
10			709	849	989	1129	1269	1409
11			856	1026	1195	1364	1533	1702
12			1017	1219	1420	1621	1822	2023
13				1429	1664	1900	2135	2370
14				1655	1928	2201	2473	2746
15				1897	2211	2523	2836	3148
16				2156	2512	2868	3223	3578
17				2432	2833	3234	3635	4035
18				2723	3173	3622	4071	4519
19				3032	3532	4032	4532	5031
20				3356	3910	4464	5017	
21					4308	4917	5526	
22					4724	5392	6060	

Table values computed from equation:  $\log Y = -0.81664 + 0.99139 \log (D^2H)$

Table 16.—Predicted dry weight of total bole wood of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
-----pounds-----								
6	70	94	118	142	166	191		
7	96	129	162	195	228	261	294	
8		169	212	256	299	343	386	
9			270	325	380	436	491	
10			335	403	471	540	609	678
11			406	489	572	656	740	823
12			485	584	683	783	883	983
13				688	805	922	1039	1157
14				800	936	1072	1209	1346
15				921	1077	1234	1392	1549
16				1050	1229	1408	1587	1767
17				1188	1390	1593	1796	1999
18				1335	1562	1790	2018	2247
19				1490	1744	1998	2253	2508
20				1655	1936	2218	2501	
21					2138	2450	2763	
22					2351	2694	3038	

Table values computed from equation:  $\log Y = -1.24531 + 1.01912 \log (D^2H)$

Table 17.—Predicted green weight of bole wood to a 4-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
-----pounds-----								
6	113	166	218	269	321	372		
7	170	241	311	381	450	520	589	
8		326	418	509	599	690	780	
9			538	653	767	881	995	
10			673	814	955	1095	1235	1375
11			821	991	1161	1331	1500	1669
12			983	1185	1387	1588	1789	1990
13				1395	1631	1867	2103	2339
14				1622	1895	2169	2442	2714
15				1865	2178	2492	2805	3117
16				2124	2481	2837	3192	3547
17				2400	2802	3203	3604	4005
18				2692	3142	3592	4041	4489
19				3001	3502	4002	4502	5001
20				3325	3880	4434	4987	
21					4278	4888	5497	
22					4694	5363	6031	

Table values computed from equations:  $\log Y = -0.81664 - 0.99139 \log (D^2H)$   
 $R = 1 - 7.11931 [4.0^{3.13434}/(D^2H)^{1.09043}]$

Table 18.—Predicted dry weight of bole wood to a 4-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
6	53	77	101	126	150	174		
7	79	112	145	179	212	245	279	
8		153	196	240	283	327	371	
9			254	309	365	421	476	
10			319	388	456	525	594	663
11			391	474	558	641	725	809
12			470	569	669	769	869	969
13				673	790	908	1025	1143
14				785	922	1058	1195	1332
15				906	1063	1220	1378	1536
16				1036	1215	1394	1574	1754
17				1174	1376	1579	1782	1986
18				1321	1548	1776	2005	2233
19				1477	1730	1985	2240	2495
20				1641	1923	2205	2488	
21					2125	2437	2750	
22					2338	2681	3025	

Table values computed from equations:  $\log Y = -1.24531 + 1.01912 \log (D^2H)$   
 $R = 1 - 8.51870 [4.0^{3.01905}/(D^2H)^{1.10385}]$

Table 19.—Predicted green weight of bole wood to 7-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
8			238	332	425	518	610	
9			363	480	597	714	830	
10			501	645	788	931	1073	1215
11			652	825	998	1169	1341	1511
12			817	1022	1226	1430	1633	1835
13				1235	1473	1711	1949	2186
14				1464	1740	2015	2290	2564
15				1709	2025	2340	2655	2969
16				1970	2329	2687	3044	3401
17				2248	2652	3055	3458	3860
18				2542	2994	3446	3896	4346
19				2852	3355	3857	4359	4860
20				3178	3735	4291	4846	
21					4134	4746	5357	
22					4552	5223	5892	

Table values computed from equations:  $\log Y = -0.81664 + 0.99139 \log (D^2H)$   
 $R = 1 - 7.11931 [7.0^{3.13434}/(D^2H)^{1.09043}]$



Table 20.—Predicted dry weight of bole wood to a 7-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
8			125	170	215	259	304	
9			185	241	297	354	410	
10			251	320	390	460	529	599
11			324	408	492	577	661	746
12			404	504	605	705	806	907
13				609	727	845	963	1082
14				722	859	996	1134	1271
15				844	1001	1159	1317	1476
16				974	1153	1333	1514	1694
17				1113	1316	1519	1723	1927
18				1260	1488	1717	1946	2175
19				1416	1671	1926	2181	2437
20				1581	1864	2147	2430	
21					2067	2379	2692	
22					2280	2624	2968	

Table values computed from equations:  $\log Y = -1.24531 + 1.01912 \log (D^2H)$   
 $R = 1 - 8.51870 [7.0^{3.01905} / (D^2H)^{1.10385}]$

Table 21.—Predicted green weight of crown wood, bark and foliage of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
6	64	83	100	117	134	151		
7	84	108	131	153	175	197	218	
8		136	165	193	221	248	275	
9			202	237	271	304	337	
10			243	285	325	365	404	443
11			287	336	384	431	477	523
12			333	390	446	501	555	608
13				448	513	575	637	698
14				510	583	654	725	794
15				575	657	737	817	895
16				643	734	825	913	1000
17				714	816	916	1014	1111
18				788	901	1011	1120	1227
19				866	989	1111	1230	1347
20				946	1081	1214	1344	
21					1177	1321	1463	
22					1275	1432	1586	

Table values computed from equation:  $\log Y = -0.81900 + 0.86637 \log (D^2H)$   
 Crown consists of all lateral branches and the bole from 4-inch dbh to the tip

Table 22.—Predicted dry weight of crown wood, bark and foliage of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
6	27	36	43	51	59	66		
7	36	47	57	67	77	87	96	
8		59	72	85	98	110	122	
9			89	105	121	136	151	
10			108	127	146	164	182	200
11			128	151	173	195	216	238
12			149	176	202	227	253	278
13				203	233	262	291	320
14				232	266	299	333	365
15				262	301	339	376	413
16				294	337	380	422	464
17				328	376	423	470	517
18				363	416	469	521	572
19				400	458	517	574	630
20				438	502	566	629	
21					548	618	686	
22					596	671	745	

Table values computed from equation:  $\log Y = -1.26878 + 0.89268 \log (D^2H)$   
 Crown consists of all lateral branches and the bole from 4-inch dob to the tip

Table 23.—Predicted green weight of crown wood and bark of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	-----pounds-----							
6	45	58	71	84	97	109		
7	59	77	94	111	128	144	160	
8		98	120	141	163	183	204	
9			148	175	201	227	252	
10			179	212	243	275	306	336
11			213	252	289	326	363	399
12			250	294	339	382	425	467
13				340	391	442	491	540
14				389	447	505	562	618
15				441	507	572	636	700
16				496	570	643	715	787
17				553	636	718	798	878
18				613	705	796	885	974
19				676	778	878	976	1074
20				742	853	963	1071	
21					932	1052	1170	
22					1014	1144	1273	

Table values computed from equation:  $\log Y = -1.09334 + 0.90495 \log (D^2H)$   
 Crown consists of all lateral branches and the bole from 4-inch dob to the tip

Table 24.—Predicted dry weight of crown wood and bark of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	<i>pounds</i>							
6	20	26	32	38	44	50		
7	27	35	43	51	59	66	74	
8		45	55	65	75	85	95	
9			68	81	93	106	118	
10			83	98	114	129	144	158
11			99	118	136	154	172	189
12			117	138	160	181	202	222
13				161	185	210	234	258
14				184	213	241	269	296
15				209	242	274	306	337
16				236	273	309	345	380
17				264	305	346	386	425
18				294	339	384	429	473
19				325	375	425	474	523
20				358	413	468	522	
21					452	512	571	
22					493	558	623	

Table values computed from equation:  $\log Y = -1.52243 + 0.93058 \log (D^2H)$   
 Crown consists of all lateral branches and the bole from 4-inch dob to the tip

Table 25.—Predicted green weight of tree wood bark and foliage of west gulf plantation longleaf pine saplings

Dbh class	Total tree height (feet)									
	10	15	20	25	30	35	40	45	50	55
<i>inches</i>	<i>pounds</i>									
1	4	6	7	9						
2	13	19	24	29	34	38	43	48		
3		37	48	58	67	77	86	95	104	113
4			78	94	110	125	140	155	170	184
5					161	183	205	227	248	269

Table values computed from equation:  $\log Y = -0.24556 + 0.85263 \log (D^2H)$

Table 26.—Predicted dry weight of tree wood bark and foliage of west gulf plantation longleaf pine saplings

Dbh class	Total tree height (feet)									
	10	15	20	25	30	35	40	45	50	55
<i>inches</i>	<i>pounds</i>									
1	2	2	3	4						
2	6	8	10	13	15	17	19	21		
3		17	21	26	30	35	39	43	48	52
4			35	43	50	58	65	72	79	86
5					75	86	96	107	117	127

Table values computed from equation:  $\log Y = -0.65729 + 0.88019 \log (D^2H)$

Table 27.—*Predicted green weight of total bole wood and bark of west gulf plantation longleaf pine saplings*

Dbh class	Total tree height (feet)									
	10	15	20	25	30	35	40	45	50	55
<i>inches</i>	----- <i>pounds</i> -----									
1	3	4	6	7						
2	10	15	19	22	26	30	34	37		
3		29	37	45	53	60	67	74	81	88
4			61	74	86	98	110	122	133	145
5					126	144	161	178	195	212

Table values computed from equation:  $\log Y = -0.35931 + 0.85567 \log (D^2H)$

Table 28.—*Predicted dry weight of total bole wood and bark of west gulf plantation longleaf pine saplings*

Dbh class	Total tree height (feet)									
	10	15	20	25	30	35	40	45	50	55
<i>inches</i>	----- <i>pounds</i> -----									
1	1	2	2	3						
2	4	6	8	10	12	14	15	17		
3		13	17	21	24	28	31	35	38	42
4			28	34	40	46	52	58	64	69
5					60	69	77	86	94	103

Table values computed from equation:  $\log Y = -0.76622 + 0.88506 \log Y$

Table 29.—*Predicted volume of total bole wood and bark of west gulf plantation longleaf pines*

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
6	3.0	3.9	4.8	5.8	6.7	7.6		
7	4.0	5.3	6.5	7.8	9.0	10.2	11.5	
8		6.8	8.4	10.0	11.6	13.2	14.8	
9			10.6	12.6	14.6	16.6	18.6	
10			12.9	15.4	17.9	20.3	22.8	25.2
11			15.5	18.5	21.5	24.4	27.4	30.3
12			18.4	21.9	25.4	28.9	32.4	35.8
13				25.6	29.6	33.7	37.8	41.8
14				29.5	34.2	38.9	43.5	48.2
15				33.7	39.0	44.4	49.7	55.0
16				38.1	44.2	50.3	56.3	62.3
17				42.8	49.7	56.5	63.3	70.0
18				47.8	55.4	63.1	70.6	78.2
19				53.0	61.5	70.0	78.4	86.7
20				58.5	67.9	77.2	86.5	
21					74.6	84.8	95.0	
22					81.6	92.8	103.9	

Table values computed from equation:  $\log Y = -2.44693 + 0.96225 \log D^2H$

Table 30.—Predicted volume of bole wood and bark to a 4-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
6	2.1	3.1	4.0	5.0	5.9	6.8		
7	3.2	4.5	5.7	7.0	8.3	9.5	10.7	
8		6.0	7.7	9.3	10.9	12.5	14.1	
9			9.8	11.9	13.9	15.9	17.9	
10			12.2	14.7	17.2	19.6	22.1	24.5
11			14.8	17.8	20.8	23.7	26.7	29.6
12			17.7	21.2	24.7	28.2	31.7	35.1
13				24.9	29.0	33.0	37.1	41.1
14				28.8	33.5	38.2	42.9	47.5
15				33.0	38.4	43.7	49.1	54.4
16				37.4	43.5	49.6	55.6	61.7
17				42.2	49.0	55.8	62.6	69.4
18				47.1	54.8	62.4	70.0	77.5
19				52.4	60.9	69.3	77.7	86.1
20				57.9	67.3	76.6	85.9	
21					74.0	84.2	94.4	
22					81.0	92.1	103.3	

Table values computed from equation:  $\log Y = -2.44693 + 0.96225 \log (D^2H)$   
 $R = 1 - 7.19490 [4.0^{2.89957}/(D^2H)^{1.04094}]$

Table 31.—Predicted volume of bole wood and bark to a 7-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
8			4.6	6.3	7.9	9.5	11.2	
9			6.8	8.9	10.9	13.0	15.0	
10			9.2	11.8	14.3	16.8	19.2	21.7
11			11.9	14.9	17.9	20.9	23.9	26.8
12			14.8	18.4	21.9	25.4	28.9	32.4
13				22.0	26.2	30.3	34.4	38.4
14				26.0	30.8	35.5	40.2	44.9
15				30.2	35.7	41.0	46.4	51.7
16				34.7	40.8	46.9	53.0	59.0
17				39.5	46.4	53.2	60.0	66.8
18				44.5	52.2	59.8	67.4	75.0
19				49.7	58.3	66.7	75.2	83.5
20				55.3	64.7	74.0	83.3	
21					71.4	81.6	91.9	
22					78.4	89.6	100.8	

Table values computed from equation:  $\log Y = -2.44693 + 0.96225 \log (D^2H)$   
 $R = 1 - 7.19490 [7.0^{2.89957}/(D^2H)^{1.04094}]$

Table 32.—Predicted volume of bole wood of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
6	2.3	3.1	3.9	4.6	5.4	6.2		
7	3.2	4.2	5.3	6.3	7.4	8.4	9.5	
8		5.5	6.9	8.3	9.7	11.0	12.4	
9			8.7	10.5	12.2	14.0	15.7	
10			10.8	12.9	15.1	17.3	19.4	21.6
11			13.1	15.7	18.3	20.9	23.5	26.2
12			15.5	18.7	21.8	24.9	28.0	31.2
13				21.9	25.6	29.3	32.9	36.6
14				25.4	29.7	33.9	38.2	42.5
15				29.2	34.1	39.0	43.9	48.8
16				33.2	38.8	44.4	49.9	55.5
17				37.5	43.8	50.1	56.4	62.7
18				42.1	49.1	56.2	63.2	70.3
19				46.9	54.8	62.6	70.5	78.3
20				52.0	60.7	69.4	78.1	
21					67.0	76.6	86.2	
22					73.5	84.0	94.6	

Table values computed from equation:  $\log Y = -2.67764 + 1.00313 \log (D^2H)$

Table 33.—Predicted volume of bole wood to a 4-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
6	1.7	2.5	3.3	4.0	4.8	5.6		
7	2.5	3.6	4.7	5.7	6.8	7.9	8.9	
8		4.9	6.3	7.7	9.1	10.5	11.9	
9			8.2	9.9	11.7	13.4	15.2	
10			10.2	12.4	14.6	16.7	18.9	21.1
11			12.5	15.1	17.8	20.4	23.0	25.7
12			15.0	18.1	21.3	24.4	27.5	30.7
13				21.4	25.1	28.7	32.4	36.1
14				24.9	29.2	33.4	37.7	42.0
15				28.7	33.6	38.5	43.4	48.3
16				32.7	38.3	43.9	49.4	55.0
17				37.0	43.3	49.6	55.9	62.2
18				41.6	48.7	55.7	62.8	69.8
19				46.4	54.3	62.2	70.0	77.9
20				51.5	60.2	68.9	77.7	
21					66.5	76.1	85.7	
22					73.0	83.6	94.1	

Table values computed from equation:  $\log Y = -2.67764 + 1.00313 \log (D^2H)$

$$R = 1 - 7.72150 [4.0^{3.10152} / (D^2H)^{1.09346}]$$

Table 34.—Predicted volume of bole wood to a 7-inch top of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
8			3.6	5.1	6.5	7.9	9.3	10.7
9			5.5	7.3	9.1	10.9	12.7	14.5
10			7.6	9.9	12.1	14.3	16.5	18.7
11			10.0	12.6	15.3	18.0	20.6	23.3
12			12.5	15.7	18.8	22.0	25.2	28.3
13				19.0	22.7	26.4	30.1	33.8
14				22.5	26.8	31.1	35.4	39.7
15				26.3	31.3	36.2	41.1	46.0
16				30.4	36.0	41.6	47.2	52.8
17				34.7	41.1	47.4	53.7	60.0
18				39.3	46.4	53.5	60.6	67.6
19				44.2	52.1	59.9	67.8	75.7
20				49.3	58.0	66.8	75.5	
21					64.3	73.9	83.6	
22					70.9	81.4	92.0	

Table values computed from equation:  $\log Y = -2.67764 + 1.00313 \log (D^2H)$   
 $R = 1 - 7.72150 [7.03^{.10152} / (D^2H)^{1.09346}]$

Table 35.—Predicted volume of crown wood and bark of west gulf plantation longleaf pines

Dbh class	Total tree height (feet)							
	30	40	50	60	70	80	90	100
<i>inches</i>	----- <i>cu ft</i> -----							
6	.78	1.00	1.22	1.44	1.65	1.86		
7	1.02	1.32	1.61	1.89	2.17	2.45	2.71	
8		1.67	2.04	2.40	2.75	3.10	3.44	
9			2.52	2.96	3.39	3.82	4.24	
10			3.04	3.57	4.09	4.61	5.12	5.62
11			3.60	4.23	4.85	5.46	6.06	6.66
12			4.20	4.93	5.66	6.37	7.07	7.77
13				5.69	6.52	7.35	8.16	8.96
14				6.49	7.44	8.38	9.30	10.22
15				7.34	8.41	9.47	10.52	11.55
16				8.23	9.43	10.62	11.80	12.95
17				9.16	10.51	11.83	13.14	14.43
18				10.14	11.63	13.10	14.54	15.97
19				11.17	12.80	14.42	16.01	17.50
20				12.23	14.03	15.79	17.53	
21					15.30	17.22	19.12	
22					16.61	18.71	20.77	

Table values computed from equation:  $\log Y = -2.80386 + 0.88844 \log (D^2H)$   
 Crown consists of all lateral branches and the bole from 4-inch dbh to the tip

Table 36.—Predicted volume of total bole wood and bark of west gulf plantation longleaf pine saplings

Dbh class	Total tree height (feet)									
	10	15	20	25	30	35	40	45	50	55
<i>inches</i>	----- <i>cu ft</i> -----									
1	.06	.08	.10	.12						
2	.18	.25	.32	.38	.44	.51	.57	.62		
3		.49	.62	.75	.88	1.00	1.12	1.23	1.34	1.46
4			1.01	1.22	1.42	1.62	1.81	1.99	2.18	2.36
5					2.06	2.35	2.63	2.90	3.17	3.43

Table values computed from equation:  $\log Y = -2.09552 + 0.83821 \log (D^2H)$

Table 37.—Predicted volume of total bole wood of west gulf plantation longleaf pine saplings

Dbh class	Total tree height (feet)									
	10	15	20	25	30	35	40	45	50	55
<i>inches</i>	----- <i>cu ft</i> -----									
1	.03	.04	.06	.07						
2	.11	.16	.20	.25	.29	.34	.38	.42		
3		.33	.42	.52	.61	.70	.80	.89	.97	1.06
4			.71	.88	1.03	1.19	1.34	1.49	1.64	1.79
5					1.55	1.78	2.01	2.24	2.46	2.69

Table values computed from equation:  $\log Y = -2.42121 + 0.90837 \log (D^2H)$

Table 38.—Mean and standard error of wood and bark specific gravity, moisture content, and green weight per cubic foot for unthinned plantation longleaf pine trees and tree components

Tree component	Specific gravity	Moisture content	Green weight per cu ft
<b>Trees <math>\geq</math> 5 inches dbh</b>			
<b>Wood and bark</b>			
Total tree	.....	.....	61.70 $\pm$ 1.89
Bole to 7" top	.....	.....	61.67 $\pm$ 2.13
Bole 7" to 4" top	.....	.....	62.62 $\pm$ 2.24
Bole to 4" top	.....	.....	62.15 $\pm$ 1.95
Branches	.....	.....	58.56 $\pm$ 3.54
<b>Wood</b>			
Total tree	.500 $\pm$ .030	110 $\pm$ 14	65.27 $\pm$ 1.93
Bole to 7" top	.517 $\pm$ .035	103 $\pm$ 14	65.07 $\pm$ 2.06
Bole 7" to 4" top	.477 $\pm$ .037	121 $\pm$ 17	65.52 $\pm$ 2.18
Bole to 4" top	.504 $\pm$ .032	109 $\pm$ 15	65.38 $\pm$ 2.07
Branches	.481 $\pm$ .037	115 $\pm$ 15	64.30 $\pm$ 2.87
<b>Bark</b>			
Total tree	.389 $\pm$ .029	90 $\pm$ 14	45.99 $\pm$ 3.16
Bole to 7" top	.393 $\pm$ .033	74 $\pm$ 16	42.47 $\pm$ 3.84
Bole 7" to 4" top	.371 $\pm$ .031	105 $\pm$ 22	47.40 $\pm$ 4.54
Bole to 4" top	.386 $\pm$ .032	83 $\pm$ 16	43.82 $\pm$ 3.62
Branches	.397 $\pm$ .034	101 $\pm$ 18	49.57 $\pm$ 3.68
<b>Trees <math>&lt;</math> 5 inches dbh</b>			
<b>Wood and bark</b>			
Total tree	.....	.....	59.17 $\pm$ 2.39
Branches	.....	.....	51.98 $\pm$ 3.82
<b>Wood</b>			
Total tree	.479 $\pm$ .037	126 $\pm$ 18	67.21 $\pm$ 1.47
Branches	.412 $\pm$ .053	146 $\pm$ 31	62.38 $\pm$ 2.89
<b>Bark</b>			
Total tree	.353 $\pm$ .038	99 $\pm$ 24	43.30 $\pm$ 3.03
Branches	.365 $\pm$ .045	100 $\pm$ 27	44.94 $\pm$ 4.16



Table 39.—Average green and dry weight of the total tree and proportions of the tree in bole and crown (bole tip, branches and foliage) for longleaf pine trees 6–20 inches dbh

Dbh class	Average total height	Sample trees	Average total tree green weight	Tree component proportions (green)			Average total tree dry weight	Tree component proportions (dry)		
				Bole to 4" top	Crown			Bole to 4" top	Crown	
					Bole tip and branches	Needles			Bole tip and branches	Needles
<i>inches</i>	<i>feet</i>	<i>number</i>	<i>pounds</i>	-----percent-----			<i>pounds</i>	-----percent-----		
6	54	12	397	70	23	7	189	72	22	6
8	66	13	839	81	13	6	406	83	12	5
10	75	18	1497	83	12	5	716	84	12	4
12	77	12	2304	80	14	6	1084	81	14	5
14	81	9	3062	80	16	4	1512	81	15	4
16	78	11	3699	77	18	5	1851	78	18	4
18	84	4	5120	73	23	4	2465	74	23	3
20	77	4	6284	69	27	5	3005	70	26	4
Average	74		2218	77	18	5	1076	78	18	4

Table 40.—Average green and dry weight of the total tree and proportions of the tree in wood, bark and foliage for longleaf pine trees 2 to 20 inches dbh

Dbh class	Average total height	Sample trees	Average total trees green weight	Tree component proportions (green)			Average total trees dry weight	Tree component proportions (dry)		
				Wood	Bark			Wood	Bark	
					Needles	Needles			Needles	Needles
<i>inches</i>	<i>feet</i>	<i>number</i>	<i>pounds</i>	-----percent-----			<i>pounds</i>	-----percent-----		
2	19	12	21	65	24	11	9	64	27	9
4	41	16	151	72	17	11	71	71	20	9
6	54	12	397	78	15	7	189	78	16	6
8	66	13	839	81	13	6	406	81	14	5
10	75	18	1497	83	12	5	716	83	13	4
12	77	12	2304	82	12	6	1084	82	13	5
14	81	9	3062	85	11	4	1512	84	12	4
16	78	11	3699	83	12	5	1851	83	13	4
18	84	4	5120	84	12	4	2465	84	14	2
20	77	4	6284	83	12	5	3005	83	13	4
Average	62		1683	83	12	5	816	83	13	4

Table 41.—Average green and dry weight of wood in the total tree and distribution of wood and bark in the bole and branches for longleaf pine trees 6–20 inches dbh

Dbh class	Average total height	Sample trees	Average total tree wood weight	Proportion of wood in						
				Bole		Branches				
				to 8" top	to 4" top	Extra large	Large	Medium	Small	All branches
<i>inches</i>	<i>feet</i>	<i>number</i>	<i>pounds</i>	----- percent -----						
<b>Green</b>										
6	54	12	311		77	0	0	6	1	7
8	66	13	681	47	89	0	0	6	1	7
10	75	18	1245	72	90	0	0	7	1	8
12	77	12	1898	81	88	0	1	9	0	10
14	81	9	2592	82	86	0	3	10	0	13
16	78	11	3068	81	84	0	4	11	0	15
18	84	4	4310	77	79	1	7	12	0	20
20	77	4	5239	74	75	1	10	13	0	24
Average	62		1844	75	84	0	4	10	0	14
<b>Dry</b>										
6	54	12	148		78	0	0	6	1	7
8	66	13	331	50	90	0	0	6	0	6
10	75	18	594	75	91	0	0	7	1	8
12	77	12	891	83	89	0	1	9	0	10
14	81	9	1273	83	87	0	3	9	1	13
16	78	11	1530	82	84	0	5	10	0	15
18	84	4	2060	78	79	1	7	12	0	20
20	77	4	2488	75	79	1	10	13	0	24
Average	62		891	76	85	0	4	10	0	14

Table 42.—Average green and dry weight of wood and bark in the total tree and distribution of wood and bark in the bole and branches for longleaf pine trees 6–20 inches dbh

Dbh class	Average total height	Sample trees	Average total tree wood and bark weight	Proportion of wood and bark in						
				Bole		Branches				
				to 8" top	to 4" top	Extra large	Large	Medium	Small	All branches
<i>inches</i>	<i>feet</i>	<i>number</i>	<i>pounds</i>	----- percent -----						
<b>Green</b>										
6	54	12	369		75	0	0	9	1	10
8	66	13	790	49	86	0	0	8	1	9
10	75	18	1421	70	87	0	0	9	2	11
12	77	12	2168	78	85	0	1	11	1	13
14	81	9	2933	79	83	0	3	12	1	16
16	78	11	3505	78	81	0	4	13	1	18
18	84	4	4931	69	76	1	7	14	1	23
20	77	4	5988	70	72	1	10	16	1	28
Average			2107	63	81	0	4	12	1	17
<b>Dry</b>										
6	54	12	178		76	0	0	8	1	9
8	66	13	349	55	97	0	0	8	2	10
10	75	18	685	72	87	0	0	9	2	11
12	77	12	1030	80	86	0	1	11	1	13
14	81	9	1461	81	84	0	3	11	1	15
16	78	11	1776	79	82	0	5	12	1	18
18	84	4	2394	75	76	1	7	15	0	23
20	77	4	2892	72	73	1	10	15	1	27
Average	62		1026	74	82	0	4	12	1	17

Table 43.—Average green and dry weight of the crown and proportions of the crown in wood, wood and bark, and foliage for longleaf pine trees 6–20 inches dbh

Dbh class	Average total height	Sample trees	Crown weight (green)	Crown proportion (green)			Crown weight (dry)	Crown proportion (dry)		
				Branch and bole tip wood	Branch and bole tip bark	Needles		Branch and bole tip wood	Branch and bole tip bark	Needles
<i>inches</i>	<i>feet</i>	<i>number</i>	<i>pounds</i>	----- <i>percent</i> -----			<i>pounds</i>	----- <i>percent</i> -----		
6	54	12	121	58	18	24	53	60	20	20
8	66	13	156	47	22	31	68	48	24	28
10	75	18	261	47	24	29	116	48	26	26
12	77	12	457	48	22	30	203	49	24	27
14	81	9	614	58	21	21	285	59	23	18
16	78	11	855	57	20	23	401	59	22	19
18	84	4	1362	66	20	14	639	67	22	11
20	77	4	1977	65	20	15	908	65	22	13
Average	62		505	57	21	22	231	58	23	19



Baldwin, V. C., Jr.; Saucier, J. R. Aboveground weight and volume of unthinned, planted longleaf pine on west Gulf forest sites. Res. Pap. SO-191. New Orleans, LA: U.S. Department of Agriculture, Southern Forest Experiment Station; 1983. 25 p.

Presents volume and weight predictions in equations and tables for aboveground total tree and tree components of unthinned, planted longleaf pine trees.

