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RELATIONSHIP OF D.B.H. TO STUMP DIAMETER FOR FOUR MONTANA CONIFEROUS SPECIES.

By Robert W. Lange¹

INTRODUCTION

In research work on cut-over forest lands and in timber trespass cases it may be important to know the volume parameters of the original forest. Tree stumps are often the only remaining evidence of the past cutting operations. Volume tables based on diameter breast high (D.b.h.) measurements can be used for this purpose only if reliable stump diameter to D.b.h. relationships are known.

A number of authors have reported on this relationship in both hardwood and coniferous species. Hampf (1955, 1957) reported on a number of northeastern species. Horn and Keller (1957) investigated several species groups in the Lake States. In the southern Appalachians, Vimmerstedt (1957) developed a series of relationship curves for 9 species and species groups. Meyers (1963) found a close correlation between stump diameter and D.b.h. for ponderosa pine in the Southwest, and Bones (1960) shows the ratio of D.b.h. to stump diameter for 7 conifers in the Pacific Northwest.

It is well known that many mensurational relationships are influenced by environmental conditions and geographic locations. Consequently, the purpose of this study was to determine the D.b.h.—stump diameter relationship for four important commercial species in Montana generally and particularly in the Lubrecht Experimental Forest² where research in mensuration, silviculture and ecology is currently in progress.

METHOD

Five hundred saw-log size trees were randomly chosen on Lubrecht Experimental Forest for the sample. Species selected for measurement were:

Ponderosa pine (*Pinus ponderosa* Laws.)

Douglas-fir (*Pseudotsuga menziesii* var. *glauca* (Beissn.) Franco)

Western larch (*Larix occidentalis* Nutt.)

Lodgepole pine (*Pinus contorta* var. *latifolia* Engelm.)

D.b.h. and foot-high stump diameters outside bark were measured on the trees and inside bark stump diameters were determined using double bark thickness. All measurements³ were made on the uphill side of each tree. Wick (1969) concluded that no apparent bias is introduced by using only uphill side measurements. An aluminum tube (½ inch diameter) with linear marks at 1 foot (stump) and 4½ feet (breast height) was used to accurately locate the points of measurements. In order to insure uniformity, all measurements were made by the same two men using the same instruments.

The best fitting curves for the plotted field data appeared to be straight lines and linear regression equations were developed for each of the four species.

The influences of site quality and tree age were not specifically considered. The diameter relationships presented in this note are averages representing a cross section of site and age classes within Lubrecht Forest.

RESULTS

The equations for the regression lines of the four species are shown in Table 1.

Tables 2, 3, 4, and 5 present the above linear relationships in a form whereby inside bark stump diameters can be easily converted to 1-inch or 2-inch D.b.h. classes. You simply place the measured inside bark stump diameter in the proper diameter range in either column A for 1-inch D.b.h. classes or column C for 2-inch D.b.h. classes and read the corresponding D.b.h. class in either column B or D.

These tables for ponderosa and lodgepole pine, Douglas-fir, and western larch should provide reliable estimates of the D.b.h. classes for saw-log size trees from stump diameter measurements on Lubrecht Experimental Forest. More precise D.b.h. measurements can be obtained by using the equations in Table 1.

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²Located 35 miles east of Missoula, Montana, this 27,000-acre forest is managed by the Montana Forest and Conservation Experiment Station.

³These measurements were made with a diameter tape (1/10 inch calibrations) and a Swedish Bark Gauge (1/20 inch calibrations).

Table 1
Regression line equations

Species	Equation	r**	Trees Sampled	Ave. D.b.h.	Range of D.b.h.'s
Ponderosa pine	D.b.h. = 1.024 + .9173 S.D.*	.97	200	18.2"	11.0"-35.1"
Douglas-fir	D.b.h. = .1720 + .9605 S.D.*	.97	100	17.5"	11.1"-30.7"
Western larch	D.b.h. = .4617 + .9523 S.D.*	.97	100	15.8"	9.5"-34.5"
Lodgepole pine	D.b.h. = 1.2249 + .8303 S.D.*	.94	100	11.4"	9.0"-17.9"

* Stump diameter, inside bark.
** Correlation coefficient.

Table 2
Diameter at breast height and stump diameter relationship for Ponderosa pine

For 1-inch D.b.h. classes		For 2-inch D.b.h. classes	
A. Inside bark stump diameter range	B. D.b.h. Class o.b.	C. Inside bark stump diameter range	D. D.b.h. Class o.b.
Inches	Inches	Inches	Inches
9.3-10.3.....	10	8.7- 9.6.....	10
10.4-11.4.....	11		
11.5-12.5.....	12	9.7-12.9.....	12
12.6-13.6.....	13		
13.7-14.7.....	14	13.0-15.1.....	14
14.8-15.8.....	15		
15.9-16.9.....	16	15.2-17.3.....	16
17.0-18.0.....	17		
18.1-19.1.....	18	17.4-19.5.....	18
19.2-20.1.....	19		
20.2-21.2.....	20	19.6-21.7.....	20
21.3-22.3.....	21		
22.4-23.4.....	22	21.8-23.9.....	22
23.5-24.5.....	23		
24.6-25.6.....	24	24.0-26.0.....	24
25.7-26.7.....	25		
26.8-27.8.....	26	26.1-28.2.....	26
27.9-28.9.....	27		
29.0-30.0.....	28	28.3-30.4.....	28
30.1-31.0.....	29		
31.1-32.1.....	30	30.5-32.6.....	30
32.2-33.2.....	31		
33.3-34.3.....	32	32.7-34.8.....	32
34.4-35.4.....	33		
35.5-36.5.....	34	34.9-36.9.....	34
36.6-37.6.....	35		
37.7-38.7.....	36	37.0-39.1.....	36

Table 3

Diameter at breast height and stump diameter relationship for Douglas-fir

For 1-inch D.b.h. classes		For 2-inch D.b.h. classes	
A. Inside bark stump diameter range	B. D.b.h. Class o.b.	C. Inside bark stump diameter range	D. D.b.h. Class o.b.
Inches	Inches	Inches	Inches
9.8-10.8.....	10	9.2-11.2.....	10
10.9-11.8.....	11		
11.9-12.8.....	12	11.3-13.3.....	12
12.9-13.9.....	13		
14.0-14.9.....	14	13.4-15.3.....	14
15.0-16.0.....	15		
16.1-17.0.....	16	15.4-17.4.....	16
17.1-18.0.....	17		
18.1-19.1.....	18	17.5-19.5.....	18
19.2-20.1.....	19		
20.2-21.2.....	20	19.6-21.6.....	20
21.3-22.2.....	21		
22.3-23.2.....	22	21.7-23.7.....	22
23.3-24.3.....	23		
24.4-25.3.....	24	23.8-25.7.....	24
25.4-26.4.....	25		
26.5-27.4.....	26	25.8-27.8.....	26
27.5-28.5.....	27		
28.6-29.5.....	28	27.9-29.9.....	28
29.6-30.5.....	29		
30.6-31.6.....	30	30.0-32.0.....	30
31.7-32.6.....	31		
32.7-33.7.....	32	32.1-34.1.....	32
33.8-34.7.....	33		
34.8-35.7.....	34	34.2-36.2.....	34
35.8-36.8.....	35		
36.9-37.8.....	36	36.3-38.2.....	36

Table 4

Diameter at breast height and stump diameter relationship for Western larch

For 1-inch D.b.h. classes		For 2-inch D.b.h. classes	
A. Inside bark stump diameter range	B. D.b.h. Class o.b.	C. Inside bark stump diameter range	D. D.b.h. Class o.b.
Inches	Inches	Inches	Inches
9.6-10.5.....	10	9.0-11.0.....	10
10.6-11.6.....	11		
11.7-12.6.....	12	11.1-13.1.....	12
12.7-13.7.....	13		
13.8-14.7.....	14	13.2-15.2.....	14
14.8-15.8.....	15		
15.9-16.8.....	16	15.3-17.3.....	16
16.9-17.9.....	17		
18.0-18.9.....	18	17.4-19.4.....	18
19.0-20.0.....	19		
20.1-21.0.....	20	19.5-21.5.....	20
21.1-22.1.....	21		
22.2-23.1.....	22	21.6-23.6.....	22
23.2-24.2.....	23		
24.3-25.2.....	24	23.7-25.7.....	24
25.3-26.3.....	25		
26.4-27.3.....	26	25.8-27.8.....	26
27.4-28.4.....	27		
28.5-29.4.....	28	27.9-29.9.....	28
29.5-30.5.....	29		
30.6-31.5.....	30	30.0-32.0.....	30
31.6-32.6.....	31		
32.7-33.6.....	32	32.1-34.1.....	32
33.7-34.7.....	33		
34.8-35.7.....	34	34.2-36.2.....	34
35.8-36.8.....	35		
36.9-37.8.....	36	36.3-38.3.....	36

Table 5

Diameter at breast height and stump diameter relationship for Lodgepole pine

For 1-inch D.b.h. classes		For 2-inch D.b.h. classes	
A. Inside bark stump diameter range	B. D.b.h. Class o.b.	C. Inside bark stump diameter range	D. D.b.h. Class o.b.
Inches	Inches	Inches	Inches
10.1-11.2.....	10	9.4-11.7.....	10
11.3-12.4.....	11		
12.5-13.6.....	12	11.8-14.1.....	12
13.7-14.8.....	13		
14.9-16.0.....	14	14.2-16.5.....	14
16.1-17.2.....	15		
17.3-18.4.....	16	16.6-18.9.....	16
18.5-19.6.....	17		
19.7-20.8.....	18	20.0-21.3.....	18
20.9-22.0.....	19		
22.1-23.2.....	20	21.4-23.7.....	20
23.3-24.4.....	21		
24.5-25.6.....	22	23.8-26.1.....	22
25.7-26.8.....	23		
26.9-28.0.....	24	26.2-28.5.....	24

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