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USE OF A BARK THICKNESS--TREE DIAMETER RELATIONSHIP FOR ESTIMATING PAST DIAMETERS OF PONDEROSA PINE TREES

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Whenever past diameters of ponderosa pine trees are required for growth studies or for other purposes they can be estimated with these formulas:

- (1) trees 10 inches and over in diameter at breast height

$$D_p = D_n - W_g \quad (1.121)$$

Where D_p = past diameter outside bark 4.5 feet above ground

D_n = present diameter outside bark 4.5 feet above ground

W_g = diameter growth in wood for specified number of years as measured on an increment core.

- (2) trees less than 10 inches in diameter at breast height

$$D_p = D_n - W_g \quad (1.245)$$

The factors 1.121 and 1.245 represent allowances for bark growth. If bark growth is ignored, estimates of past diameters will be too high and estimates of total diameter growth will be too low. Apparently these biases would be appreciable.

Linear regression analyses were used to develop regression coefficients for the relationship between double bark thickness and tree diameter outside bark, and to establish the two straight lines shown in figure 1. The coefficients were then transformed to bark growth factors by a procedure which has been described in a similar report for Douglas-fir.^{1/}

^{1/} Johnson, F.A. Estimating past diameters of Douglas-fir trees. Research Note 112, Pacific Northwest Forest and Range Experiment Station, U.S. Forest Service. Portland, Oregon. April 1955.

As in the case of Douglas-fir one smooth curve would probably best define the relationship between bark thickness and diameter. However, the use of two straight lines appears reasonable (see figure 1), and it simplifies the problem of estimating past diameters considerably.

The lines in figure 1 happen to converge at about the 9.5-inch diameter point. Thus, if present diameter is not far above 9.5 inches, past diameter may be considerably below 9.5 inches depending on length of period from past to present and upon the rate at which the tree is increasing in diameter. In that event bark may be growing at the faster rate indicated by the first straight line for the greater part of the prediction period and formula 2 may apply even though present diameter is somewhat larger than 10 inches. Ten inches is suggested here as the point for changing formulas merely because the greatest use for the information is expected to be in growth studies involving short periods from past to present and small changes in diameter.

Data from 123 trees, all less than 9.5 inches in diameter, led to a regression coefficient of 0.197. Another analysis involving 1,951 trees greater than 8.5 inches in diameter gave a regression coefficient of 0.108. Trees in the 9-inch diameter class were used for both analyses.

The information on bark thickness and on diameter used for both analyses were taken on sample plots in eastern Oregon and eastern Washington. They are a portion of the data discussed by Walter H. Meyer on page 45 in "Growth in Selectively Cut Ponderosa Pine Forests of the Pacific Northwest."^{2/} Trees of all age and vigor classes are represented.

The formulas given above are intended for use when growth in wood and present diameter are the only items of information available for estimating past diameter. When information on age and on vigor is also available, another formula, developed previously from a different group of data, may be used.^{3/}

Scales can be developed for measuring either past diameters or diameter growth directly from increment cores. This phase of the general problem has been covered by Wilcox^{4/} and by Ibberson^{5/}. On such scales 0.446 inch will be equivalent to one inch of total diameter growth for ponderosa pine trees over 10 inches in diameter (formula 1). For trees less than 10 inches 0.402 inch will equal one inch of total diameter growth (formula 2).

^{2/} U.S. Dept. Agr. Tech. Bul. 407. 64 pages 1934.

^{3/} Breigleb, P.A. Calculating the growth of ponderosa pine forest. Pacific Northwest Forest and Range Experiment Station. U.S. Forest Service. Portland, Oregon. December 1945.

^{4/} Wilcox, E.R. Use of increment measuring scale for measuring growth in ponderosa pine. Journal Forestry 53 (4):pp 285-6. 1955.

^{5/} Ibberson, J.E. New diameter increment rule. Jour. Forestry 53(1): 1955.

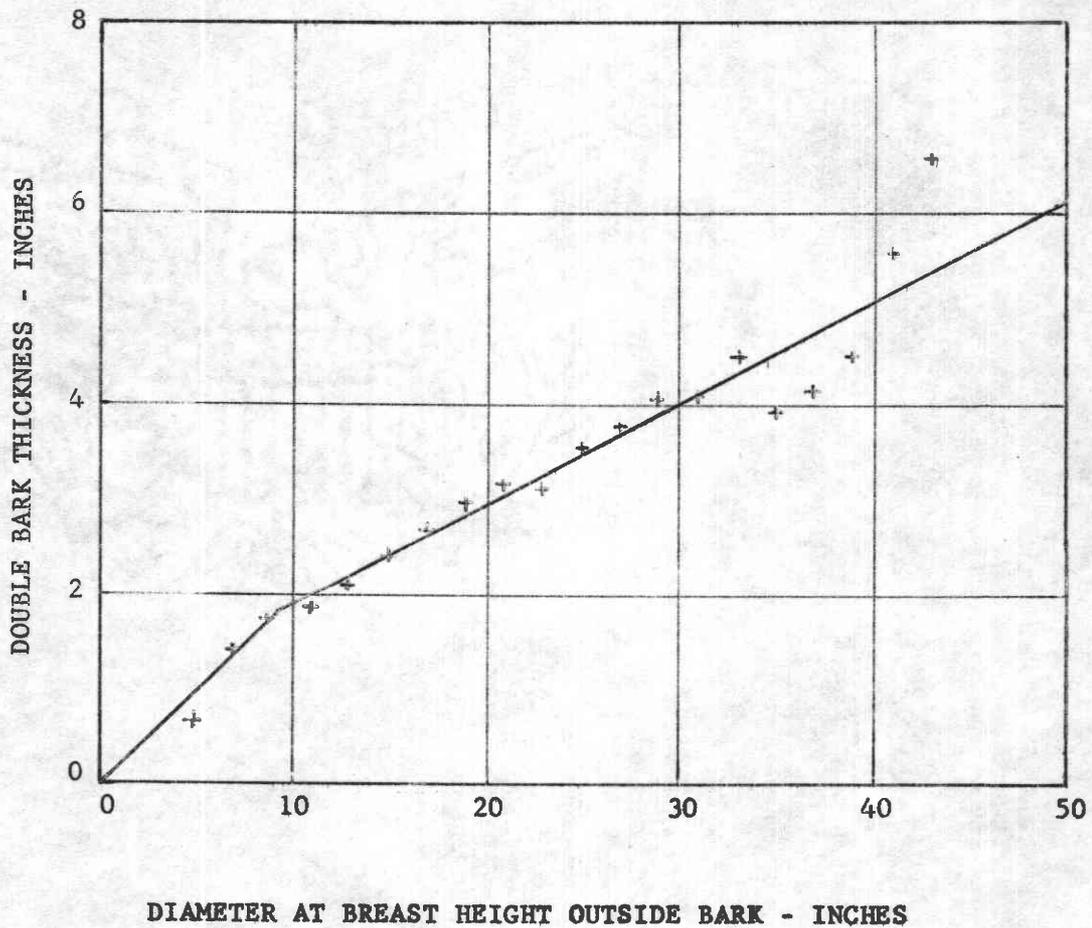


Figure 1.--Relationship of double bark thickness to diameter outside bark at breast height for ponderosa pine.