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ESTIMATING PAST DIAMETERS OF DOUGLAS-FIR TREES

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Estimates of breast height diameter outside bark for trees as of some previous date are required in certain kinds of forest growth studies. These past diameters may be found by subtracting total diameter growth from known present diameters, where total diameter growth is the sum of wood growth and bark growth.

Wood growth is readily obtained by measuring the combined width of a given number of annual rings on cores extracted from trees. Bark growth, however, must be approached indirectly by some procedure like the one to be described.

For Douglas-fir trees 10 inches and larger the relationship between bark thickness and diameter is apparently linear (see figure 1). A least-squares analysis using data from 452 trees gave:

$$B_t = 0.154D - 0.60$$

where B_t = double bark thickness 4.5 feet above ground.

D = tree diameter outside bark 4.5 feet above ground.

The regression coefficient, 0.154, could be considered an indirect estimate of bark growth. It indicates change in bark thickness per unit change in outside bark diameter.

Thus,

$$B_g = 0.154D_g$$

where B_g = bark growth

D_g = total diameter growth

Therefore, $D_g = W_g + 0.154D_g$

where W_g = wood growth (twice radial wood growth)

And,

$$D_g = W_g\ (1.182)$$

Wood growth for the required number of years is simply multiplied by 1.182, and the product is then subtracted from present outside bark diameter for an estimate of previous outside bark diameter.

Data from 75 trees 10 inches in diameter and less were used in another least-squares analysis. Linearity was also apparent here (see figure 1), and logic indicated a line through the origin of both axes. This analysis gave:

$$B_t = 0.094D$$

And, by the reasoning used before:

$$D_g = W_g\ (1.104)$$

Undoubtedly one smooth curve would define the true relationship between bark thickness and tree diameter more accurately. The two straight lines were used for simplicity. Bias in the estimation of past tree diameters from this procedure may be largest at the 10-inch diameter point where the two lines converge, but even there it may be of small consequence. For example, estimated past diameter for a tree now 10 inches in diameter which grew 1 inch in a certain period would be 8.8 inches using the factor 1.182. It would be 8.9 inches by the factor 1.104.

The trees used for these analyses came from widely scattered points in western Oregon and western Washington. They ranged in age from 20 to 466 years. The standard errors of the regression coefficients were 0.005 for 0.154 and 0.003 for 0.094.

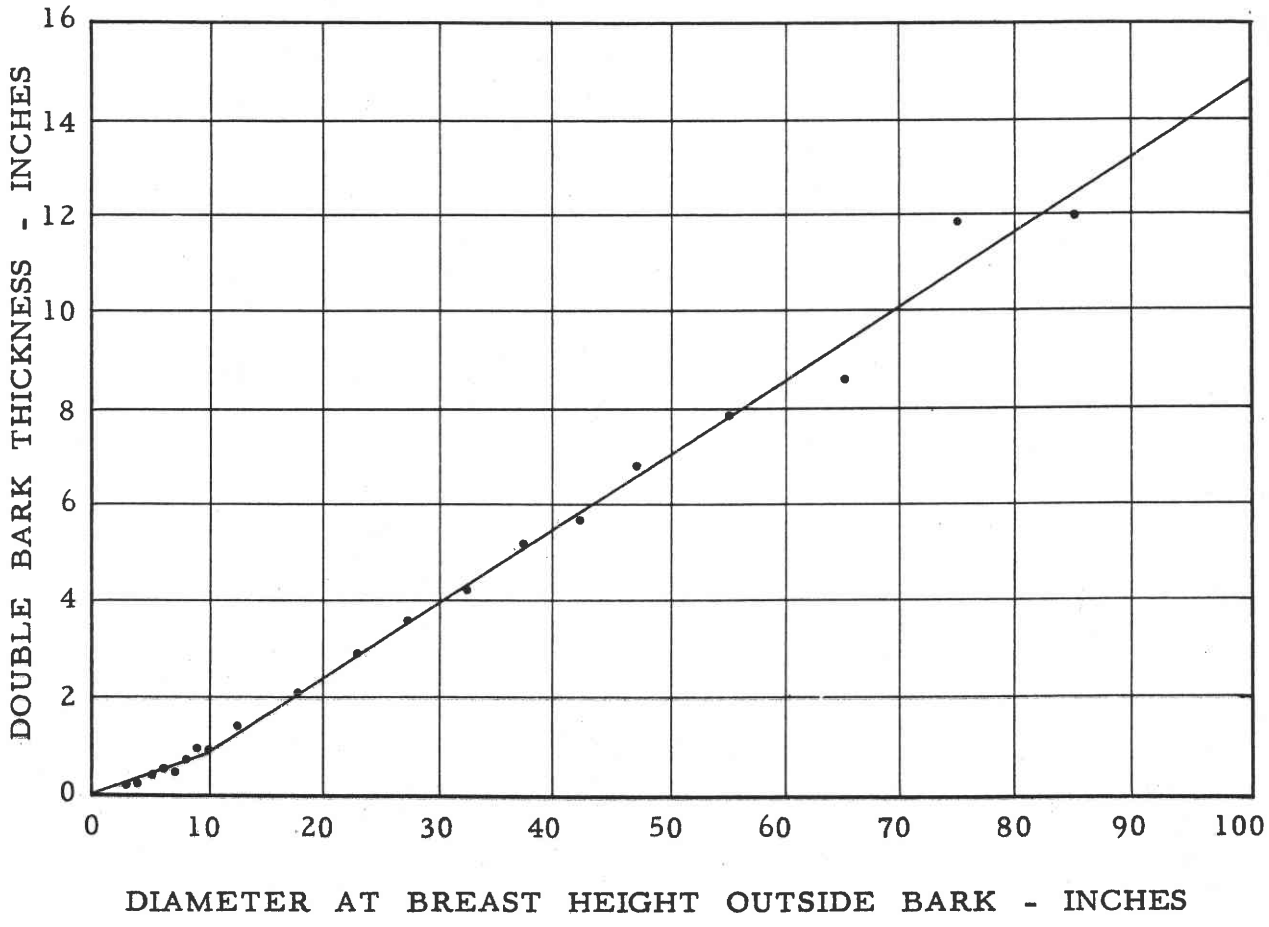

Figure 1.--Relationship of double bark thickness to diameter at breast height outside bark for Douglas-fir.