UNIVERSITY OF GEORGIA
Warnell School of Forestry & Natural Resources

Publication WSFNR-22-10A

March 2022

# Cutover and Old-field Planted Longleaf Pine Total and Merchantable Stemwood with Bark Green Weight Equations for Unthinned Stands

Thomas Harris[1], Sameen Raut[1], Bronson Bullock[2], Cristian Montes[2], Joe Dahlen[2], and David Dickens[2]

[1]*former Master of Science student, UGA Warnell School of Forestry and Natural Resources, Athens, GA*

[2]*Biometricians, Wood Quality, and Forest Productivity Professors, respectively, UGA Warnell School of Forestry and Natural Resources, Athens, GA*

In 2020, new sets of volume and weight equations were developed for planted, unthinned longleaf pine (Pinus palustris) plantations. These equations are based on measurements collected (destructively sampled; taking wood discs from different heights of each tree) from 324 trees with no visible stem defect in 20 established stands located throughout Georgia. Approximately one-half of the trees were collected from sites planted on agriculture fields in the prior rotation (previous common crops were corn, soybeans, cotton, peanuts, a winter grain or grasses for hay or cattle), and the other one-half of the trees were collected from sites planted on cutover forested sites (prior crop was trees).

The planted stands varied in age from 12 through 25 years with longleaf green weights ranging from 18 to 104 tons/acre. A summary of the stands is presented in Table 1 and is derived from three standard 1/10 acre forest inventory plots installed at each sampled longleaf pine stand. The map showing the complete distribution of sites is shown in Figure 1. Eleven old-field and nine cutover planted, unthinned stands were sampled.

The longleaf stemwood with bark green weight total and merchantable equations that follow will be helpful to forest landowners and practicing foresters to estimate individual longleaf tree weights to help determine the stand weights per acre from planted cutover and old-field, grass pastures, and hay cutting fields. Examples using the total and merchantable weight equations are found after the equations.

**Table 1: Stand summary over all 20 sample sites used in this research based on installation of three forest inventory 1/10 ac plots at each site.**

| | Age | Avg. DBH (in.) | Avg. H (ft.) | BA ($ft^2$/ac) | Dominant H (ft.) | SI (ft) | TPA | Tons/ac | Vol/ac ($ft^3$/ac) |
|---|---|---|---|---|---|---|---|---|---|
| min. | 12 | 5.3 | 29.9 | 38 | 39.2 | 89.3 | 150 | 18.2 | 589 |
| mean | 17 | 7.1 | 44.6 | 87 | 47.1 | 101.8 | 312 | 62.0 | 2001 |
| max. | 25 | 9.0 | 61.9 | 121 | 53.8 | 109.8 | 453 | 104.3 | 3362 |

Where: DBH = Diameter at breast height (4.5 ft), inches, H = Total stem height, feet, BA = Basal area, square feet per acre, SI = Estimated site index, base age 50, feet, TPA = Trees per acre

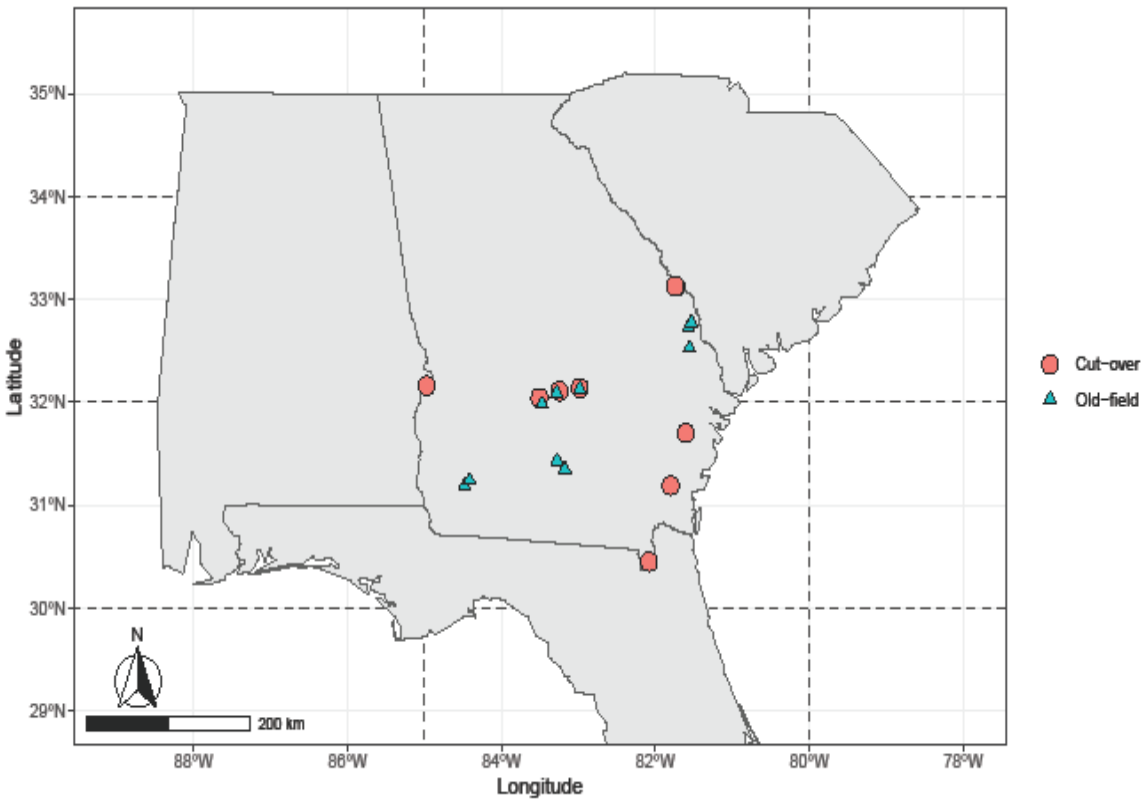


**Figure 1:** *Location of 20 study sites of longleaf pine stands sampled in Georgia.*

The longleaf stemwood with bark green weight equation developed is as follows:

$$\widehat{W} = 3.470008 + 0.152546\ (D^2H)$$

where $\widehat{W}$ = the estimated total stemwood with bark green weight (pounds), D = diameter at breast height (inches), and H = total height (feet).

The full equation to predict green weight at a specified top diameter outside bark (DOB) combines the total green weight equation (above) and is as follows:

$$\widehat{GWT}_{merch} = \left(3.470008 + 0.152546(D^2H)\right)\left(1 - 0.669269\left(\frac{d^{3.1217456}}{D^{3.1909342}}\right)\right)$$

where $\widehat{GWT}_{merch}$ = estimated merchantable green weight outside bark (lb.)

d = upper diameter limit, outside bark (in.)

(1) D = diameter at breast height (DBH), 4.5 ft. above ground (in.)
H = total height (ft.)

Examples of using the total stemwood with bark green weight equation:

(1) 11.5" dbh and 75 feet total height: 3.470008 + 0.152546 ($11.5^2$ x 75) =1516.6 lbs

(2) 6.5" dbh and 52 feet total height: 3.470008 + 0.152546 ($6.5^2$ x 52) = 338.6 lbs

(3) 13.5" dbh and 85 feet total height: 3.470008 + 0.152546 ($13.5^2$ x 85) = 2366.6 lbs

Examples of using merchantable stemwood with bark green weight equation to a specified diameter outside bark (DOB):

(1) Using example 1 above (11.5" dbh and 75 ft total ht) to a 6" top DOB
= 1516.6 lbs [1-0.669269 ($6^{3.1217456}$/ $11.5^{3.1909342}$)]
= 1516.6 [1-0.669269 (268.65/2424.47)]
= 1516.6 [1-0.669269 (0.11080772)]
= 1516.6 (1- 0.074) = 1516.6 (0.926)
= 1404 lbs green wt to a 6" top DOB

(2) Using example 2 above (6.5" dbh and 52 ft total ht) to a 3" top DOB
= 338.6 lbs [1-0.669269 ($3^{3.1217456}$/ $6.5^{3.1909342}$)]
= 338.6 [1-0.669269 (30.864/392.6)]
= 338.6 [1-0.669269 (0.0786)]
= 338.6 (1-0.053) = 338.6 (0.947)
= 321 lbs green wt to a 3" top DOB

(3) Using example 3 above (13.5" dbh and 85 ft total height) to an 8' top DOB green weight
= 2366.6 lbs [1 -0.669269 ($8^{3.1217456}$/$13.5^{3.1909342}$)]
= 2366.6 [1-0.669369 (659.5 / 4404.1)]
= 2366.6 [1-(0.669269 (0.1631)]
= 2366.6 (1 – 0.109) = 2366.6 (0.891)
= 2108 lbs to an 8" top DOB

## ACKNOWLEDGEMENTS:

The authors would like to thank the Natural Resource Conservation Service (NRCS) for a cooperative agreement to support this work. Data collection was done by UGA graduate students: Thomas Harris, Sameen Raut, and Mark Porter; along with the help of Research Professional, Bryan Simmons. The authors would also like to thank the landowners that allowed access to their planted, unthinned longleaf pine plantations.