Forest Research Branch

DIAMETER CONVERSIONS BETWEEN STUMP AND BREAST HEIGHT FOR NORTHERN SPECIES, QUEBEC

by

LUC VALIQUETTE

Sommaire en français

DEPARTMENT OF FORESTRY PUBLICATION No. 1052

1964

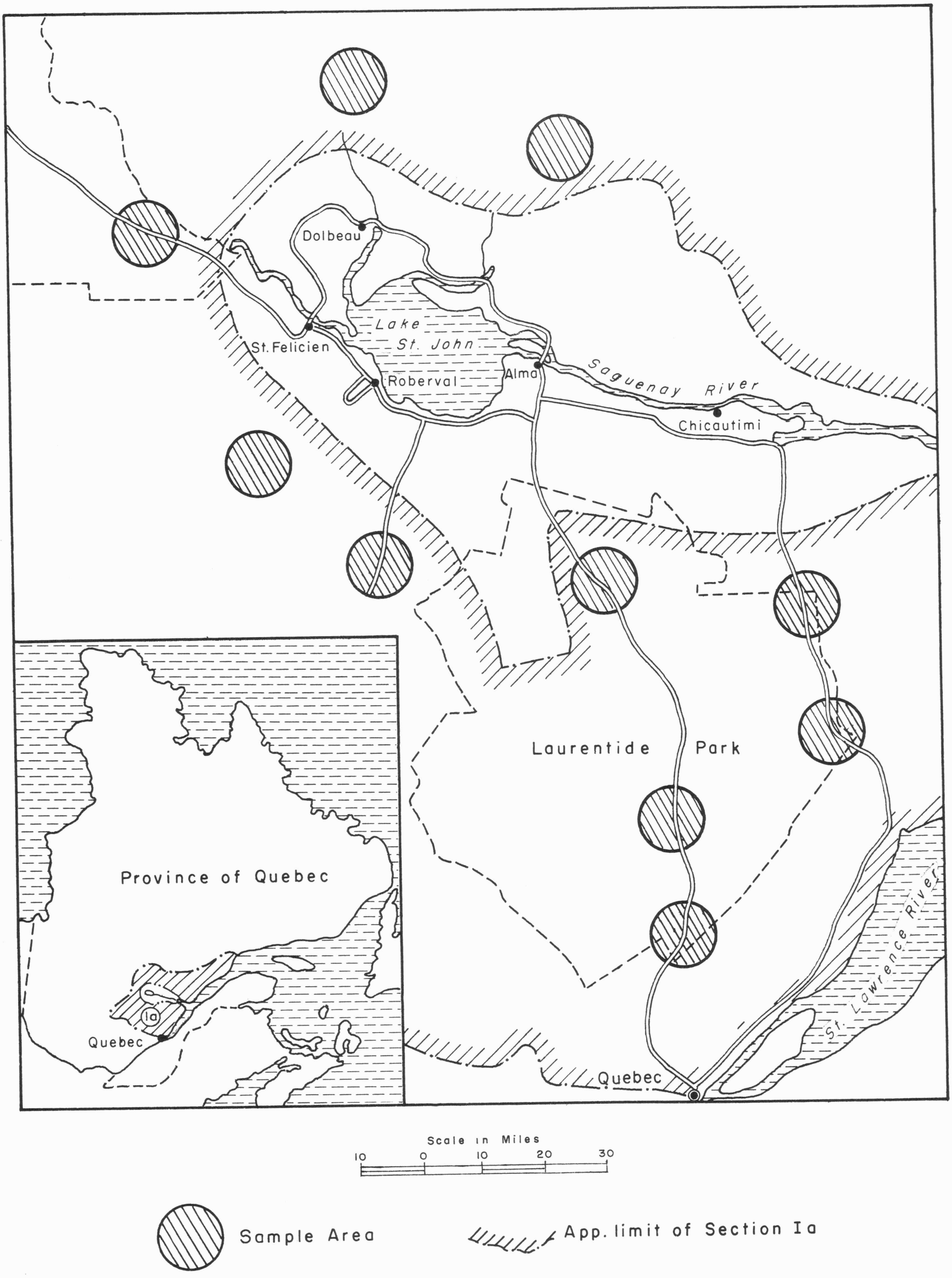
ABSTRACT

The relationships between breast-height diameter and stump diameter for different stump heights have been determined for all the common tree species in the boreal region of Quebec. Sample linear regression equations were developed and found to relate the variables involved most adequately.

Issued under the authority of
The Honourable Maurice Sauvé, P.C., M.P.,
Minister of Forestry
Ottawa, 1964

Cat. No. Fo 47—

TABLE OF CONTENTS



The areas sampled in the Boreal Forest Region, Section Ia

DIAMETER CONVERSIONS BETWEEN STUMP AND BREAST HEIGHT FOR NORTHERN SPECIES, QUEBEC[1]

by

Luc Valiquette[2]

INTRODUCTION

Sometimes it is desirable to estimate from stumps the basal area and volume removed from an entirely or partially cut-over area. Such estimates would be needed when: 1) Cutters have crossed property lines or have removed trees not marked for cutting; 2) It is necessary to reconstruct stand history to evaluate the effect of different cutting practices on establishment, quality, and density of reproduction; and 3) Instead of the usual timber production survey, a timber removal survey has to be made by measurement of stumps on a sample area.

Conversely at other times it may be desired to estimate stump diameter from d.b.h. in order to translate d.b.h. classes into stump classes for the benefit of those (cutters, scalers, and cut inspectors, for example) who prefer to work in terms of the latter.

These estimates are possible if the regressions of: I) d.b.h. outside bark on stump diameter inside bark; and II) stump diameter outside bark on d.b.h. outside bark, at different stump heights, are known for the tree species encountered. Stump diameter could be converted to the corresponding d.b.h. (Regression I) and, from this, the basal area and volume (in conjunction with d.b.h./volume tables) can be estimated for a cut-over stand. The translation of d.b.h. into corresponding stump diameter could be obtained from Regression II. Such regressions have been worked out for a number of boreal tree species in Quebec and are hereafter reported on.

Results of a similar study are given in the "Form-Class Volume Tables" (Anon. 1948) for eight eastern Canadian tree species. Most of the relationships shown, however, are for a stump height of 1.5 feet. Despite the cutting regulation (Anon. 1960) prohibiting stumps higher than 1.0 foot on Crown lands in Quebec, wide variations depending on the operator, the cutting season, etc., are encountered; hence the necessity to establish relationships for various stump heights.

Similar studies have been made in the United States and in other countries for a number of tree species but most of them are not found in the boreal region of Quebec. Perhaps the most extensive studies were those of Hampf (1954; 1955a, b, c, d and e; 1957a and b) in the northeastern U.S.A. Bones (1960 and 1961), Vimmerstedt (1957), Horn and Keller (1957), Miller (1957), Quigley (1954), Carl and Young (1954), Schaeffer (1953), Church (1953), McCormack (1953), and McLintock (1951) are other workers who have conducted such studies in the past decade.

---

[1] Department of Forestry, Canada, Forest Research Branch Contribution No. 592.

[2] Research Officer, Forest Research Branch, Department of Forestry, Box 35, Sillery, P.Q.

MATERIALS AND METHODS

Sampling was confined to accessible areas and operable stands in the northeastern forest section (B.1a), boreal region of Quebec (Frontispiece). The following common species of economic or numerical importance were studied: black spruce, white spruce, balsam fir, jack pine, trembling aspen and white birch[1].

In each stand ten to fifteen trees with a d.b.h. ranging from four to fifteen inches were randomly chosen. This range includes most trees cut in the boreal region of Quebec.

On each tree, the following measurements were taken: (1) diameter outside bark in the 4.50, 2.00, 1.50, 1.25, 1.00, 0.75, 0.50 and 0.25-foot classes (at random within $\pm$ .125 foot) above the average ground level, and (2) double bark thickness in the same stump-height classes.

Diameters were measured with a diameter tape to the nearest tenth of an inch. However, because of frequent stem irregularities at the root swell level, the following convention was established: any concave arc of the "girth" between two convex ones was measured as if there was a straight line tangent to the two successive convex arcs. Such a convention always gives a "stump diameter" slightly higher than the "true stump diameter" for the lower stump-height classes.

Bark thickness was taken with a Swedish bark gauge on two sides of the tree (approximately 90 degrees apart) to the nearest twentieth of an inch. This instrument was used to facilitate the measurements but tests were systematically scheduled during the collection of data in order to check their accuracy. Measurements obtained with a sharp linoleum knife and scale were used as true-reference values. Inside-bark stump diameters could be used for Regression I thus avoiding inaccuracies due to logging damage to bark, shrinkage or loosening of bark and bark peeling often encountered in cut-over areas.

RESULTS

Using the least-squares method two linear regression equations were determined from the data of the different stump-height classes for each species:

Regression I—

$$Y_0 = a + b.X_1$$

where Y_0 : d.b.h. outside bark,
a : sample regression constant,
b : sample regression coefficient, and
X_1 : stump diameter inside bark; and

Regression II—

$$X_0 = c + d.Y_0$$

where X_0 : stump diameter outside bark,
c : sample regression constant,
d : sample regression coefficient, and
Y_0 : d.b.h. outside bark.

As there are seven stump-height classes for each of the species, forty-two

[1] Botanical names of tree species are those used in "Native Trees of Canada", Dept. of Forestry Bull. 61, 6th ed., 1961.

two-variable linear regression equations were determined for each regression (I and II). The linear regression equations found are graphically presented in Figure 1 (Regression I) and Figure 2 (Regression II). Statistics pertaining to these regression lines are given in Tables 1 (Regression I) and 2 (Regression II). Since in practice most tallies are subdivided into 1-inch diameter classes, the independent variables were also subdivided on this basis and the regression equations re-determined. The resulting standard deviation from regression and the standard error of the estimates pertaining to these regressions are included in the same tables.

The main statistics presented are graphically related to stump height in Figures 3, 4, 5 and 6 for Regression I, and in Figures 7, 8, 9 and 10 for Regression II. In Figures 4 and 8 the values (1 + 10.b and c + 10.d) of the dependent variable when that of the independent variable equals 10 inches were used because the regression lines found did not intercept on the same side of the ordinate axis. At these new reference lines ($X_1 = 10$ and $Y_0 = 10$) all the sample regression lines intercept on one side only and smooth curves result.

DISCUSSION AND CONCLUSIONS

A two-variable regression line was found to be the most practical means of relating the variables involved for the different stump-height classes of each species. A multiple regression line, using the stump height as an additional independent variable in both Regressions (I and II), was possible but was avoided, because of the complexities introduced in the computation of the statistics and in the application of the inferences related to a multiple regression equation with unequal variances.

The sample regression equations, computed when the values of the independent variables were subdivided into 1.0-inch classes, are not presented because they were not significantly different from the first ones determined. In fact, they were less precise than the others but were computed to determine the proper variances related to a 1-inch class subdivision of the independent variable within each regression.

The graphical representation of the main statistics (Figures 3, 4, 5, 6, 7, 8, 9 and 11) provides a basis for estimating the statistics related to another regression line at a stump-height class not considered. For instance, if one is interested to estimate the statistics related to the regression line at the 0.90-foot stump-height class for black spruce in order to determine from stump diameter inside bark the breast-height diameter outside bark, one will have:

sample regression coefficient (b)	: 0.815 (from Figure 3),
(a + 10.b)	: 8.925 (from Figure 4),
sample regression constant (a)	: 0.775 (from (a + 10.b) − 10.b),
sample standard deviation from regression (SSD_0)	: 0.346 (from Figure 5),
sample standard deviation from regression (SSD_1)	: 0.434 (from Figure 6).

Thus, any estimate of the statistics related to a regression line at a particular stump height (within the range of the stump height studied) is possible.

An analysis of variance was made within each stump-height class and the sample regression equations were found to be significantly different at the 0.5 per cent level. The use of a single regression including all species for each stump-height class, which was not necessarily invalidated by the latter inference was avoided because in practice the species are tallied separately and also because if a relatively large number of trees is considered the statistical significance of differences is important. Moreover, one observes in Figures 4 and 8 that a 10-inch stump-diameter i.b. tree (or a 10-inch d.b.h. o.b. tree) in any of the stump-height classes considered has a d.b.h. o.b. (or stump diameter o.b.) that varies with species (especially in the lower stump-height classes).

The inferences concerning the populations sampled could be used inside as well as outside the sample areas, but to be sure of the estimates an accuracy test (Freese. 1960) could be made. Thus, if significant differences occur a new sample regression line should be estimated if the predictions are important enough.

SUMMARY

Occasionally foresters wish to estimate diameters at breast height (d.b.h.) and/or tree volumes after the trees have been harvested and only the stumps remain, or conversely they need to translate d.b.h. classes into stump diameter classes. These estimates are possible if the relationships of d.b.h. and stump diameter for different stump heights are known. These have been determined for balsam fir, black spruce, white spruce, jack pine, trembling aspen and white birch, and are described in the present study.

SOMMAIRE

Il arrive que des forestiers veuillent faire l'estimation des diamètres à hauteur de poitrine (d.h.p.) et (ou) du volume ligneux des arbres après récolte alors qu'il ne reste que les souches sur place; il arrive aussi qu'inversement ils aient besoin de convertir les classes de d.h.p. en classes de diamètre à la souche. Ces estimés ne sont possibles que si les relations entre le d.h.p. et le diamètre à la souche pour différentes hauteurs de souche sont connues. Ces dernières ont été déterminées pour le sapin baumier, l'épinette noire, l'épinette blanche, le pin gris, le peuplier faux-tremble et le bouleau blanc, et sont décrites dans la presente étude.

FIGURES 1a TO 1f

Regression lines of breast-height diameter (o.b.) on stump diameter (i.b.) by species and stump-height class.

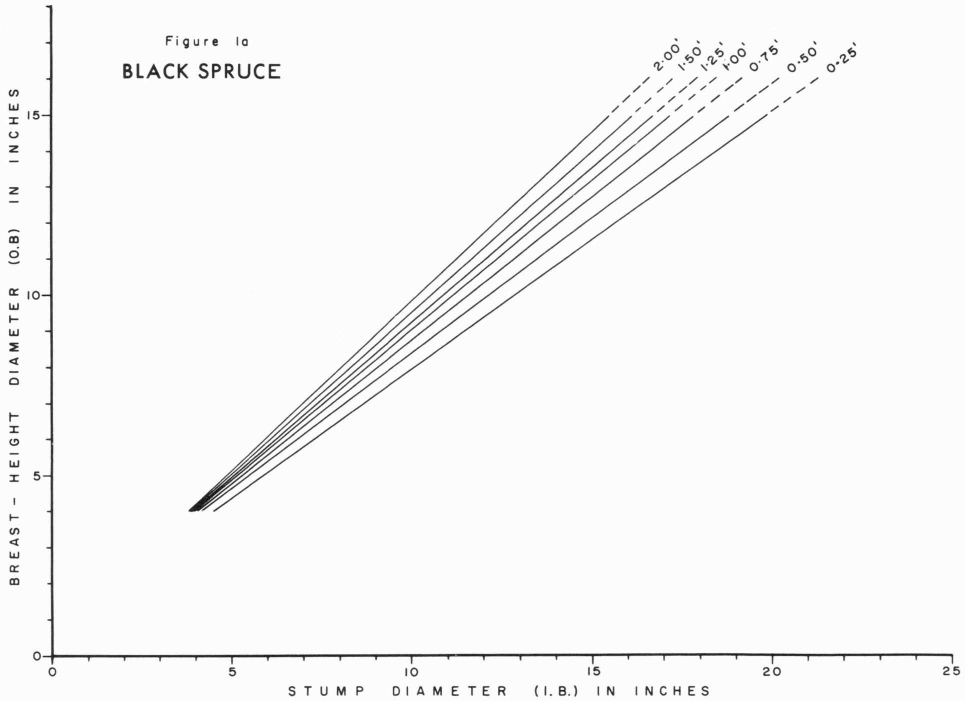


Figure 1a
BLACK SPRUCE
2·00'
1·50'
1·25'
1·00'
0·75'
0·50'
0·25'
BREAST - HEIGHT DIAMETER (O.B) IN INCHES
STUMP DIAMETER (I.B.) IN INCHES
0
5
10
15
20
25

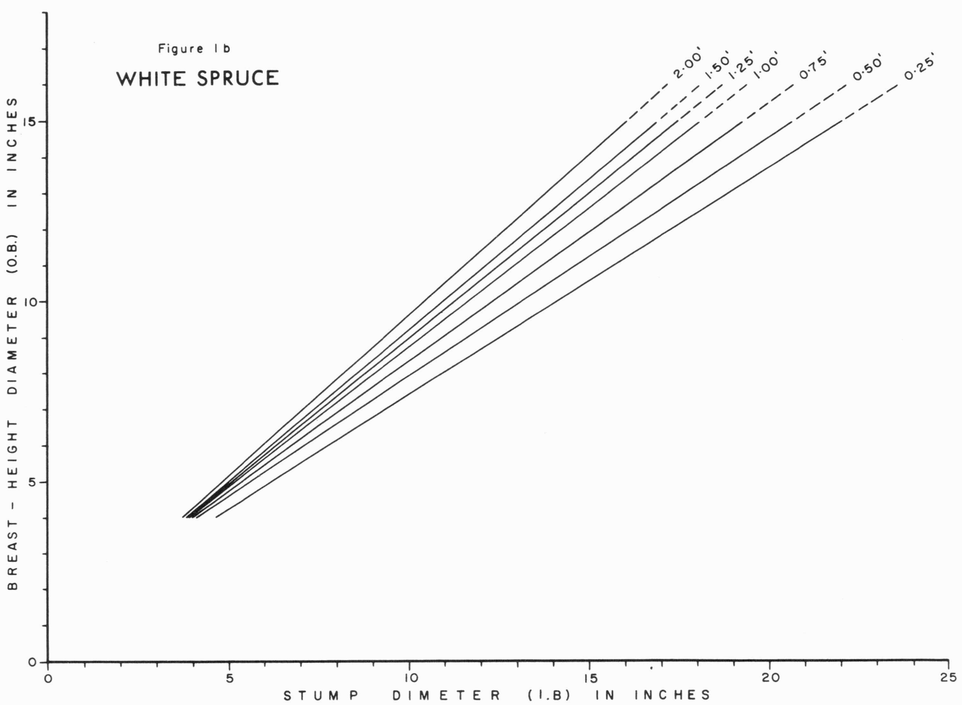


Figure 1b
WHITE SPRUCE
2·00'
1·50'
1·25'
1·00'
0·75'
0·50'
0·25'
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
STUMP DIMETER (I.B) IN INCHES
0
5
10
15
20
25

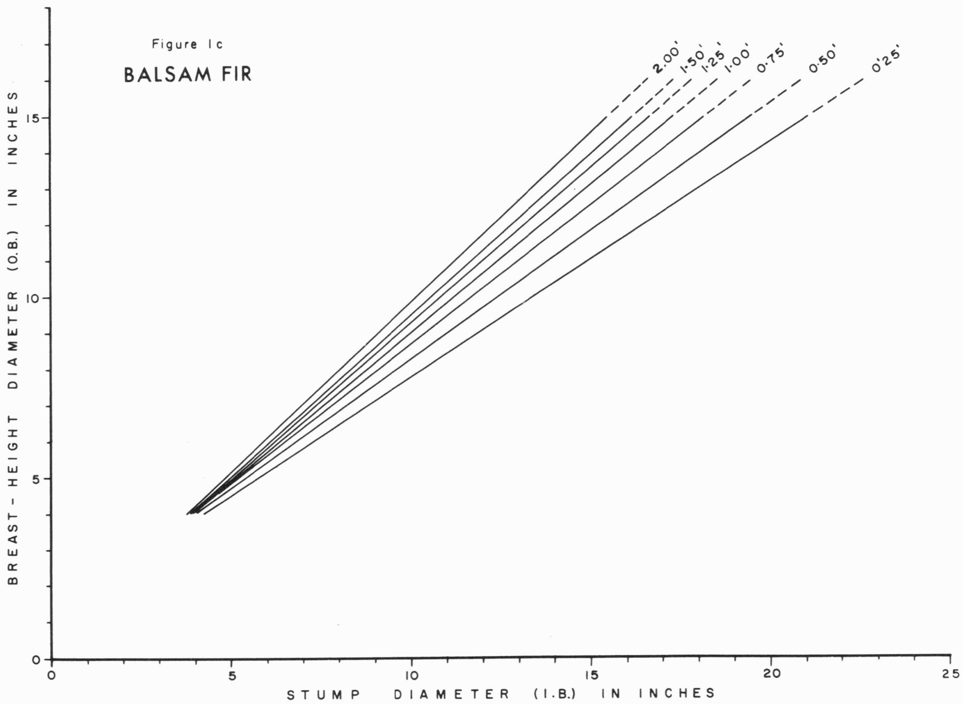


Figure 1c
BALSAM FIR
2.00'
1.50'
1.25'
1.00'
0.75'
0.50'
0.25'
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
STUMP DIAMETER (I.B.) IN INCHES
0
5
10
15
20
25

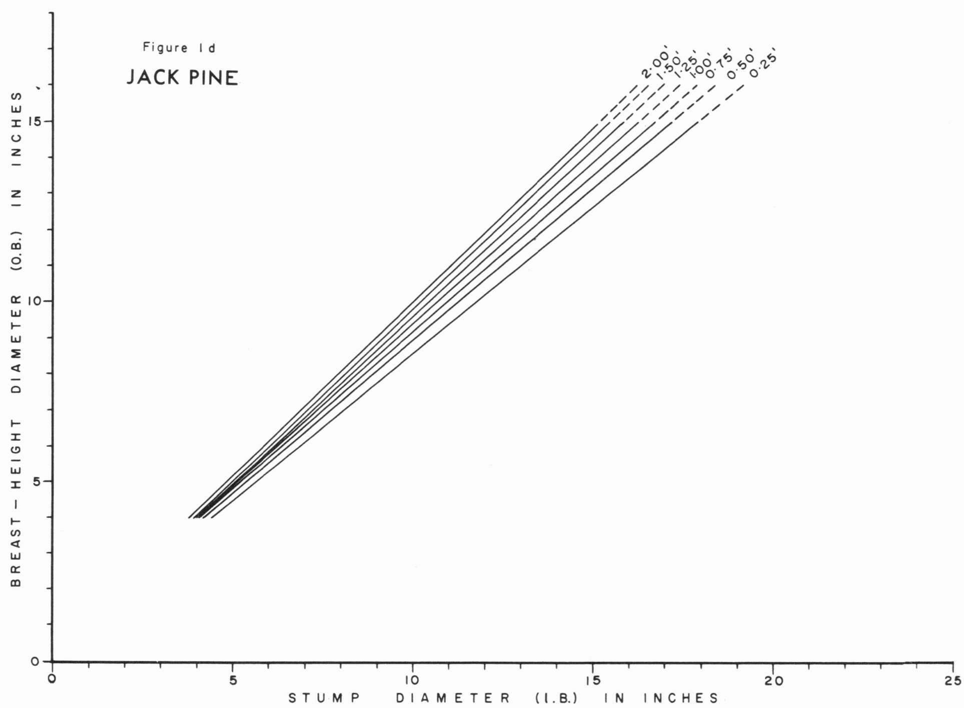


Figure 1d
JACK PINE
2.00'
1.50'
1.25'
1.00'
0.75'
0.50'
0.25'
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
STUMP DIAMETER (I.B.) IN INCHES
0
5
10
15
20
25

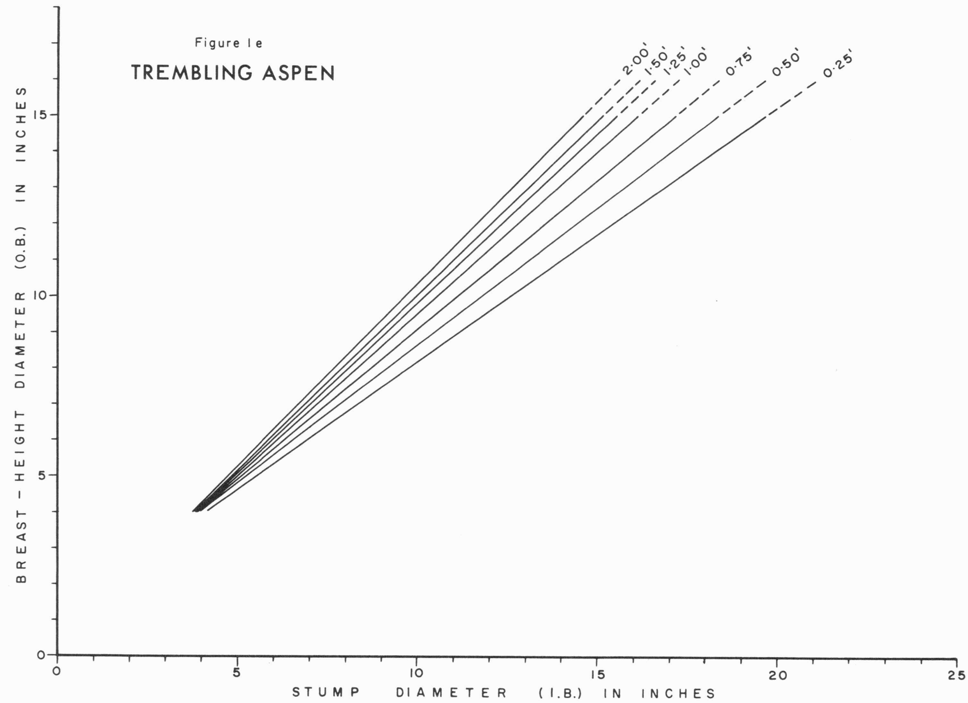


Figure 1e
TREMBLING ASPEN
2·00'
1·50'
1·25'
1·00'
0·75'
0·50'
0·25'
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
STUMP DIAMETER (I.B.) IN INCHES
0
5
10
15
20
25

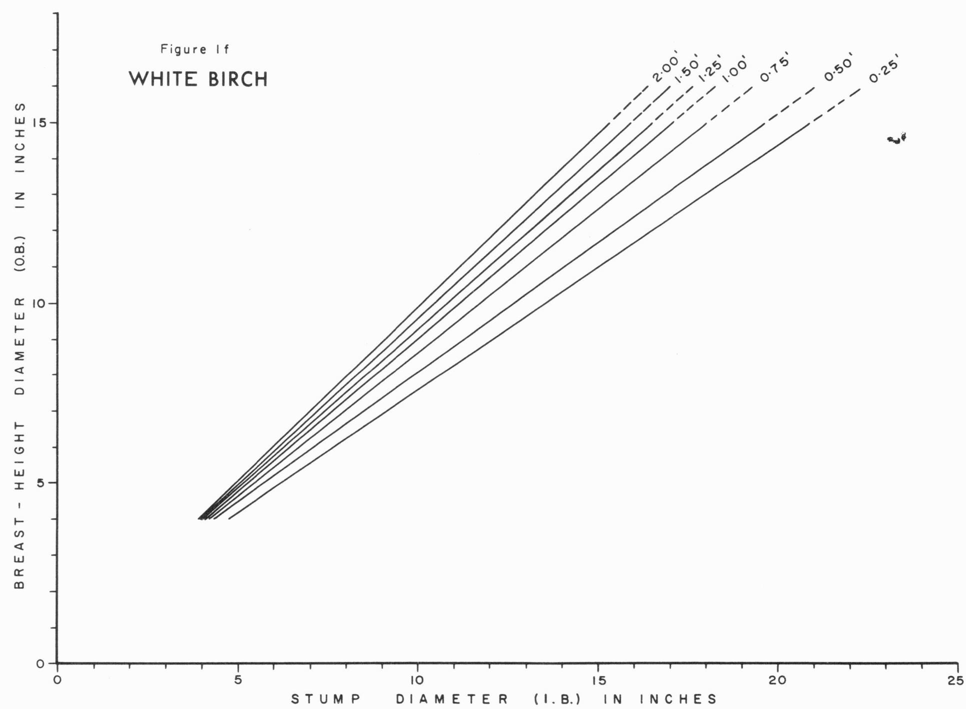


Figure 1f
WHITE BIRCH
2·00'
1·50'
1·25'
1·00'
0·75'
0·50'
0·25'
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
STUMP DIAMETER (I.B.) IN INCHES
0
5
10
15
20
25

FIGURES 2a TO 2f

Regression lines of stump diameter (o.b.)
on breast-height diameter (o.b.) by
species and stump-height class.

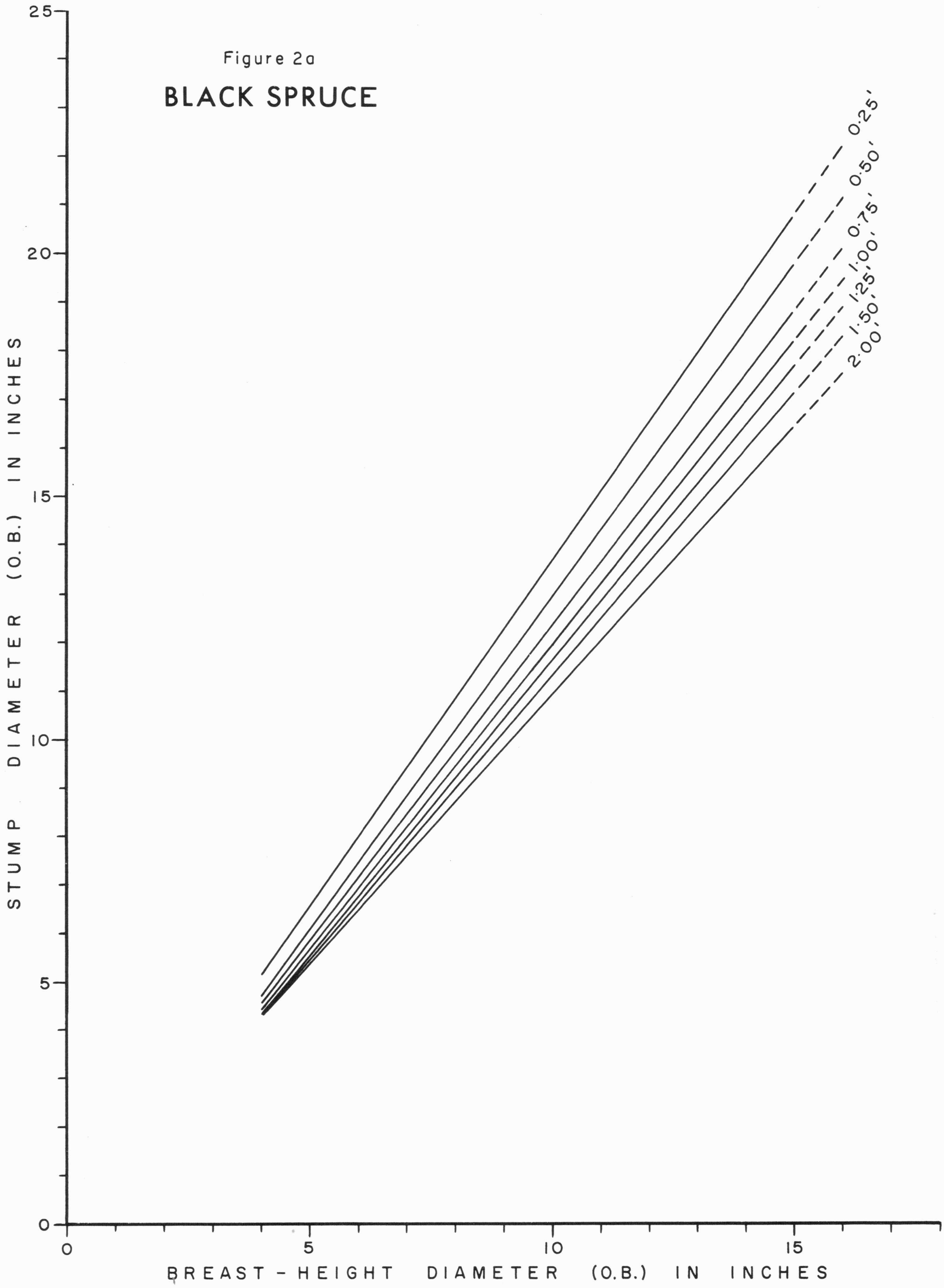


Figure 2a
BLACK SPRUCE
0.25'
0.50'
0.75'
1.00'
1.25'
1.50'
2.00'
STUMP DIAMETER (O.B.) IN INCHES
BREAST-HEIGHT DIAMETER (O.B.) IN INCHES
0
5
10
15
20
25

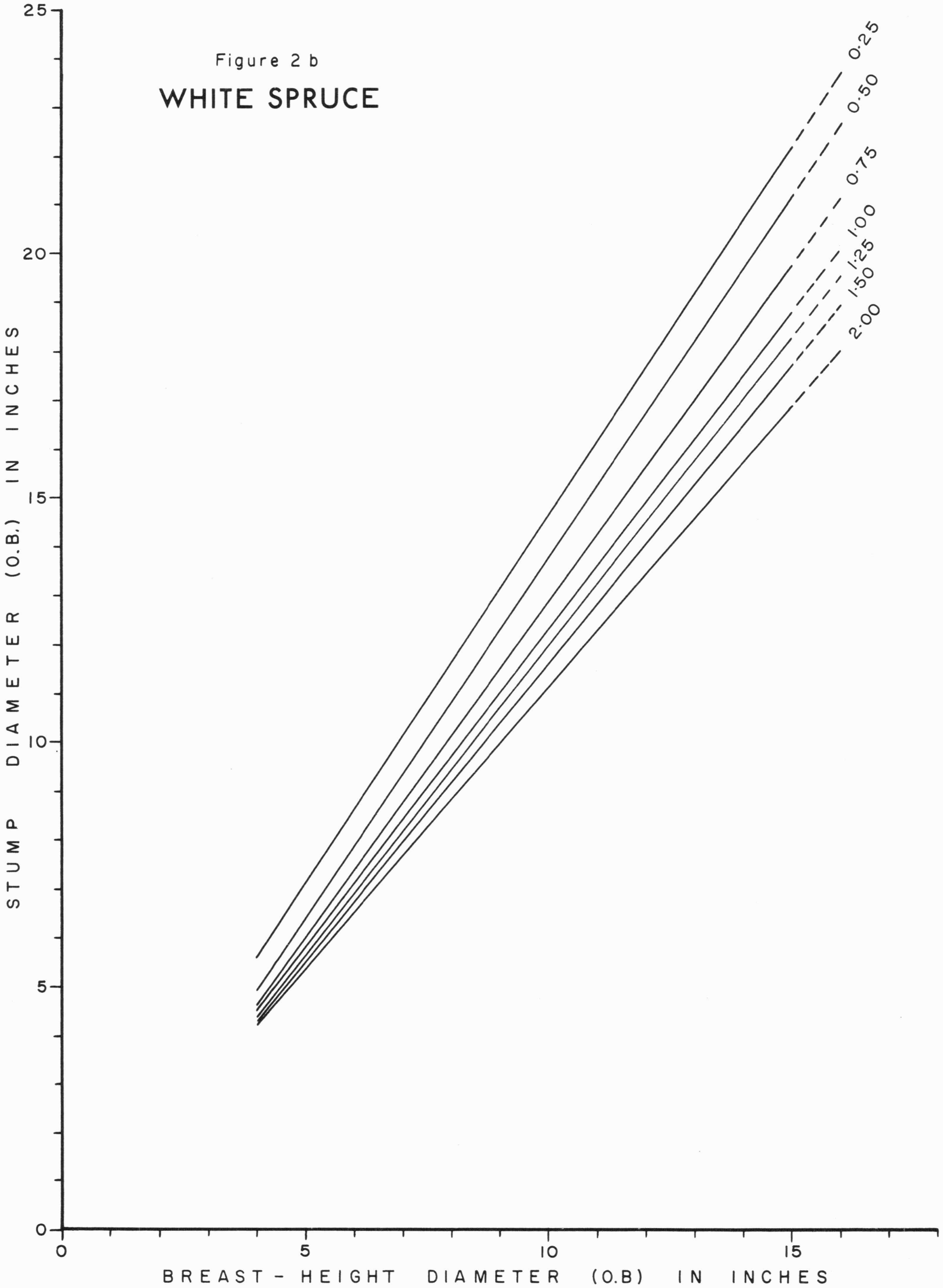


Figure 2 b
WHITE SPRUCE
0·25
0·50
0·75
1·00
1·25
1·50
2·00
25
20
15
10
5
0
STUMP DIAMETER (O.B.) IN INCHES
0
5
10
15
BREAST - HEIGHT DIAMETER (O.B) IN INCHES

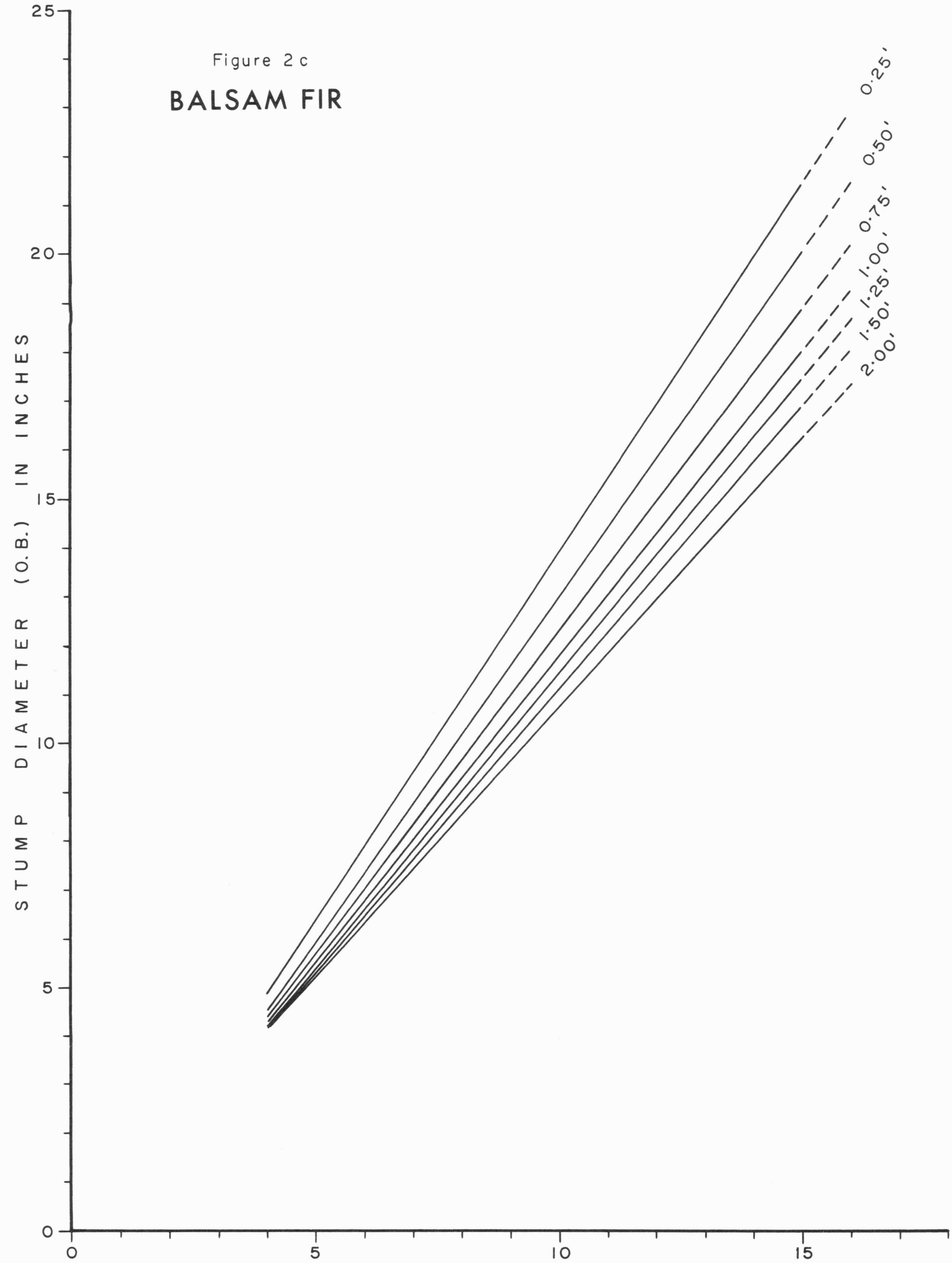


Figure 2c
BALSAM FIR
0·25'
0·50'
0·75'
1·00'
1·25'
1·50'
2·00'
STUMP DIAMETER (O.B.) IN INCHES
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
0
5
10
15
20
25

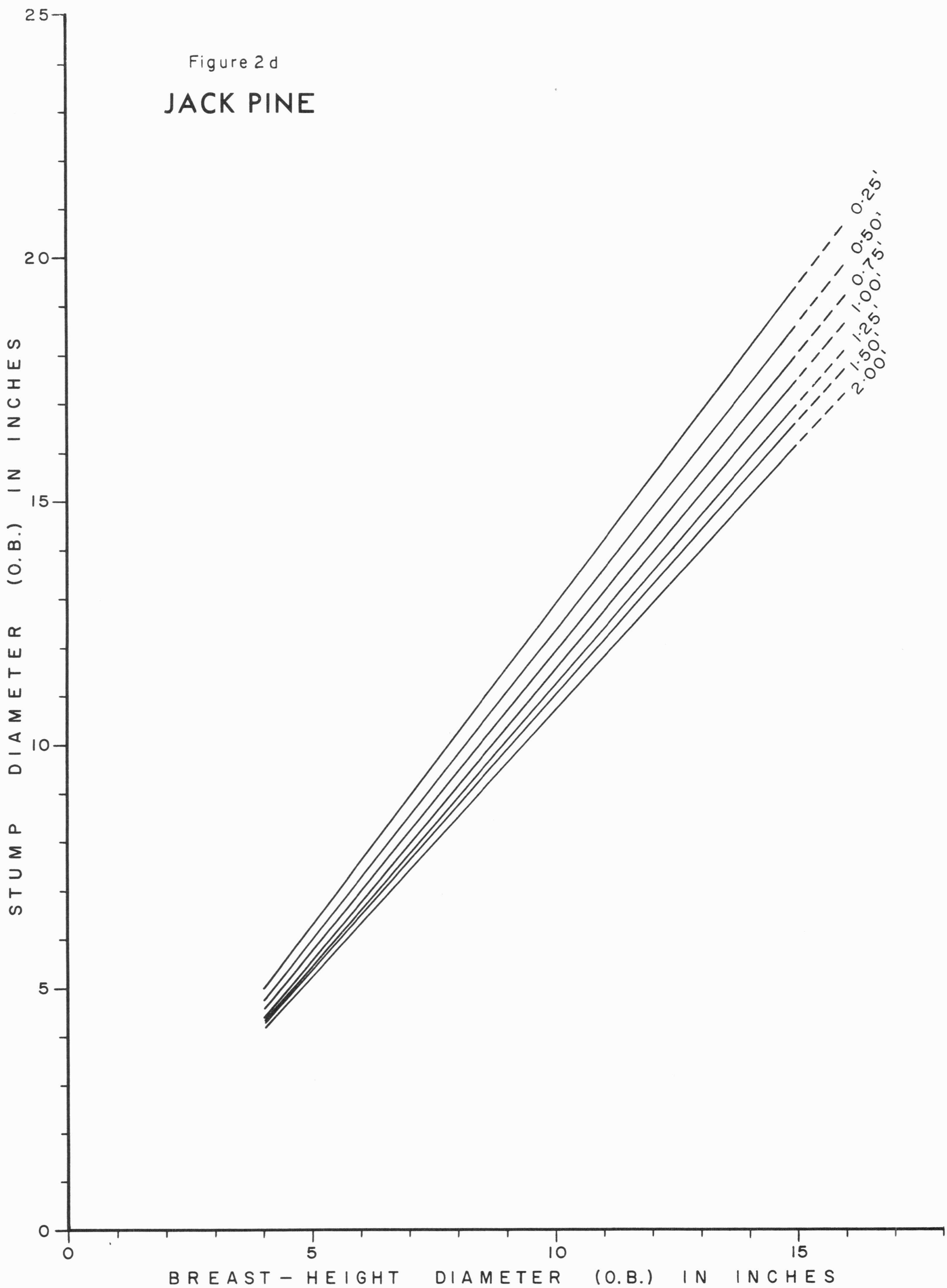


Figure 2d
JACK PINE
0.25'
0.50'
0.75'
1.00'
1.25'
1.50'
2.00'
STUMP DIAMETER (O.B.) IN INCHES
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES
0
5
10
15
20
25

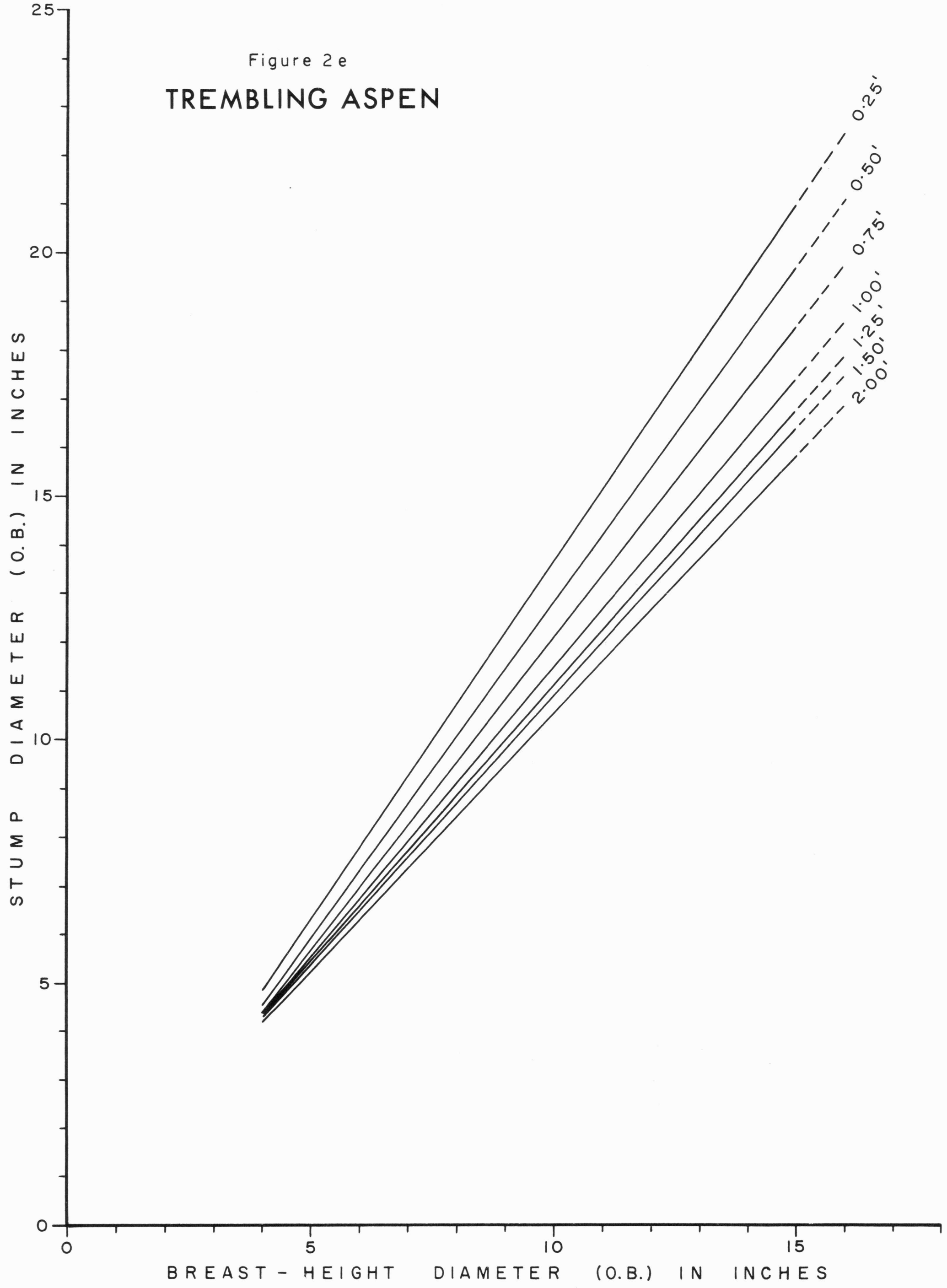


Figure 2e
TREMBLING ASPEN
0·25'
0·50'
0·75'
1·00'
1·25'
1·50'
2·00'
25
20
15
10
5
0
0
5
10
15
STUMP DIAMETER (O.B.) IN INCHES
BREAST - HEIGHT DIAMETER (O.B.) IN INCHES

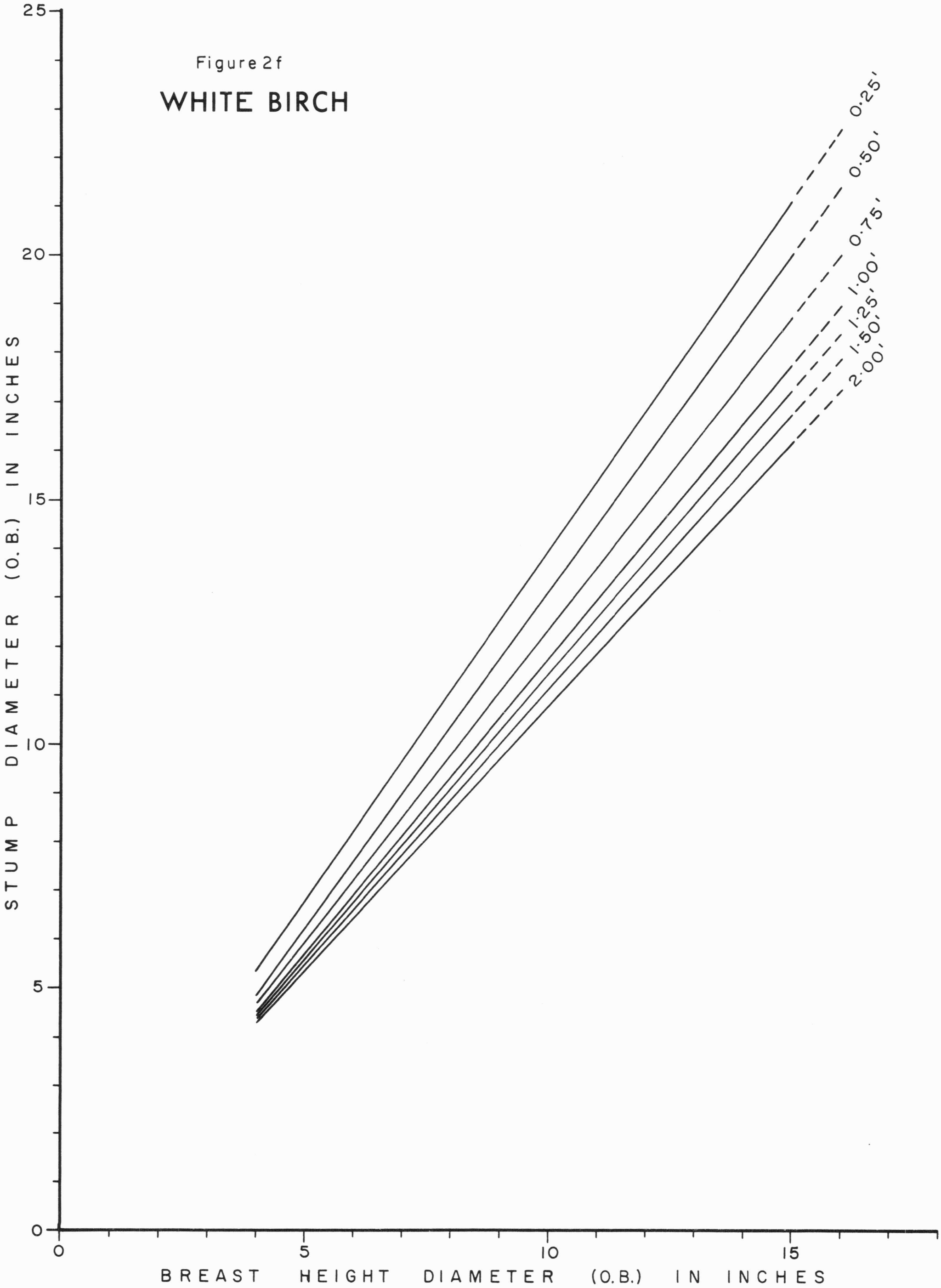


Figure 2f
WHITE BIRCH
0·25'
0·50'
0·75'
1·00'
1·25'
1·50'
2·00'
25
20
15
10
5
0
STUMP DIAMETER (O.B.) IN INCHES
0
5
10
15
BREAST HEIGHT DIAMETER (O.B.) IN INCHES

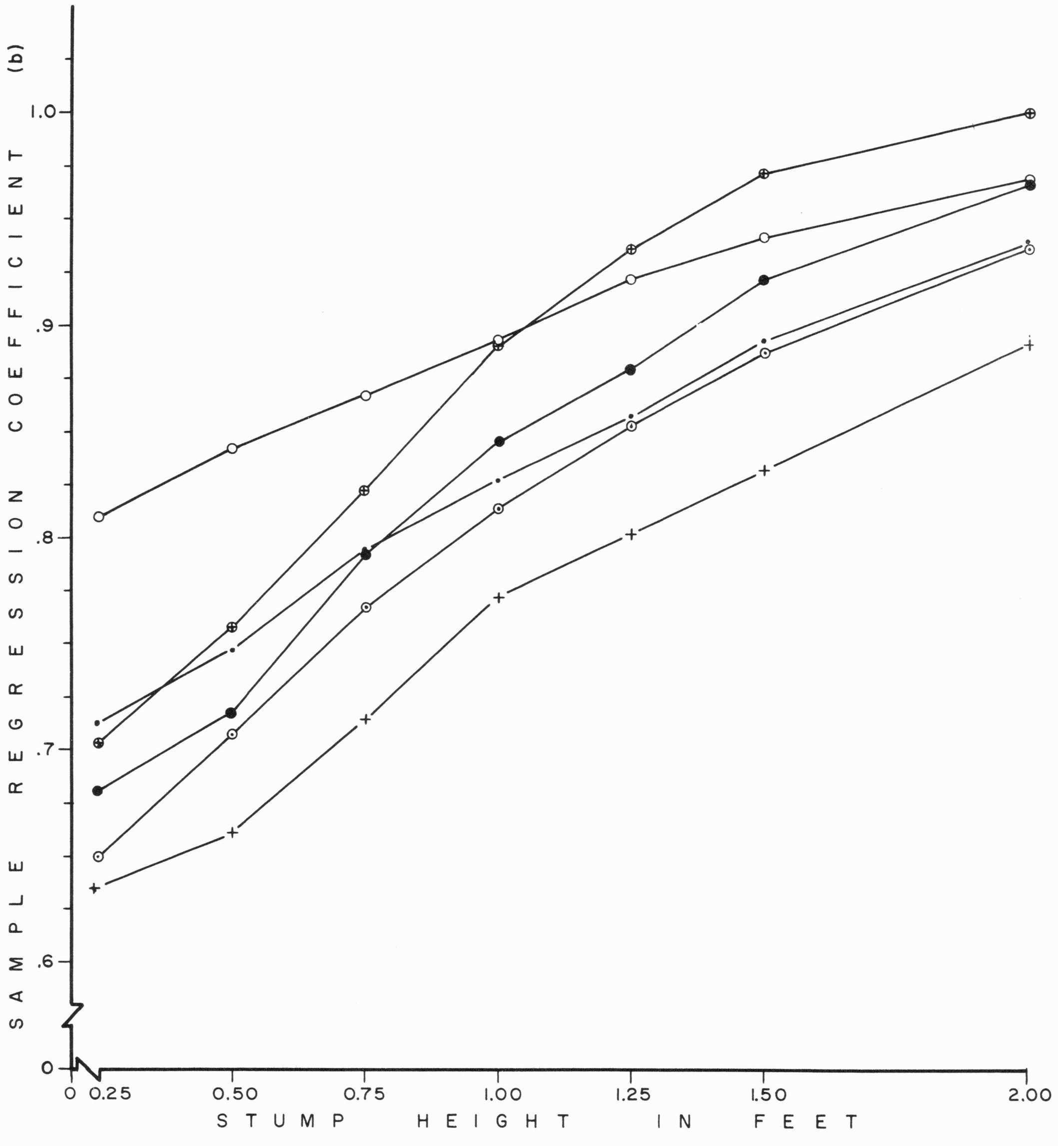


Figure 4. Relationships between the sample regression coefficient of the sample regression equation $Y_0 = a + b.X_1$, and the stump height

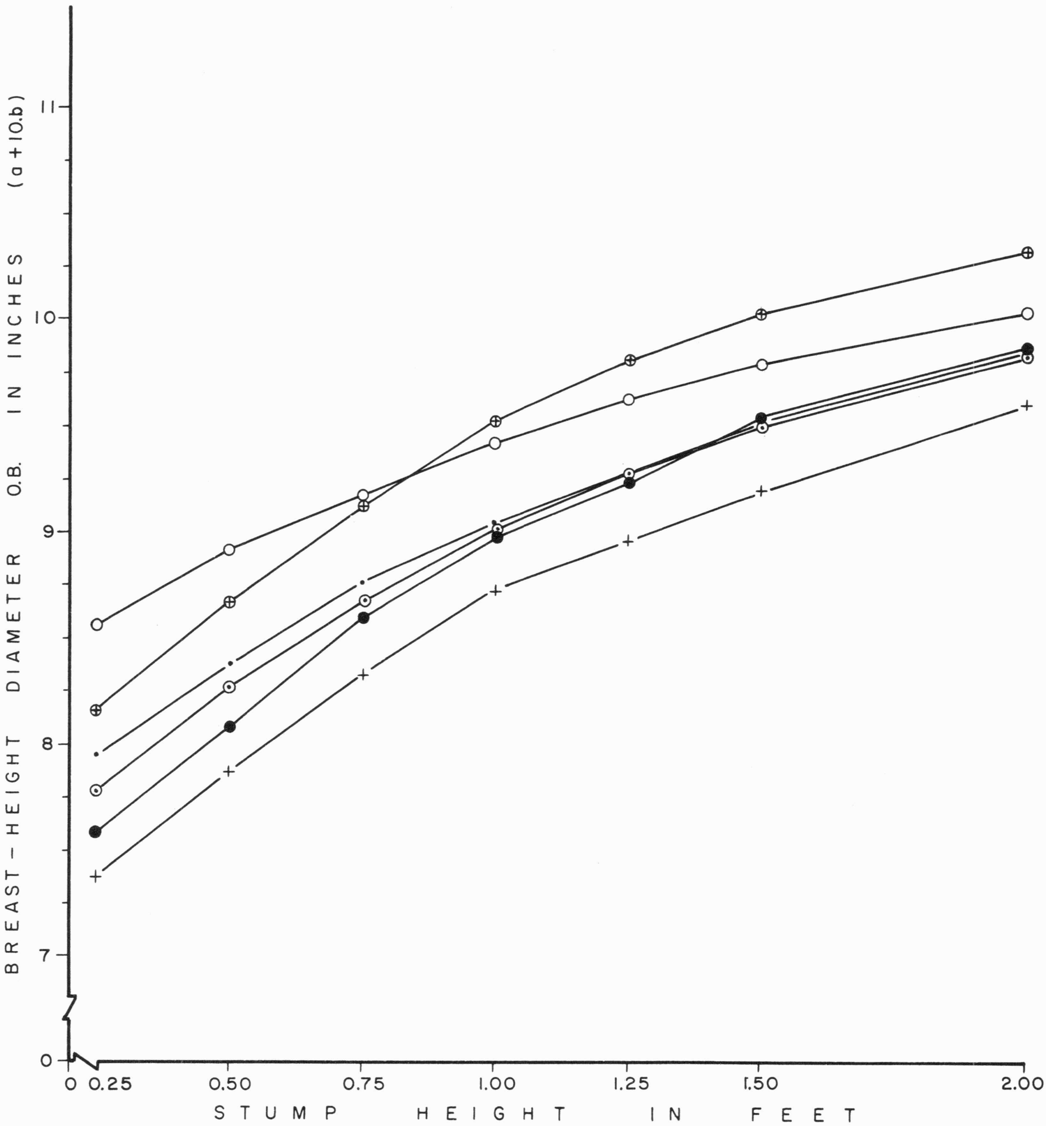


Figure 5. Relationships between the breast-height diameter outside bark (Y_O) and the stump height, when the stump diameter inside bark (X_I) within the sample regrssion equation $Y_O = a + b.X_I$ is equal to 10 inches.

· — bS ○— bF ⊕— tA

+ — wS ⊙— jP ●— wB

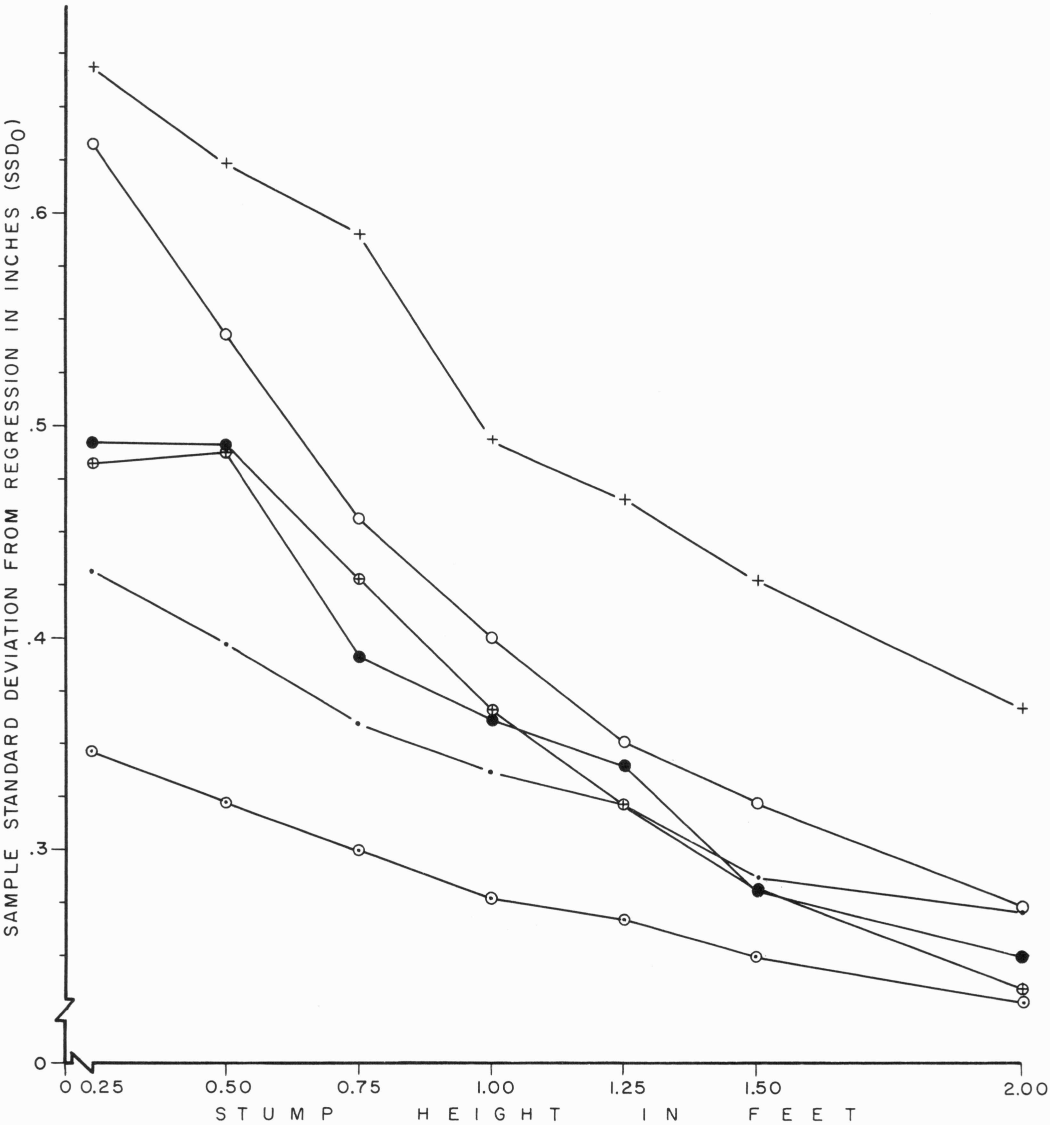


Figure 6. Relationships between the sample standard deviation from regression (SSD_O) and the stump height, when the stump diameters inside bark (X_1), within the sample regression equation $Y_O = a + b.X_1$ are subdivided into 0.1-inch classes.

· — bS   ○— bF   ⊕— tA

+— wS   ⊙— jP   ●— wB

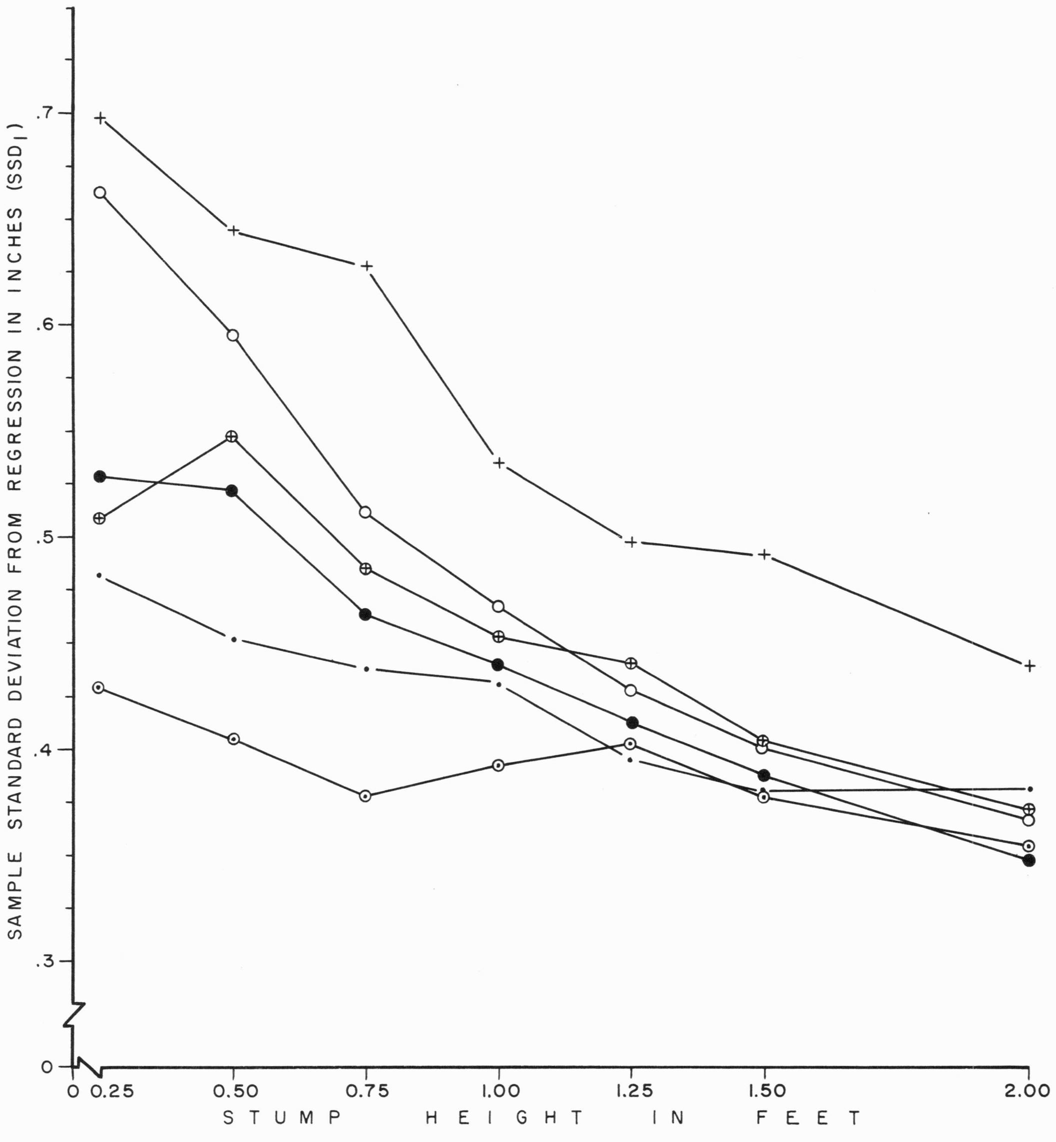


Figure 7. Relationships between the sample standard deviation from regression (SSD$_I$) and the stump height, when the stump diameters inside bark (X_I) within the sample regression equation $Y_O = a + b.X_I$ are subdivided into 1.0-inch classes.

· — bS   O— bF   ⊕— tA

+ — wS   ⊙— jP   ●— wB

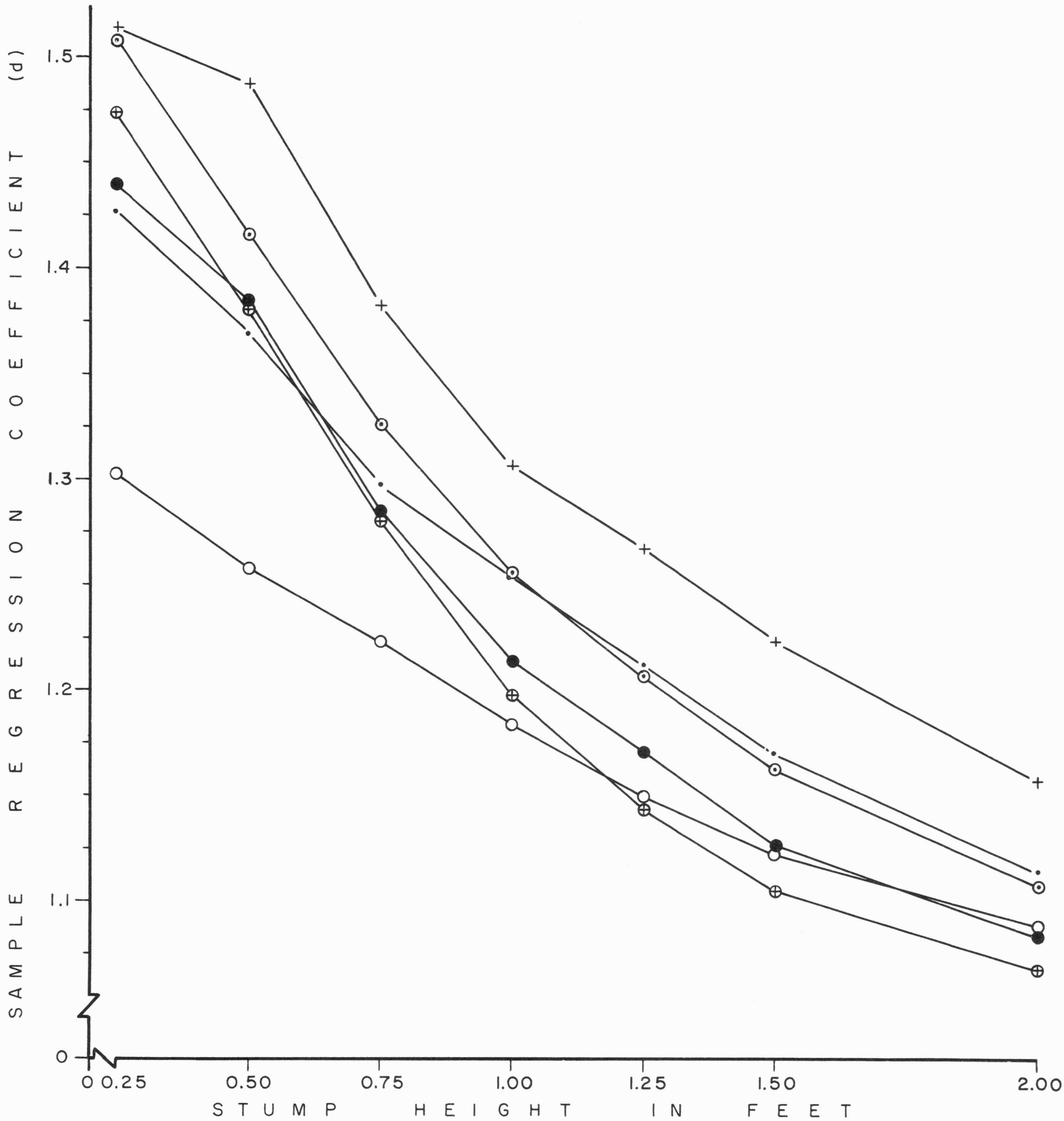


Figure 8. Relationships between the sample regression coefficient (d) of the sample regression equation $X_0 = c + d.Y_0$, and the stump height.

·— bS
+— wS
○— bF
⊙— jP
⊕— tA
●— wB

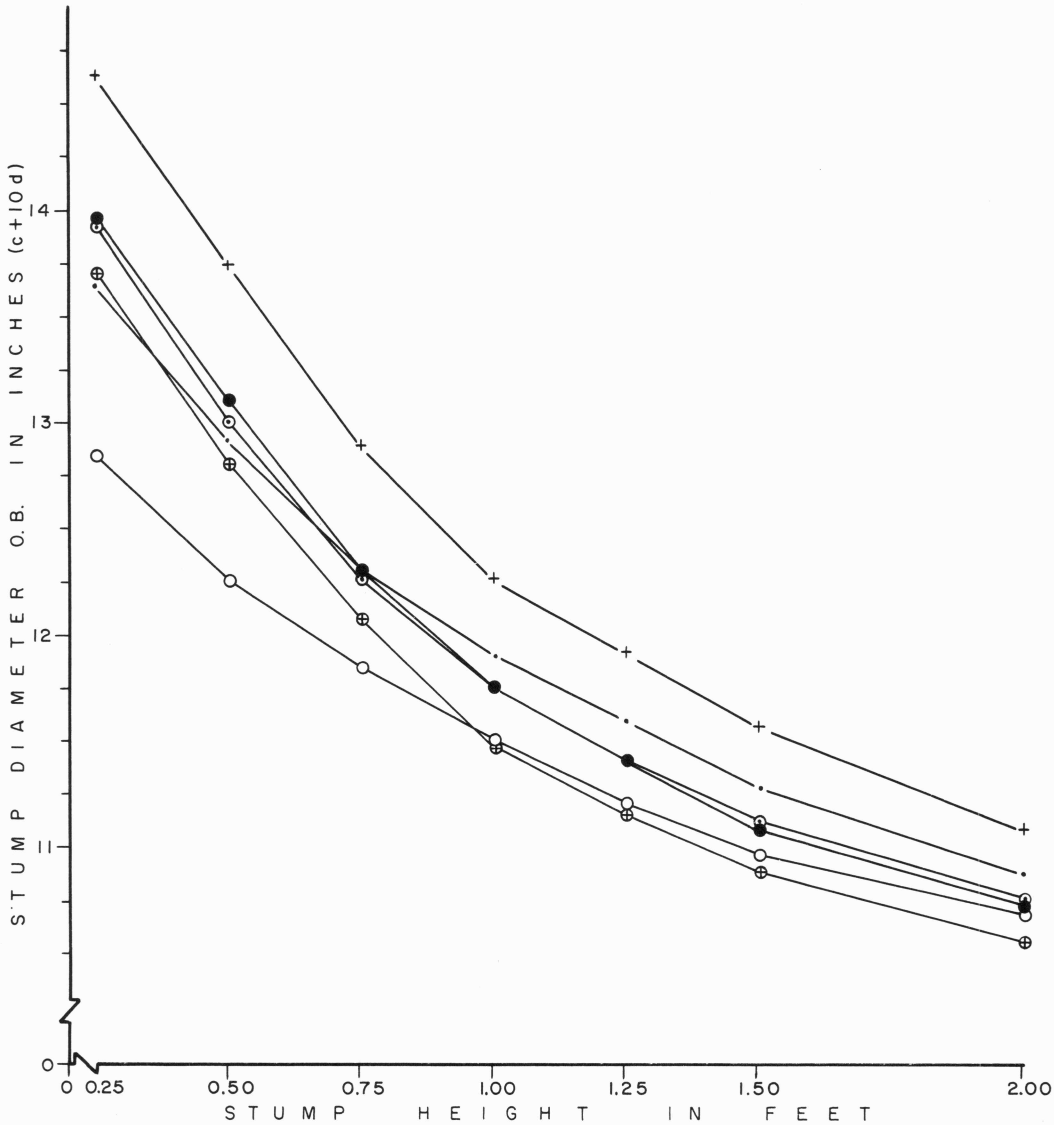


Figure 9. Relationships between the stump diameter outside bark (X_O) and the stump height when the breast-height diameter outside bark (Y_O) within the sample regression equation $X_O = c + d.Y_O$ is equal to 10 inches.

· — bS ○— bF ⊕— tA

+ — wS ⊙— jP ● wB

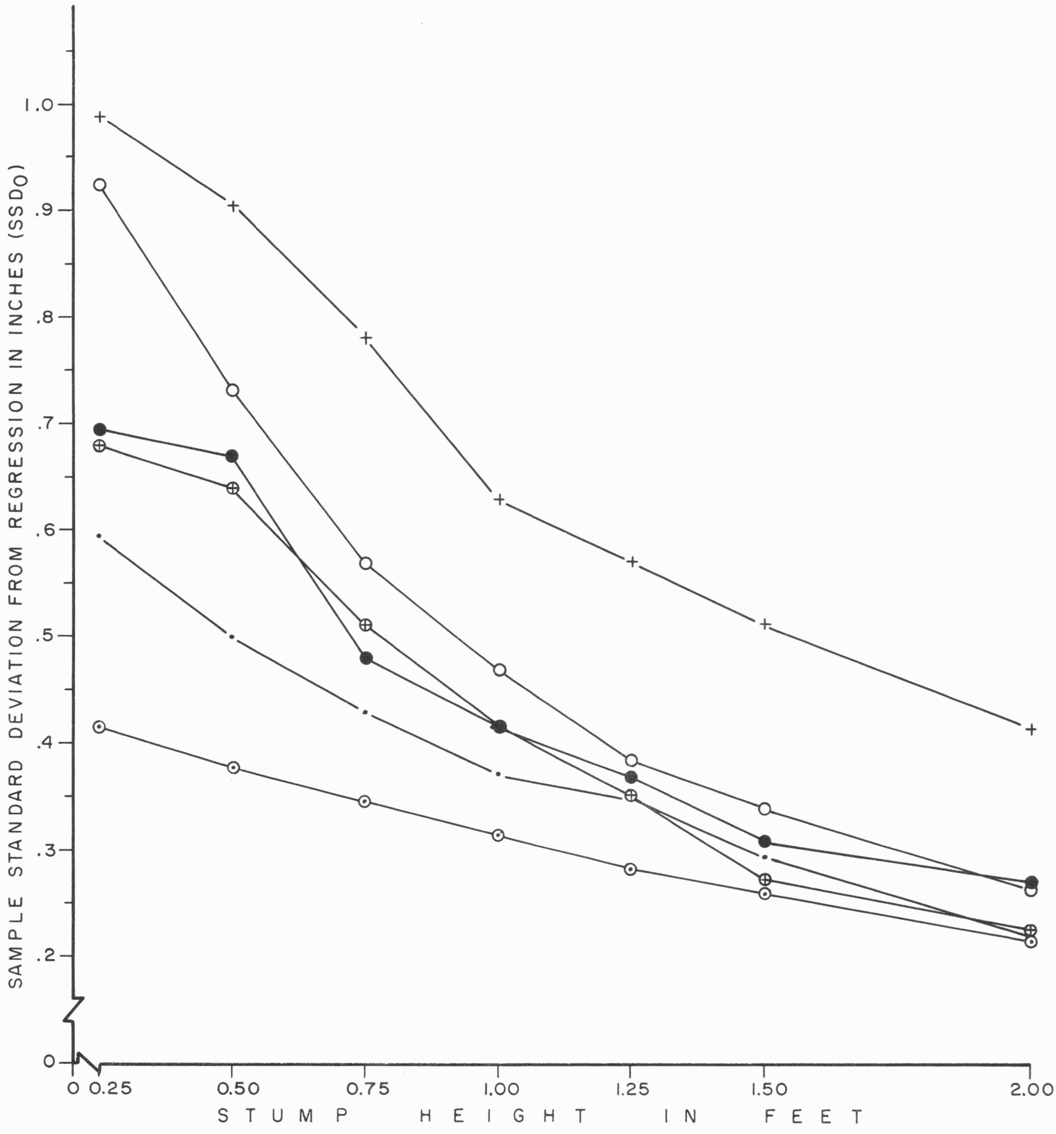


Figure 10 Relationships between the sample standard deviation from regression (SSD$_O$) and the stump height, when the breast-height diameters outside bark (Y_O) within the sample regression equation $X_O = c + d.Y_O$ are subdivided into 0.1-inch classes.

· — bS   ○— bF   ⊕— tA
+ — wS   ⊙— jP   ●— wB

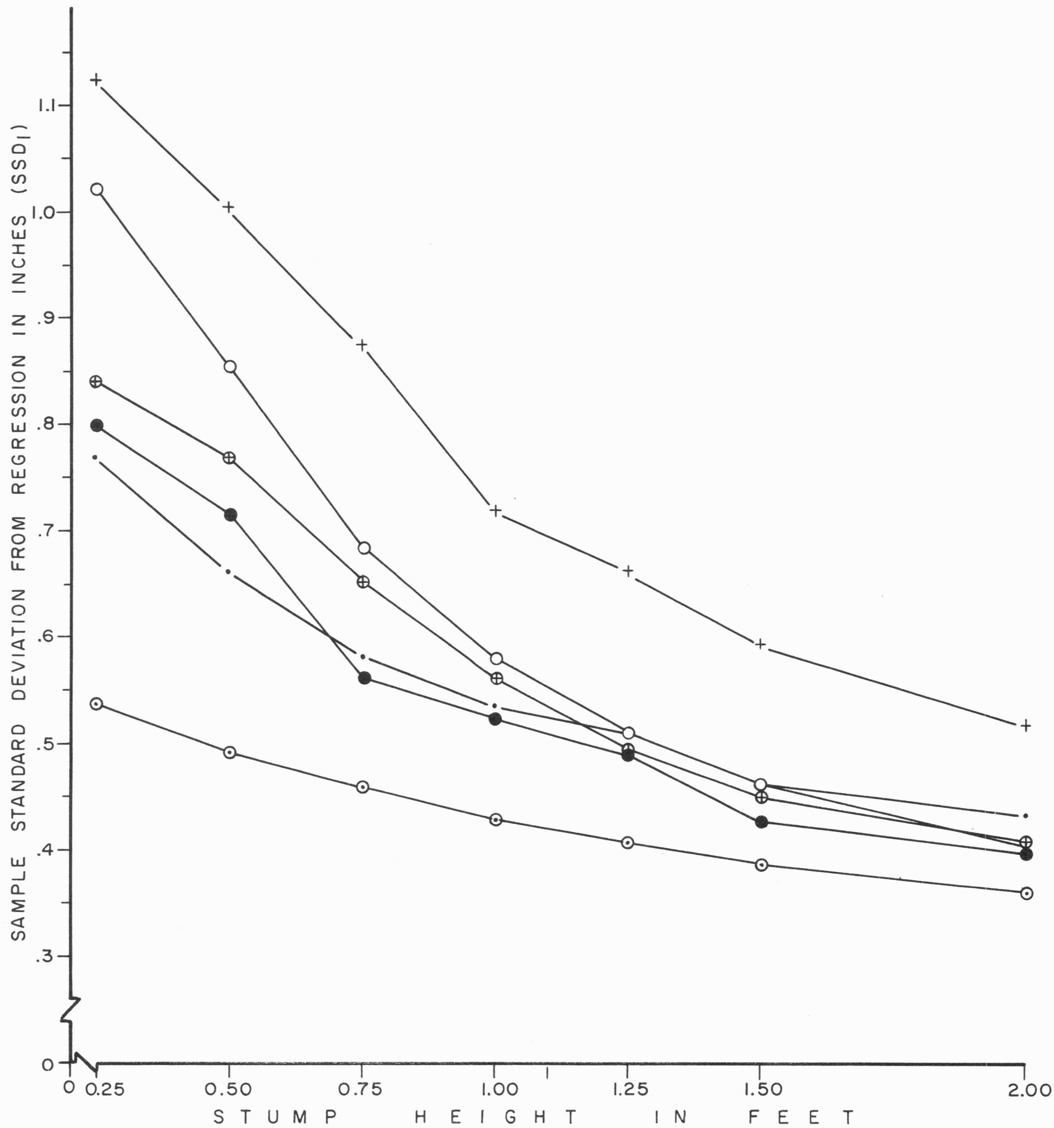


Figure 11 Relationships between the sample standard deviation from regression (SSD_I) and the stump height, when the breast-height diameters outside bark (Y_O) within the sample regression equation $X_O = c + d.Y_O$ are subdivided into 1.0-inch classes.

TABLE 1.—STATISTICS PERTAINING TO THE REGRESSION LINES OF BREAST-HEIGHT DIAMETER (O.B.) ON STUMP DIAMETER (I.B.) FOR THE SEVEN STUMP HEIGHT CLASSES OF THE SPECIES STUDIED

Sp.	SHC	N	Y_0	X_1	a	b	SSD_0	SSD_1	SSE_0	SSE_1
	ft.		in.	in.	in.		in.	in.	in.	in.
	2.00	332	6.29	6.22	.439	.940	.271	.381	.0149	.0209
	1.50	332	6.29	6.40	.570	.894	.288	.379	.0158	.0208
	1.25	332	6.29	6.53	.686	.858	.321	.395	.0176	.0217
bS	1.00	332	6.29	6.68	.756	.828	.337	.431	.0185	.0237
	0.75	332	6.29	6.90	.807	.795	.360	.438	.0197	.0241
	0.50	332	6.29	7.22	.890	.748	.398	.453	.0219	.0249
	0.25	317	6.17	7.51	.820	.712	.431	.481	.0242	.0271
	2.00	207	7.89	8.10	.668	.892	.367	.439	.0255	.0305
	1.50	207	7.89	8.44	.864	.833	.427	.491	.0297	.0341
	1.25	207	7.89	8.67	.936	.802	.466	.498	.0324	.0346
wS	1.00	207	7.89	8.92	.990	.773	.494	.535	.0343	.0372
	0.75	207	7.89	9.37	1.190	.715	.590	.627	.0410	.0436
	0.50	204	7.87	9.95	1.298	.661	.624	.644	.0437	.0451
	0.25	184	7.63	10.39	1.029	.635	.669	.697	.0493	.0514
	2.00	348	7.54	7.55	.451	.938	.274	.366	.0147	.0197
	1.50	348	7.54	7.79	.607	.889	.323	.401	.0173	.0215
	1.25	348	7.54	7.96	.741	.854	.351	.428	.0188	.0230
bF	1.00	348	7.54	8.17	.876	.815	.400	.468	.0214	.0251
	0.75	348	7.54	8.49	1.021	.767	.456	.511	.0244	.0274
	0.50	345	7.49	8.91	1.184	.708	.543	.595	.0292	.0321
	0.25	318	7.37	9.41	1.260	.650	.632	.663	.0355	.0372
	2.00	200	7.14	7.04	.307	.970	.229	.354	.0162	.0250
	1.50	200	7.14	7.19	.350	.944	.250	.377	.0177	.0267
	1.25	200	7.14	7.30	.404	.922	.267	.401	.0189	.0284
jP	1.00	200	7.14	7.45	.477	.894	.278	.391	.0197	.0276
	0.75	200	7.14	7.64	.503	.868	.300	.379	.0212	.0268
	0.50	200	7.14	7.90	.486	.842	.322	.405	.0228	.0286
	0.25	199	7.12	8.24	.450	.810	.346	.430	.0245	.0305
	2.00	198	7.02	6.75	.187	1.012	.235	.371	.0167	.0263
	1.50	198	7.02	6.90	.305	.973	.282	.402	.0200	.0286
	1.25	198	7.02	7.03	.441	.936	.321	.440	.0228	.0312
tA	1.00	198	7.02	7.19	.613	.891	.366	.452	.0260	.0321
	0.75	198	7.02	7.45	.889	.823	.428	.485	.0304	.0344
	0.50	197	6.99	7.79	1.081	.758	.488	.548	.0348	.0391
	0.25	188	6.77	8.04	1.107	.704	.482	.509	.0351	.0371
	2.00	201	6.39	6.42	.185	.967	.250	.348	.0176	.0246
	1.50	201	6.39	6.60	.299	.923	.281	.388	.0199	.0274
	1.25	201	6.39	6.75	.444	.880	.340	.412	.0240	.0291
wB	1.00	201	6.39	6.92	.534	.846	.361	.440	.0255	.0311
	0.75	200	6.36	7.17	.662	.794	.391	.464	.0277	.0329
	0.50	199	6.34	7.57	.903	.718	.490	.522	.0347	.0371
	0.25	184	6.12	7.87	.755	.681	.492	.529	.0362	.0391

Sp. —Species: bS—black spruce; wS—white spruce; bF—balsam fir; jP—jack pine; tA—trembling aspen; wB—white birch.

SHC —*S*tump *H*eight *C*lass (the midpoint of the class range [±0.125 foot] is given).

N —Number of trees sampled.

Y_0 —Sample mean of diameters (o.b.) at breast height.

X_1 —Sample mean of stump diameters (i.b.).

a —Sample regression constant.

b —Sample regression coefficient.

SSD_0—*S*ample *S*tandard *D*eviation from regression when the independent variable (X_1) is subdivided into .1-inch classes.

SSD_1—*S*ample *S*tandard *D*eviation from regression when the independent variable (X_1) is subdivided into 1.0-inch classes.

SSE_0—*S*ample *S*tandard *E*rror of the estimates when the independent variable (X_1) is subdivided into .1-inch classes.

SS_1E —*S*ample *S*tandard *E*rror of the estimates when the independent variable (X_1) is subdivided into 1.0-inch classes.

TABLE 2.—STATISTICS PERTAINING TO THE REGRESSION LINES OF STUMP DIAMETER (O.B.) ON BREAST-HEIGHT DIAMETER. (O.B.) FOR THE SEVEN STUMP HEIGHT CLASSES OF THE SPECIES STUDIED

Sp.	SHC	N	Xo	Y_0	c	d	SSD_0	SSD_1	SSE_0	SSE_1
	ft.		in.	in.	in.		in.	in.	in.	in.
	2.00	332	6.76	6.29	−.253	1.114	.269	.433	.0147	.0238
	1.50	332	6.96	6.29	−.399	1.170	.295	.463	.0162	.0254
	1.25	332	7.11	6.29	−.521	1.213	.347	.508	.0190	.0279
bS	1.00	332	7.28	6.29	−.608	1.254	.373	.534	.0205	.0294
	0.75	332	7.51	6.29	−.653	1.298	.430	.583	.0236	.0320
	0.50	332	7.86	6.29	−.761	1.370	.500	.662	.0274	.0364
	0.25	317	8.18	6.17	−.622	1.428	.594	.771	.0333	.0434
	2.00	207	8.65	7.89	−.485	1.157	.415	.517	.0289	.0360
	1.50	207	9.01	7.89	−.652	1.224	.512	.592	.0356	.0411
	1.25	207	9.25	7.89	−.741	1.267	.573	.662	.0398	.0460
wS	1.00	207	9.53	7.89	−.778	1.306	.630	.719	.0438	.0500
	0.75	207	9.98	7.89	−.933	1.383	.781	.875	.0543	.0608
	0.50	204	10.59	7.87	−1.119	1.488	.904	1.003	.0633	.0702
	0.25	184	11.06	7.63	−.496	1.514	.988	1.124	.0729	.0828
	2.00	348	8.02	7.54	−.329	1.108	.264	.402	.0141	.0216
	1.50	348	8.28	7.54	−.490	1.163	.340	.464	.0182	.0249
	1.25	348	8.46	7.54	−.639	1.206	.388	.511	.0208	.0275
bF	1.00	348	8.69	7.54	−.779	1.256	.470	.583	.0252	.0313
	0.75	348	9.03	7.54	−.958	1.325	.570	.685	.0305	.0368
	0.50	345	9.47	7.49	−1.137	1.416	.733	.855	.0395	.0461
	0.25	318	9.99	7.37	−1.127	1.508	.925	1.023	.0518	.0575
	2.00	200	7.58	7.14	−.180	1.088	.217	.361	.0154	.0256
	1.50	200	7.78	7.14	−.230	1.122	.260	.387	.0184	.0274
	1.25	200	7.92	7.14	−.285	1.150	.283	.407	.0200	.0288
jP	1.00	200	8.10	7.14	−.345	1.184	.314	.431	.0222	.0305
	0.75	200	8.35	7.14	−.363	1.222	.344	.461	.0243	.0326
	0.50	200	8.68	7.14	−.295	1.258	.378	.492	.0268	.0348
	0.25	199	9.11	7.12	−.173	1.303	.416	.538	.0295	.0381
	2.00	198	7.40	7.02	−.086	1.067	.224	.407	.0159	.0289
	1.50	198	7.61	7.02	−.149	1.105	.276	.449	.0196	.0319
	1.25	198	7.77	7.02	−.261	1.144	.352	.496	.0250	.0352
tA	1.00	198	7.96	7.02	−.436	1.197	.418	.563	.0297	.0400
	0.75	198	8.27	7.02	−.722	1.281	.512	.653	.0364	.0464
	0.50	197	8.66	6.99	−.986	1.381	.641	.770	.0457	.0548
	0.25	188	8.95	6.77	−1.019	1.474	.679	.842	.0495	.0614
	2.00	201	6.85	6.39	−.078	1.084	.271	.397	.0191	.0281
	1.50	201	7.04	6.39	−.152	1.125	.311	.428	.0220	.0303
	1.25	201	7.20	6.39	−.278	1.171	.370	.489	.0261	.0346
wB	1.00	201	7.39	6.39	−.371	1.214	.414	.526	.0292	.0372
	0.75	200	7.65	6.36	−.511	1.284	.481	.562	.0340	.0398
	0.50	200	8.10	6.36	−.708	1.384	.671	.718	.0474	.0509
	0.25	185	8.42	6.14	−.424	1.440	.695	.801	.0511	.0591

Sp. —Species: bS—black spruce; wS—white spruce; bF—balsam fir; jP—jack pine; tA—trembling aspen; wB—white birch.

SHC —*S*tump *H*eight *C*lass (the midpoint of the class range [±0.125 foot] is given).

N —Number of trees sampled.

X_0 —Sample mean of stump diameters (o.b.)

Y_0 —Sample mean of diameters (o.b.) at breast height.

c —Sample regression constant.

d —Sample regression coefficient.

SSD_0—*S*ample *S*tandard *D*eviation from regression when the independent variable (Y_0) is subdivided into .1-inch classes.

SSD_1—*S*ample *S*tandard *D*eviation from regression when the independent variable (Y_0) is subdivided into 1.0-inch classes.

SSE_0—*S*ample *S*tandard *E*rror of the estimates when the independent variable (Y_0) is subdivided into .1-inch classes.

SSE_1—*S*ample *S*tandard *E*rror of the estimates when the independent variable (Y_0) is subdivided into 1.0-inch classes.

REFERENCES

ANON. 1948. Form-class volume tables. Canada. Dep. of Mines and Res., 2nd Ed. pp. 261.

———— 1960. Woods and Forests Regulations of the Province of Quebec. The Que. For. Ind. Ass. Ltd., pp. 34.

BONES, J. T. 1960. Estimating d.b.h. from stump diameter in the Pacific Northwest. Res. Note Pacif. Nthwest. For. Range Exp. Sta. No. 186. pp. 2.

———— 1961. Estimating spruce and hemlock d.b.h. from stump diameter. Tech. Note Northern For. Exp. Sta. No. 51. pp. 2.

CARL, C. M., and H. E. YOUNG. 1954. Stump-dbh relationships for hardwoods in the vicinity of Bingham, Maine. Tech. Note Univ. Me. For. Dep. No. 27. pp. 2.

CHURCH, T. W., jr. 1953. Converting Virginia pine stump diameters to diameters breast high. For. Res. Note Ntheast. For. Exp. Sta. No. 23. pp. 2.

FREESE, F. 1960. Testing accuracy. For. Sc. 6(2). pp. 139-45.

HAMPF, F. E. 1954. Relationship of stump diameter to d.b.h. for white pine in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 38. pp. 4.

———— 1955a. Relationship of stump diameter to d.b.h. for sugar maple in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 42. pp. 3.

———— 1955b. Relationship of stump diameter to d.b.h. for American beech in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 43. pp. 3.

———— 1955c. Relationship of stump diameter to d.b.h. for yellow birch in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 45. pp. 2.

———— 1955d. Relationship of stump diameter to d.b.h. for northern red oak in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 46. pp. 2.

———— 1955e. Relationship of stump diameter to d.b.h. for yellow-poplar in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 55. pp. 3.

———— 1957a. Relationship of stump diameter to d.b.h. for pitch pine in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 65. pp. 3.

———— 1957b. Relationship of stump diameter to d.b.h. for white oak in the Northeast. For. Res. Note Ntheast. For. Exp. Sta. No. 66. pp. 3.

HORN, A. G., and R. C. KELLER. 1957. Tree diameter at breast height in relation to stump diameter by species group. Tech. Note, Lake St. For. Exp. Sta. No. 507. pp. 2.

MCCORMACK, J. F. 1953. D.B.H. in relation to stump diameters at various heights for southern yellow pines and hardwoods. Res. Note Stheast. For. Exp. Sta. No. 43. pp. 2.

MCLINTOCK, T. F. 1951. Stump diameter related to d.b.h. for spruce-fir region. Ntheast. Res. Note Ntheast. For. Exp. Sta. No. 4. pp. 2.

MILLER, S. R. 1957. Relationship of stump diameter to diameter at breast height for slash pine. Woodl. Res. Note, Union Bag Pap. Corp., Savannah No. 4. pp. 2.

QUIGLEY, K. L. 1954. Estimating volume (of hardwoods) from stump measurements. Tech. Pap. Cent. St. For. Exp. Sta. No. 142. pp. 5.

ROWE, J. S. 1959. Forest regions of Canada. For. Br. Can. Bull. 123. pp. 71.

SCHAEFFER, L. 1953. Estimation des peuplements forestiers après réalisation. Rev. for. franc. 5(6), pp. 430-32.

VIMMERSTEDT, J. P. 1957. Estimating d.b.h. from stump diameter in Southern Appalachian species. Res. Note Stheast. For. Exp. Sta. No. 110. pp. 2.