VOL. I JANUARY, 1937 No. 8

BLACK ROCK FOREST PAPERS

HENRY H. TRYON, DIRECTOR

DIAMETER OUTSIDE BARK AS AN INDEX OF BARK THICKNESS AT BREAST HEIGHT FOR RED AND CHESTNUT OAK

By
HAROLD F. SCHOLZ

CORNWALL-ON-THE-HUDSON, NEW YORK

DIAMETER OUTSIDE BARK AS AN INDEX OF BARK THICKNESS AT BREAST HEIGHT FOR RED AND CHESTNUT OAK

By HAROLD F. SCHOLZ [1]

FOREWORD

ACKNOWLEDGEMENT is made to Mr. S. R. Gevorkiantz of the Lake States Forest Experiment Station for reviewing this paper and making many helpful suggestions for improving it. Credit is also due Mr. Robert M. Borg who assisted in collecting the field data.

INTRODUCTION

RED OAK (Quercus borealis Michx.) and chestnut oak (Quercus montana Willd.) are two of the most common of the forest trees found in the Hudson River Highlands of lower New York and adjacent New Jersey (Tryon, 1930). In fact, red and chestnut oak are so widely distributed and show such a range in adaptability to site conditions that they might well be called "key" species for much of this region. Their common occurrence, along with the fact that they are commercially valuable, places them rather high in a scale of priority in forest management plans.

Nor should the "ecological stability" of red oak and chestnut oak be overlooked. Because of their ability to reproduce both by seeds and sprouts, and their relatively high tolerance to shade, oak follows oak on many sites, generation after generation. Thus a knowledge of the ecological requirements, site preferences, and rate of growth is a requisite for the proper silvicultural treatment of these two species.

Cognizance was given to this fact when, in 1931, a study was made of the physical properties of the cove soils of the Black Rock Forest (Scholz, 1931). Although there was no opportunity at that time to make exhaustive quantitative studies of the ecological factors affecting the growth of red and chestnut oak, it was possible, incidental to the investigation of numerous soil profiles, to collect considerable data upon the interrelation of diameter, age, and total height for these key species. It is the plan to summarize these data and make them available in the form of several short papers of which this is the first.

THE BARK THICKNESS FACTOR AND ITS IMPORTANCE

It is often desirable to ascertain the current, periodic, or mean annual diameter growth of trees in a forest stand. Thus it may be necessary to determine whether a very moderate or light thinning has resulted in the acceleration of diameter growth of the stems left uncut, and if so, the manner in which the response has occurred, i.e., was the reduction in density of the stand followed by an immediate increase in the diameter growth or was there a period of "lag"? Or again, the problem might be one of comparing the diameter growth of trees in the intermediate and dominant crown classes in even-aged stands. These are only two of many illustrations where a knowledge of diameter increment becomes of technical importance to the forester.

When making diameter studies such as those above, it is desirable ordinarily to translate the growth into terms of wood increment inside the bark. Thus the technician is faced with the necessity of establishing the relationship between the diameter of the tree as measured outside bark to its diameter inside bark.

Such a relationship has been established for the breast height diameters of 459 chestnut oak and 418 red oak examined on the Black Rock Forest. A summary of these data is herewith presented.

METHOD USED IN COLLECTING DATA

As previously indicated, information pertaining to the composition and growth of forest stands was taken in conjunction with an investigation of a number of soil profiles. Actually, there were 46 "sets" of these profiles, each set consisting of three separate holes or wells dug so as to fall on the corners of a triangular-shaped area. The distance between wells varied from 42 to 306 feet, the average being 103 feet, and the area included within the triangles, the boundaries of which were defined by the sets of soil profiles, varied from 0.04 acre to 0.58 acre.

Each soil well served as the center for a twenty-fifth acre, circular sample plot which means, of course, that the total sample for each set of soil profiles was three twenty-fifths of an acre.[2] On these plots, a tally was made of all trees (seedlings, saplings, and poles), and the diameter, total age at breast height, and total height was determined for all red and chestnut oak 1.6 inches D. B. H. (outside bark) or larger. These two oaks were chosen as key species because one or both of them occurred on 94 per cent—on 126 of the 134 plots—of the total sample areas.

Diameters were measured to the nearest 0.1 inch by means of a standard steel diameter tape. Total age at breast height (4.5 feet above the average ground level) was determined by ring counts on cores extracted with a Swedish increment borer. Heights were measured to the nearest foot with a Klaussner hypsometer. Bark thickness was obtained by means of a Swedish bark punch. In every case, two measurements were taken on opposite sides of the tree. If these measurements showed any great amount of variation, bark thickness was determined at a third point on the bole. The two, or three, readings were then averaged *in the field,* and the bark thickness recorded to the nearest 0.05 inch.

---

[1] Assistant Silviculturist, Lake States Forest Experiment Station. Data for this paper were collected in 1930-31 while the author was a student at Harvard Forest.

[2] To be exact, only 134 sample plots were taken. In one case, two, instead of the usual three, soil holes or wells comprised a profile set, and there were no sample plots taken for Profile Number 44 since it fell on a natural "bald" devoid of tree growth.

Method of Analyzing Data

In order to determine the relationship of the diameters of red and chestnut oak as measured outside bark at breast height to their diameters inside bark at the same point, the following steps have been necessary: 1) All trees have been grouped, by species, into 1-inch diameter classes (d.o.b.), 2) The corresponding d.i.b. has been determined for each tree by subtracting double the average bark thickness, as determined in the field, from the d.o.b., 3) Weighted averages have been calculated for d.o.b. and d.i.b. by inch classes, 4) The weighted averages, standard deviations, and standard errors for d.o.b. and d.i.b. have been computed for both samples (418 red oak and 459 chestnut oak), 5) Weighted average d.i.b. has been plotted over weighted average d.o.b. by inch classes for each species, and curves have been fitted, mathematically, to these two sets of points by the method of least squares (Bruce and Schumacher, 1935), 6) A table showing the relationship of d.o.b., d.i.b., and double bark thickness has been prepared. These table values have been read from the curves above, and 7) The standard error of estimate and the alienation index have been calculated.

Relationship of D.O.B., D.I.B., and Bark Thickness at Breast Height for Red and Chestnut Oak

The results of these analyses are shown below (Figure 1 and Table 1). Since they are more or less self-explanatory, no detailed discussion of the figure or table is necessary. The high reliability of the averages for the samples used as a basis for the two curves should be noted. Attention should also be called to the degree to which d.i.b. is associated with d.o.b.—Alienation Index for chestnut oak, 0.10; Alienation Index for red oak, 0.06. It is apparent from these values that the d.i.b. and bark thickness of red and chestnut oak in the Hudson Highlands Region is primarily the function of d.o.b. and secondarily the function of sundry other factors such as site, exposure, stand density, and age.

REFERENCES

1. Bruce, Donald, and Schumacher, F. X. 1935. Forest Mensuration. McGraw-Hill Book Company, New York, N. Y.
2. Scholz, Harold F. 1931. Physical Properties of the Cove Soils of the Black Rock Forest. The Black Rock Forest Bulletin 2, Cornwall-on-the-Hudson, N. Y.
3. Tryon, Henry H. 1930. The Black Rock Forest. The Black Rock Forest Bulletin 1. Cornwall-on-the-Hudson, N. Y.

Table 1

Relation Between d.o.b., d.i.b.[3] and Bark Thickness at Breast Height for Red Oak and Chestnut Oak

	RED OAK		CHESTNUT OAK	
D.B.H. Outside Bark Inches	D.B.H. Inside Bark Inches	Doubled Bark Thickness Inches	D.B.H. Inside Bark Inches	Doubled Bark Thickness Inches
1.0	*0.80*	*0.20*	*0.65*	*0.35*
1.5	*1.25*	*0.25*	*1.10*	*0.40*
2.0	*1.70*	*0.30*	*1.55*	*0.45*
2.5	2.15	0.35	2.00	0.50
3.0	2.60	0.40	2.40	0.60
3.5	3.05	0.45	2.85	0.65
4.0	3.55	0.45	3.30	0.70
4.5	4.00	0.50	3.75	0.75
5.0	4.45	0.55	4.15	0.85
5.5	4.90	0.60	4.60	0.90
6.0	5.35	0.65	5.05	0.95
6.5	5.80	0.70	5.50	1.00
7.0	6.25	0.75	5.90	1.10
7.5	6.75	0.75	6.35	1.15
8.0	7.20	0.80	6.80	1.20
8.5	7.65	0.85	7.25	1.25
9.0	8.10	0.90	7.65	1.35
9.5	8.55	0.95	8.10	1.40
10.0	9.00	1.00	8.55	1.45
10.5	9.50	1.00	9.00	1.50
11.0	9.95	1.05	9.40	1.60
11.5	10.40	1.10	9.85	1.65
12.0	10.85	1.15	10.30	1.70
12.5	11.30	1.20	10.75	1.75
13.0	11.75	1.25	11.15	1.85
13.5	12.25	1.25	11.60	1.90
14.0	12.70	1.30	*12.05*	*1.95*
14.5	13.15	1.35	*12.45*	*2.05*
15.0	13.60	1.40	*12.90*	*2.10*
15.5	14.05	1.45	*13.35*	*2.15*
16.0	14.50	1.50	*13.80*	*2.20*
16.5	*15.00*	*1.50*	*14.20*	*2.30*
17.0	*15.45*	*1.55*	*14.65*	*2.35*
17.5	*15.90*	*1.60*	*15.10*	*2.40*
18.0	*16.35*	*1.65*	*15.55*	*2.45*

[3] Italicized values have been taken from portions of the curves projected beyond the limits of the field data. Both d.i.b. and bark thickness are shown to hundredths of an inch. Since d.o.b. is seldom measured closer than to the nearest 0.1 inch and bark thickness and radial growth to the nearest 0.05 inch in the field, the d.i.b. and doubled bark thickness measurements shown in the table should ordinarily be rounded off to the nearest 0.1 inch.

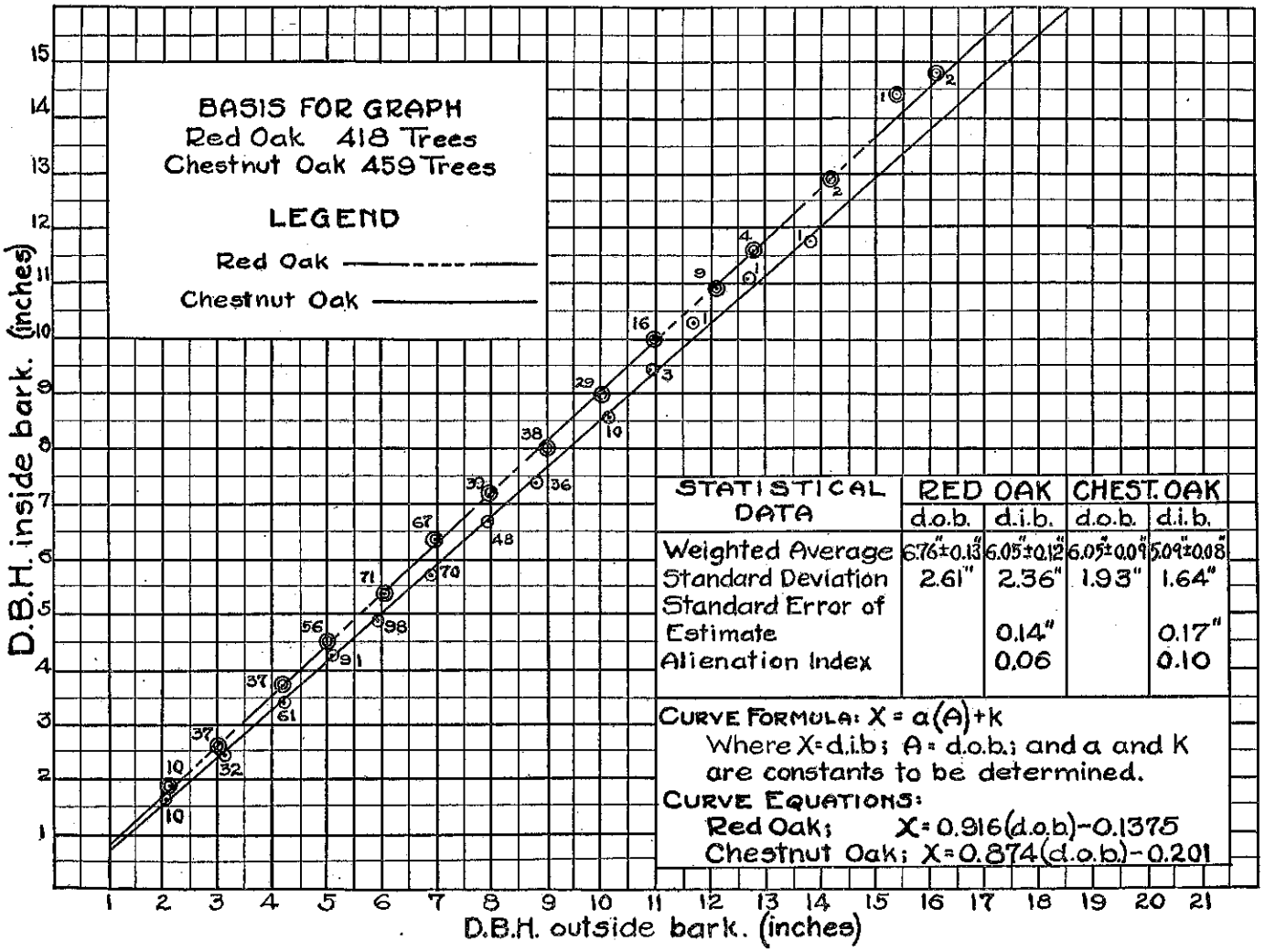

FIG. 1.—Relationship of d.o.b. to d.i.b. for Chestnut Oak and Red Oak in the Hudson Highlands Region of New York and Adjacent New Jersey.