United States
Department of
Agriculture

Forest Service

**Northeastern Forest
Experiment Station**

NE-GTR-114

A Field Guide to Quantity and Value Growth of Upland Oak

Martin E. Dale
David E. Lutz

Abstract

Information is presented on the average yield and expected growth response of upland oak stands in Pennsylvania. Forest Survey data were used to classify oak stands into 20 broad size-stocking classes. For each class, tables provide the expected quantity and value of wood before and after thinning treatments. Future stand development is given in terms of volume and value 10 years later with or without thinning treatments. Rate of value increase over the 10-year period is shown for each size-stocking class with or without a thinning treatment.

The Authors

Martin E. Dale, research forester, joined the USDA Forest Service in 1957, specializing in forest management and silviculture research at Berea, Kentucky. In 1973, he received a Ph.D. degree in forest biometry from Iowa State University, and was assigned to the Northeastern Forest Experiment Station's Forestry Sciences Laboratory at Delaware, Ohio. Currently, he is engaged in research on the growth and yield of managed upland oaks.

David E. Lutz, forestry technician, received a B.S. degree in surveying from the Ohio State University, College of Engineering in 1981, a B.S. degree in forest management from the Ohio State University in 1984. He joined the Northeastern Forest Experiment Station's Forestry Sciences Laboratory at Delaware, Ohio in 1983 on a temporary assignment to assist in data processing and computer programming. Currently he is an Ohio registered surveyor with a consulting civil engineering and surveying company.

Manuscript received for publication 27 February 1986

Northeastern Forest Experiment Station
370 Reed Road, Broomall, PA 19008
November 1986

Introduction

Silvicultural guides have been used extensively for prescribing stand treatments in the upland oak forests for more than 20 years. These guides, based on years of scientific research, observations, and consultations with experienced forest managers, have contributed significantly to efficient timber production (Roach and Gingrich 1968). Although these guides are extremely useful, managers could use additional information on expected quantity and value to be generated by a prescribed silvicultural treatment. Also, the expected growth in quantity and value of residual trees 10 years later with or without treatment would be extremely useful.

Some of this information is available through computer programs that forecast growth, yield, and economic evaluations of either individual trees or forest stands. These estimates are fine in the office, but, practicing foresters need simple, on-the-spot field estimates of potential volumes to be removed or left as residual trees after a prescribed treatment, and the value of such treatment. Indeed, much of this information is critical to prescribe the appropriate stand treatment. The purpose of this guide is to provide information on average responses from a large number of stands in terms of quantity and value of wood before and after thinning treatments. Also, the guide provides future estimates of how these stands respond in volume and value 10 years later with or without treatment. We are not presenting new silvicultural guidelines nor altering the old ones. Rather, this is additional information and should be used along with established tools to help practicing foresters reach a stand prescription for their own specific set of management objectives.

Relationship to Oak Stocking Charts

The key to stand prescriptions thorughout the silvicultural guide hinges on the stocking charts developed by Gingrich (1967). From stand basal area and number of trees per acre, silviculturalists read these charts to determine relative stand stocking and mean tree size (Fig. 1). When stand stocking exceeds B-level or approximately 58 percent stocking, a thinning will theoretically increase individual tree growth and thus may be a desirable silvicultural treatment. However, from the managers viewpoint the decision to thin, harvest, or apply other treatments must be based on many other factors. The manager must consider stand age, site quality, current volume and value of trees, expected volume and value of a cut, expected growth with or without treatents, available markets, and many other important considerations. All of these factors along with the specific management objective must be evalauted to reach the best course of action.

No simple set of guidelines could adequately provide precise information for all of these factors, and besides, each individual stand has its own unique characteristics. Our intent here is to show how general trends in stand volume and stand value are related to stocking percent and mean tree size. All this information is presented within the framework of the upland oak stocking charts.

Though the quantitative yield and dollar values in the yield and value tables (Appendix D) are based on a limited sample of stands from one geographical area, similar trends and relative values apply over a broad region. We believe the relative values and trends are far more important than specific stand values from the tables. Specific stand values should be interpreted cautiously even within the geographical area. The initial timber volumes and values as well as growth estimates are conservative, perhaps by 20 to 25 percent but they are consistent with forest survey statistics.

Some variables presented are designed for specific users. Extension foresters, consultants, service foresters, or others may wish to develop simpler tables extracting or using only information useful for their purpose.

Development of yield and value tables

Data

The average stand volume and value information was developed from the 10-point cluster plots used in the USDA Forest Service's 1978 forest survey of Pennsylvania. Original field plots were first screened to select all plots where oak and hickory species constituted a plurality of stand basal area. Our sample consisted of 506 plots representing the 7,510,100 acres of upland oak type in Pennsylvania.

Stocking and Mean Stand Diameter

Plots were classified into six stocking classes ranging from less than 20 percent to greater than 100 percent. Stands were further classified according to the tabulation below into five arbitrary mean diameter classes: 3.0–5.0, 5.1–8.0, 8.1–11.0, 11.1–15.0, and greater than 15 inches. We could have reduced the variation in volume and value by using smaller diameter classes, but then the number of observations in some classes would have been too small to obtain reliable averages. Mean stand diameter included only trees 3.0 inches and greater for seedling and sapling stands. It included trees 4.0 inches or larger for stands classified by the forest survey as poletimber, and 5.0 inches and larger in sawtimber stands.

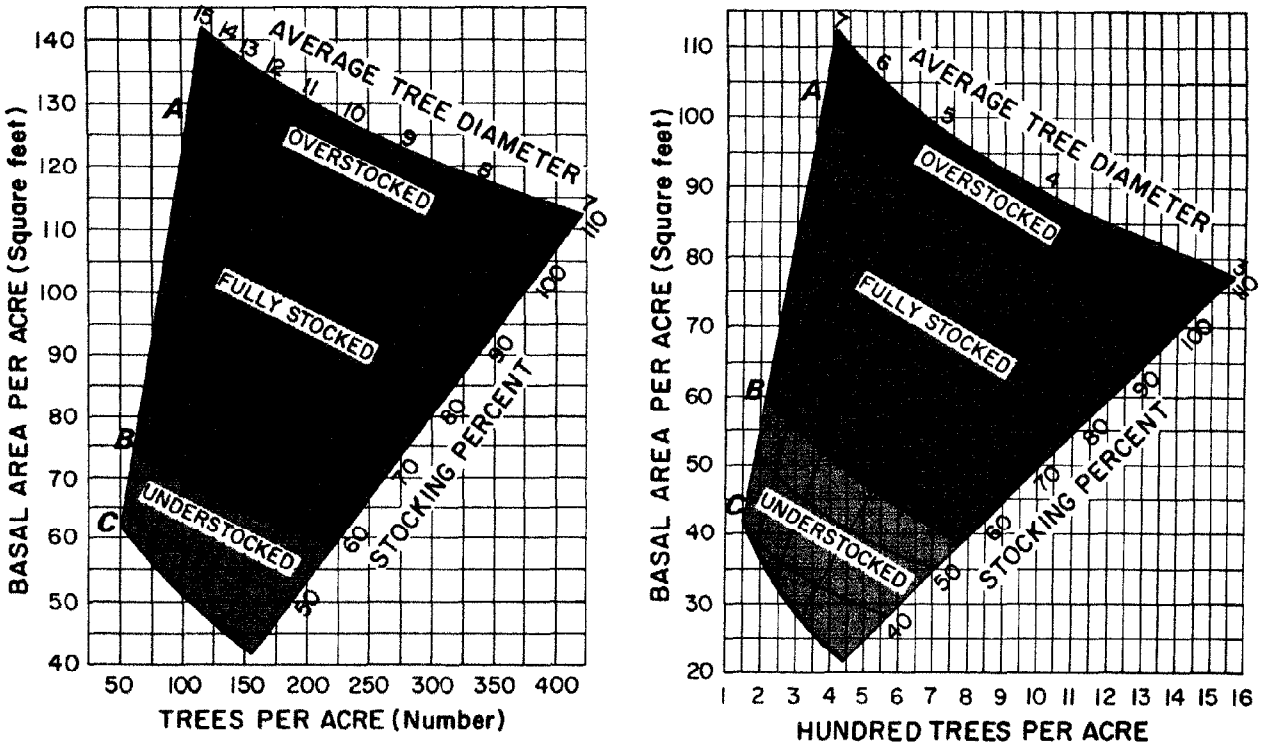

Figure 1.—Stocking chart for upland oak.

Number of sample plots by stocking and diameter.

Mean stand diameter	Stocking percent						Total
	0–20	21–40	41–60	61–80	81–100	100 +	
3.0–5.0	2	3	13	10	8	7	43
5.1–8.0	3	9	26	37	42	26	143
8.1–11.0	2	11	39	72	58	27	209
11.1–15.0	2	3	28	30	30	12	105
15.1 +	—	2	3	1	—	—	6
Total	9	28	109	150	138	72	506

The less than 20 percent stocking class contained only nine plots, and in all stocking classes only six plots had average diameters larger than 15 inches. Both groups were dropped from further analyses because of insufficient observations. Stand characteristics were then determined for each of the remaining 20 stocking and mean diameter classes. Each of these remaining classes had at least three plots and most had 10 or more. Although the acres each plot represents vary somewhat from plot to plot, the percentage in any one cell is approximately proportional to the total upland oak acreage of Pennsylvania.

Present Stand Characteristics

Using the individual characteristics of each sampled tree, we computed several tree variables such as volume, basal area, stocking, and value. Each variable was multiplied by the number of trees it represented per acre and summed to obtain per acre totals. Mean value of each variable per acre was computed based on all plots within a given stocking and mean d.b.h. class (Tables 1A–5D).

For each stocking and diameter class, we present the mean and standard deviation for 11 important stand characteristics: (1) basal area; (2) number of trees; (3) average d.b.h.; (4) diameter of tree with median basal area; (5) total stocking percent; (6) stocking percent of acceptable trees; (7) merchantable cubic-foot volume; (8) cordwood volume; (9) board-foot volume, Internatonal 1/4-inch rule; (10) dollar value using tree value conversion standards (Mendel et al. 1976, DeBald and Mendel 1976); and (11) rate of value increase over a 10-year period. The non-inflated dollar values are used for computing the real rate of return that is given for the average stands with and without a thinning treatment applied.

For a more detailed description of each variable, see Appendix A. Variable 4, the diameter of tree with median basal area, is not commonly used. It represents the size of tree where we have half the basal area in larger trees, or half the basal area in smaller trees. It is a good measure of the main stand canopy and typically close to the minimum size tree we would want to select as a potential crop tree. The merchantable cubic-foot and board-foot volumes used the identical volume equations of forest survey in the Northeast (Scott 1979, 1981).

Future Stand Characteristics

Projected growth for 10 years was computed (Appendix B) for every sample tree, weighted by the appropriate number of trees per acre after adjusting for mortality, and summed to obtain totals. Means and standard deviations were computed for each variable Tables 1A through 5D.

Stand Characteristics After Thinning

For those stands exceeding 60 percent stocking, we computed stand characteristics after imposing a hypothetical thinning that reduced stocking to the B-level. Details of the thinning rule we used for selecting to leave or cut tress are given in Appendix C. Tables 3A through 5D show the characteristics of the residual stand after thinning as well as the quantity and value of timber that could be cut. We also show in the tables the expected future development of these stands over the next 10-year period after the thinning. Means and standard deviations of each variable were computed as before.

Use of Yield and Value Tables

A Specific Stand

Foresters may use the tables to assist in making decisions concerning a specific individual stand. For example, suppose a prism cruise of a large poletimber stand indicates 100 square feet of basal area and 225 trees per acre 4 inches d.b.h. and larger. From the oak stocking charts (Fig. 2), you find this stand is 90 percent stocked and has a mean d.b.h. near 9 inches. Each cell in this stocking chart is identified by a number and letter which is the key to the table with the mean stand volumes and values for this cell. This stand fell in stocking class 4 and size class C, therefore, the appropriate values are found in Table 4C.

From Table 4C we find that 58 of our sample plots fell in this size-stocking class. Our stands averaged 103 square feet basal area, 211 trees per acre, and were about 90 percent stocked. Also, we found an average volume at the present time of 25 cords or 4,763 board feet with a value of about $204 per acre. Table 4C shows that if we do nothing at all, the average of such stands will increase in 10 years to 111 square feet of basal area and be 95 percent stocked with 186 trees per acre. Volume will increase by 3.2 cords or by 1,365 board feet. Such stands typically increase by $53.43 per acre, which is a rate of value increase over the 10 years of 2.5 percent.

Table 4C can help you decide whether or not to thin your stand at this time. For example, thinning to approximately B-level stocking would provide for a cut of 100 trees per acre with 36 square feet of basal area. This cut would typically amount to about 585 cubic feet, 7.3 cords or 783 board feet with a value of $45.29 per acre.

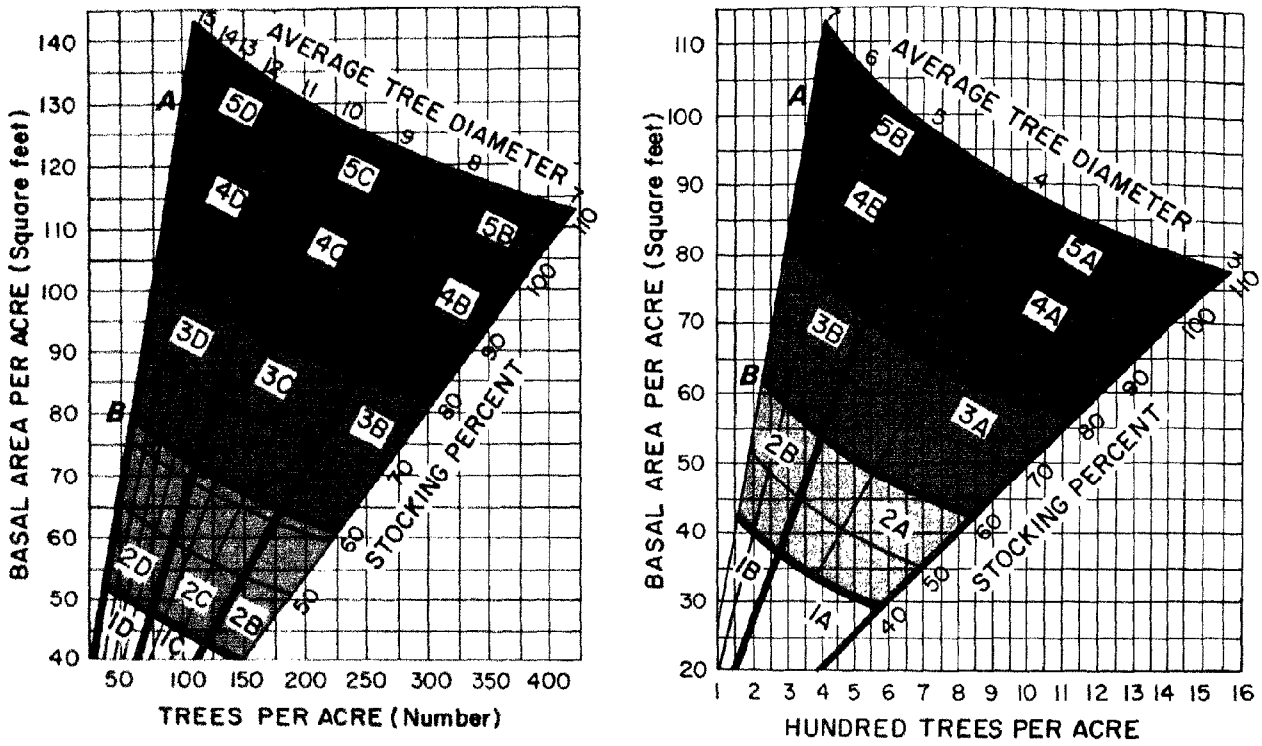

Figure 2.—Stocking chart illustrating mean d.b.h.—stocking categories.

Of course, before you decide to thin it is wise to look at how such a stand would respond to thinning. From Table 4C 10-years growth on the thinned stand would average about 339 cubic feet, which is 4.2 cords or 1,731 board feet. The value of the thinned stand increased from $158.95 to $230.84 or an increase of $71.90 per acre. Rate of value increase on our thinned stand over the 10-year period averaged 3.9 percent compared to 2.5 percent if not thinned. Besides this more favorable rate of value increase on the residual stand, remember the timber products removed would provide an additional value of $45.29 per acre.

In the above example, your decision might very well be to thin this stand now. However, large pole stands that were stocked with somewhat less basal area and number of trees (3C stands) might be treated differently. These stands are increasing at a rate of 3.1 percent without thinning or about a $50.00 increase in 10 years (Table 3C). If such stands were thinned to B-level now, they yield only 3.2 cords per acre, or 343 board feet with a value of about $19.76. In this instance, the volume thinned is so low it may not even cover the cost of removal. Many managers might wisely opt to wait 10 years or more before thinning such stands or until they can make a commercial thinning.

Priority for Treatment

The tables may be especially useful in helping managers decide on the priority of stands for treatment. For example, an inventory of all your stands can be used to place each stand in a specific cell of Figure 2. Even stands that fall outside the tabled values such as the stands with 20 percent or less stocking, or stands with greater than 15 inches mean diameter may fall in an obvious treatment category. Severely understocked stands likely need a regeneration cut to develop a new well-stocked stand in the future, whereas, stands larger than 15 inches mean diameter are generally beyond maturity and may need regeneration. The priority of other stands for treatment depends upon your own individual circumstances and management objectives.

The tables can be extremely useful, however, regardless of your particular situation. The information on yields with or without thinning, quantity and value of expected cut, and 10-year future growth with or without thinning can be used to develop your own priority of treatment for each of the different stand categories. Obviously some stands would benefit greatly from a thinning now, whereas, others have insufficient volume or value for an immediate commercial thinning. Timing of the harvest or regeneration cutting should hinge, of course, upon the quantity, size, and distributions of advanced reproduction.

The size of trees or quantity of wood to be removed by thinning in some young stands and some lower stocked stands is insufficient to pay for the treatment. Since we are looking only at 10-year responses here, the manager must be careful about completely discarding such pre-commercial treatments. Information similar to what is given here is needed for responses over the entire rotation. Only computer generated long-term simulations will provide this type information and it is beyond the scope of this report.

However, managers can usually easily identify more than sufficient acreage needing some type of high-priority treatment over the next 10-year-planning period.

Interpolation

Some stands may fall very close to an adjacent stocking or mean diameter class or both. Suppose an inventory of your small pole stand indicates 250 trees per acre 4 inches or larger and 85 square feet of basal area. Plotting basal area and number of trees on Figure 2 indicates the stand is about 79 percent stocked and has a mean stand diameter of about 7.9 inches. This stand falls in category 3B, but is extremely close to 3C, 4B, and also 4C.

Estimated board-foot volume, for example, indicates only 991 board feet using the mean volume from Table 3B. Because the standard deviation is 676 board feet, we might expect that approximately two-thirds of the observations in this size-stocking class would fall within the range of 315 to 1,667 board feet (991 ± 676). Now, since our stand has a mean diameter of 1.2 inches larger than average for 3B stands and since volume is closely related to diameter, we would expect this stand to be closer to the upper range in volume. In many instances, using the standard deviation as above will likely improve your estimate of the particular variable.

Interpolation can also be done by averaging the values if close to an adjacent size-stocking category. In the above example, averaging the board-foot volume for 3B and 3C stands we might estimate our stand as $(991 + 3488)/2 =$ 2,240 board feet. However, our best estimate in this example may come from averaging all four categories, 3B, 3C, 4B, and 4C, for an estimate of 2,616 board feet.

Many of the stand characteristics listed in the tables can be interpolated for a specific stand from graphs similar to Figures 3 or 4. The mean board-foot volume for each of the size-stocking categories is given in Figure 3. From this graph, one might estimate the board-foot volume for our example above as approximately 2,600 board feet. This compares closely with the 2,616 board feet by averaging the four categories above. Estimates from the graph are read by using the exact stand diameter and by approximating the proportional distance between stocking levels as shown in Figure 3.

Similarly, the present stand value would be estimated as $125.00 per acre from Figure 4 compared with $121.59 by averaging the four cells.

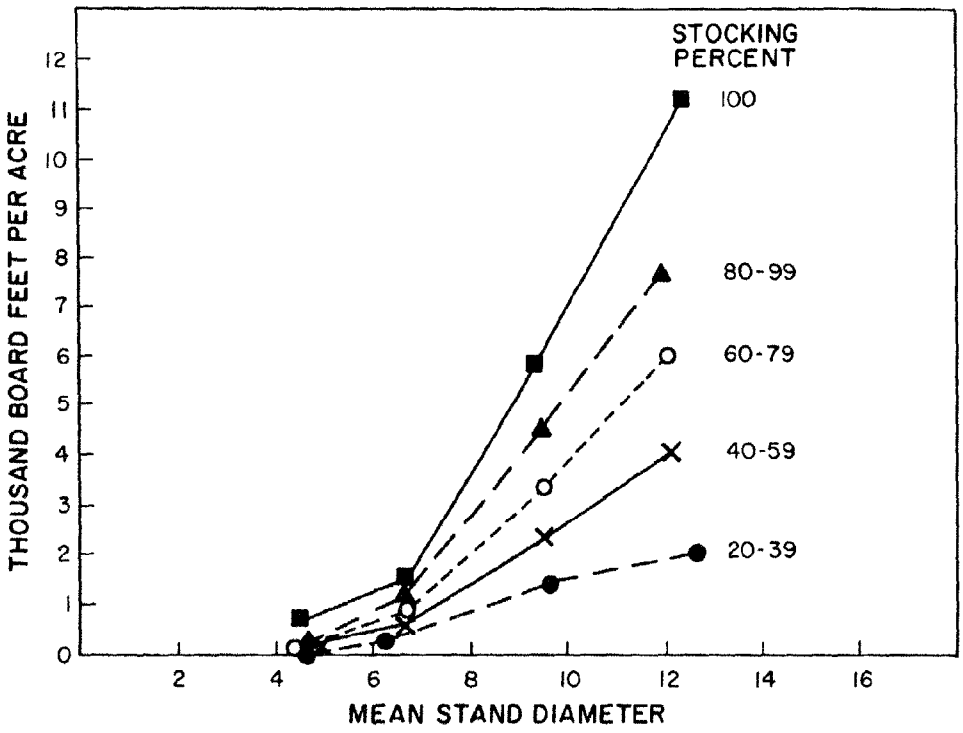

Figure 3.—Mean board-foot volume by stocking and mean d.b.h.

Literature Cited

Dale, Martin E. **Individual tree growth and simulation of stand development of an 80-year-old white oak stand**. *In*: Ek, A. R.; Balsiger, J. W.; Prommitz, L. C. eds. **Forest modeling and inventory**. Washington, DC: Society of American Foresters and Madison, WI: University of Wisconsin–Madison College of Agricultural and Life Sciences, School of Natural Resources; 1975:46–63.

Dale, M. E.; Brisbin, R. L. **Butt log quality of trees in Pennsylvania oak stands**. Res. Pap. NE–568. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1985. 8p.

DeBald, P. S.; Mendel, J. J. **Composite volume and value tables for hardwood pulpwood. SETs: Stand Evaluation Tools 3**. Res. Pap. NE–338. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1976. 43p.

Gingrich, S. F. **Measuring and evaluating stocking and stand density in upland hardwood forests in the Central States**. Forest Science 13:38–52; 1967.

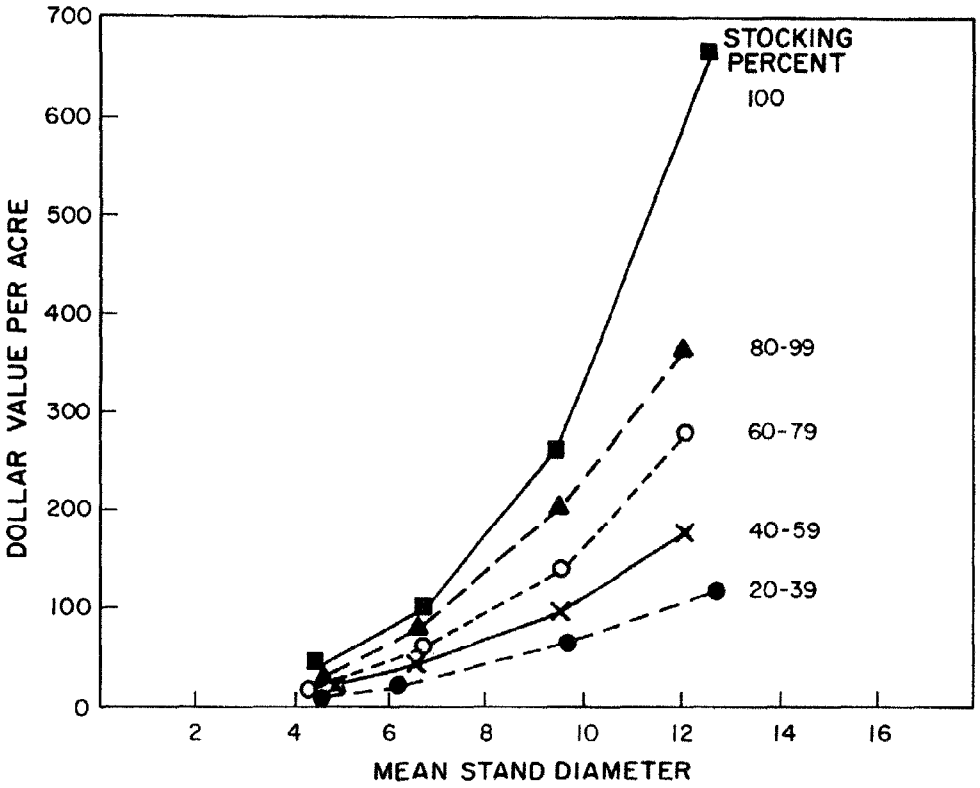

Figure 4.—Average stand value per acre by stocking and mean d.b.h.

Mendel, J. J.; DeBald, P. S.; Dale, M. E. **Tree value conversion standards for hardwood sawtimber. SETs: Stand Evaluation Tools 2**. Res. Pap. NE–337. Upper Darby, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1976. 74p.

Roach, B. A.; Gingrich, S. F. **Even-aged silviculture for upland central hardwoods**. Agric. Handb. 355. Washington, DC: U.S. Department of Agriculture; 1968. 39p.

Scott, C. T. **Northeastern forest survey board-foot volume equations**. Res. Note NE–271. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1979. 3p.

Scott, C. T. **Northeastern forest survey revised cubic-foot volume equations**. Res. Note NE–304. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1981. 3p.

Appendix A—Stand Variables

Basal Area Per Acre

The initial basal area per acre for each plot was based on the inventory by Forest Survey. Each tree tallied by the 37.5 factor prism represented 3.75 square feet of basal area since each plot consisted of a cluster of 10 prism points. Thus, if 30 trees were tallied on the plot, basal area per acre was computed as 30 * 3.75 = 112.5 square feet.

Number of Trees Per Acre

The 3.75 square feet of basal area for each tally tree was converted to number of trees per acre by dividing by the appropriate basal area for a tree of a given diameter and summed over all tally trees on a plot.

Mean Diameter

Mean stand diameter or average diameter shown in the tables was computed from basal area and number of trees and, thus, is the quadratic mean stand diameter.

D.b.h. of Median Basal Area

Each sample tree was ranked from smallest to largest on a plot. The d.b.h. here is the diameter of the tree that represents 50 percent of the cumulative basal area. The size of trees where 50 percent of the plot basal area is in larger trees is a good measure of the main stand canopy, and generally is about the size of the smallest codominant trees

Stocking Percent

The tree-area ratio for each observed tree was computed using Gingrich's (1967) equation. Total stocking percent was obtained by summing over all trees on a plot including culls and noncommercial species.

Acceptable Stocking Percent

This was computed as above except we excluded all culls, rotten trees, rough trees, and noncommercial species. Noncommercial species are listed in Forest Survey field manual instructions and include species such as dogwood, sourwood, serviceberry, pawpaw, redbud, sassafras, willow, boxelder, hawthorn, and other woody shrubs and trees that are noncommercial.

Cubic-Foot Volume

Cubic-foot volume was computed based on the d.b.h. and bole length as recorded by survey crews. We used the identical nonlinear equation form and model coefficients listed by Scott (1981). Our volume computations are the same as those used in the forest survey of the 14 Northeastern states. Minimum top diameter outside bark was 4 inches unless merchantability was limited by forks, extreme crook, rot, or other stem deformities. Per acre volumes were determined by multiplying the individual tree volume by the number of trees each sample represented and summing over each of the sample trees tallied. Percentage deductions for cull were applied, as recorded on the initial inventory, therefore, cubic-foot volume is net content of the merchantable portion of trees.

Cord Volume

The cordwood volume per acre was determined by dividing the net merchantable cubic-foot volume by 80 cubic feet.

Board-Foot Volume

Board-foot volume, International 1/4-inch rule, was computed using the model and coefficients of Scott (1979). Net volume was computed using the same procedures as above by applying cull deductions observed in the field for each of the sampled trees. Board-foot volume was computed for hardwoods 11.0 inches d.b.h. and larger and for softwoods 9.0 inches or larger.

Tree Value

We used the tree-value conversion standards (Mendel et al. 1976, DeBald and Mendel 1976) to develop value information for each tree. Trees less than sawtimber size were evaluated as pulpwood at $4 per cord. Larger hardwood trees were evaluated based on the expected lumber yields by grade and volume. The tree-value conversion standards allow for conversion costs including logging and milling. The final value of a tree, thus, depends on the species, butt log grade, expected board-foot lumber yields by grade, and the conversion costs. For some species, the small sawtimber trees of lower grades are occasionally more valuable as pulpwood than the sawn lumber. We compared the value of a tree as lumber to the value of the tree as pulpwood, and the higher dollar value was assigned.

Rate of Value Increase

After the stand projections were completed with or without thinning treatments (Appendix B), we computed rate of value increase. This rate of value increase was based on the initial stand value either before or after treatment and the projected stand value before or after treatment. Future values did not consider inflation, so the rate of value increase is real. Percentages for each plot were determined using the equation:

$$Y = \left(\frac{FV}{PV}\right)^{1/n} - 1$$

where

Y = rate of value increase in percent

FV = Future value or value in 10 years

PV = Present stand value

n = number of years, that is, 10 years

The rate of value increase shown in the tables is the mean for all plots in that stocking and d.b.h. class, and, therefore, differs slightly from the calculation if the average dollar values from the tables were used.

Appendix B—Projected Growth for 10 Years

Projected stand characteristics basically involved changes in the tree diameter, number of trees, merchantable stem height for both pulpwood and sawlogs, and tree quality or butt-log grade. A detailed description of the growth-projection techniques is beyond the scope of this paper, but, a brief outline of the procedures follows.

Basal Area Growth

We used individual tree-growth equations to obtain basal area growth of each sample tree over a 10-year period (Dale 1975). The equations applied to six species groups: white oak, black oak, hickory, red maple, other timber species, and shrubs. Growth rates varied, not only by species but also by site, stocking, mean stand diameter, and sample-tree diameter.

Individual tree-growth projections were validated using growth records over a 9- to 13-year period from permanent plot data for the oak-hickory type in Pennsylvania. The projections are quite adequate for the short period of 10 years used here.

Number of Trees

The change in number of trees due to mortality was based on the relationship between net basal-area growth and gross basal-area growth per acre. Gross basal-area growth was determined as indicated above. Net basal-area growth was computed for each plot as:

$$NG = (.98 - EXP(-2.0*(130 - P)/P))*GG$$

where

NG = Net basal-area growth

P = Percent stocking of plot

GG = Gross basal-area growth

EXP = Base of natural logarithms

Coefficients in the above equation were based on 20-year growth records from 72 permanent growth plots located in the upland oak type. Computed net growth was proportionally allocated back to each sample tree. From the initial and final basal-area per tree and the amount of basal-area growth, we were able to derive the number of living or dead trees represented by each sample tree tallied with the prism.

Merchantable Stem Height

Merchantable stem height to a 4-inch top d.o.b. (diameter outside bark) was initially estimated for all trees larger than 5.0 inches. Sawlog height was also estimated to a 10-inch top d.o.b. for hardwood sawtimber trees and a 7.0 inch d.o.b. for softwoods. These estimated heights were used in computing initial tree volumes, but, for projected volumes we had to allow for increased height growth. Merchantable equations for pulpwood and sawlog trees were developed for each of the 17 species groups using the nonlinear model form:

$$H_i = \beta_0 * S^{**}.25(1 - EXP(\beta_1(D_i - 4.0)))$$

where

Hi = Merchantable height for pulpwood or sawlogs of ith tree

S = Site index

Di = Diameter breast height of ith tree

EXP = Base of natural logarithms

β_0, β_1 = parameters to be estimated

By solving these equations for merchantable height using initial and projected d.b.h., we computed height growth as the difference between height at time 2 and time 1. This height growth was then added to the original height. Ingrowth trees were merely assigned an average merchantable height based on the species, site, and projected d.b.h. using the appropriate equation.

Butt-Log Grade

The procedure for predicting change in butt-log grade over time was similar to merchantable height changes.

Nonlinear models of the following form were used to fit the distribution of trees for each grade.

$$Y(i,1) = \beta_0 * (1 - EXP(\beta_1 * (D_i - Co))) ** \beta_2$$

where

Y(i, 1) = Proportion of trees in the ith diameter class that are of a specified grade

EXP = Base of natural logarithm

Di = Midpoint of the ith diameter class

Co = A constant, to be assigned. It is the minimum d.b.h. that qualifies for a specified grade.

β_o, β_1, β_2 = Model parameters to be estimated by nonlinear regression techniques.

More details of fitting the grade distributions along with models and coefficients for eight hardwood species groups are available (Dale and Brisbin 1985).

The probability of a tree changing grade was determined using a random number generator and sampling from the grade probabilities obtained by solving the above equations for a given species, size, and initial grade. Ingrowth trees reaching sawtimber size at the end of the projection period were randomly assigned to hardwood factory lumber log grade 3 or a grade 4 which is a hardwood construction log depending on the species, size, and computed probabilities. A small probability (5 percent) was allowed for the possibility of trees decreasing in grade.

Appendix C—Thinning Rule

A rather complex thinning rule was developed based on a number of tree characteristics recorded by forest survey crews. We found the tree-class code used by survey particularly useful. This code classifies live trees into four classes: desirable, acceptable, rough, and rotten. In addition to the tree class, we used other tree characteristics such as species, size, and log grade. Also, based on species we assigned three relative value classes: low-, intermediate-, and high-value hardwoods.

From the tree and value characteristics, we assigned each tree a three digit thinning code. By ranking from best to worst, we were able to select the best trees to leave to provide the appropriate B-level stocking. Trees near the bottom of this list (to be removed first) included trees that were rotten, rough, unmerchantable species, and trees that were considered mature (larger than 24 inches). Scheduled next for removal were acceptable trees that were low value because of species or log grade. The very best trees at the top of the list were trees classified desirable, high value, and log grade 1.

Appendix D—Yield and Value Tables

Table 1A.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 3.0–5.0 INCHES; STOCKING 21–40 PERCENT (3 PLOTS)			
Basal area per acre, ft^2	26.9	52.2	25.3
(per acre)	(7.0)	(7.0)	(5.7)
No. of trees	235	232	−3
	(45)	(44)	(1)
Average d.b.h., inches	4.6	6.4	1.9
	(0.2)	(0.3)	(0.5)
D.b.h., inches, at 50% of	5.0	7.2	2.2
basal area	(0.9)	(1.6)	(0.8)
Stocking percent	31.7	53.3	21.7
	(8.0)	(8.4)	(4.9)
Stocking percent of	24.4	39.8	15.3
acceptable trees	(13.0)	(15.0)	(2.1)
Cubic-foot volume	141	594	453
	(96)	(168)	(261)
Cord volume	1.8	7.4	5.7
	(1.2)	(2.1)	(3.3)
Board-foot volume	0	791	791
	0	(1371)	(1371)
Tree value, dollars	7.40	33.62	26.22
	(5.03)	(7.44)	(12.40)
Rate of value increase, percent	NA	NA	0.200
			(0.152)

Table 1B.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 5.1–8.0 INCHES; STOCKING 21–40 PERCENT (9 PLOTS)			
Basal area per acre, ft^2	33.1	50.3	17.2
	(5.9)	(8.4)	(4.2)
No. of trees	169	167	−2
	(49)	(49)	2
Average D.b.h., inches	6.2	7.6	1.5
	(0.9)	(0.9)	0.2
D.b.h., inches, at 50% of basal area	7.3	8.9	1.6
	(1.6)	(1.6)	(0.2)
Stocking percent	34.2	48.2	14.1
	(6.1)	(8.7)	(3.8)
Stocking percent of acceptable trees	25.1	35.9	10.8
	(8.0)	(12.2)	(4.7)
Cubic-foot volume	319	669	351
	(86)	(154)	(108)
Cord volume	4.0	8.4	4.4
	(1.1)	(1.9)	(1.3)
Board-foot volume	303	846	543
	(258)	(475)	(419)
Tree value, dollars	19.52	39.14	19.62
	(7.88)	(10.27)	(5.46)
Rate of value increase, percent	NA	NA	0.076
			(0.022)

Table 1C.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 8.1–11.0 INCHES; STOCKING 21–40 PERCENT (11 PLOTS)			
Basal acre per acre, ft^2	38.1	48.7	10.6
	(7.0)	(6.8)	(1.7)
No. of trees	75	74	−1
	(13)	(13)	(1)
Average d.b.h., inches	9.7	11.0	1.4
	(0.9)	(0.8)	(0.2)
D.b.h., inches, at 50% of basal area	10.0	11.4	1.4
	(1.7)	(1.7)	(0.2)
Stocking percent	33.2	40.9	7.7
	(5.5)	(5.5)	(1.4)
Stocking percent of acceptable trees	30.1	37.0	6.9
	(7.8)	(8.5)	(1.5)
Cubic-foot volume	672	916	244
	(204)	(229)	(57)
Cord volume	8.4	11.5	3.1
	(2.6)	(2.9)	(0.7)
Board-foot volume	1492	2482	990
	(992)	(1108)	(407)
Tree value, dollars	65.22	93.86	28.64
	(55.16)	(68.74)	(16.11)
Rate of value increase, percent	NA	NA	0.043
			(0.015)

Table 1D.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 11.1–15.0 INCHES; STOCKING 21–40 PERCENT (3 PLOTS)			
Basal area per acre, ft^2	41.2	47.4	6.2
	(3.8)	(7.5)	(3.8)
No. of trees	48	46	−3
	(13)	(11)	(4)
Average d.b.h., inches	12.7	14.0	1.2
	(2.0)	(2.0)	(0.1)
D.b.h., inches, at 50% of basal area	18.0	19.4	1.4
	(8.1)	(8.0)	(0.5)
Stocking percent	32.6	36.9	4.2
	(2.4)	(4.9)	(3.0)
Stocking percent of acceptable trees	26.8	30.5	3.7
	(3.1)	(6.3)	(3.4)
Cubic-foot volume	638	767	131
	(30)	(61)	(56)
Cord volume	8.0	9.6	1.6
	(0.4)	(0.8)	(0.7)
Board-foot volume	2134	2665	531
	(406)	(256)	(245)
Tree value, dollars	118.77	147.49	28.73
	(90.09)	(108.40)	(21.72)
Rate of value increase, percent	NA	NA	0.020
			(0.011)

Table 2A.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 3.0–5.0 INCHES; STOCKING 41–60 PERCENT (13 PLOTS)			
Basal area per acre, ft^2	44.3	68.5	24.2
	(5.7)	(9.1)	(5.3)
No. of trees	354	345	−9
	(51)	(46)	(5)
Average d.b.h., inches	4.8	6.0	1.2
	(0.1)	(0.3)	(0.2)
D.b.h., inches, at 50% of basal area	5.0	6.3	1.3
	(0.6)	(0.9)	(0.4)
Stocking percent	50.8	71.7	20.9
	(6.7)	(9.4)	(4.7)
Stocking Percent of acceptable trees	40.4	56.8	16.4
	(9.6)	(13.0)	(4.9)
Cubic-foot volume	275	691	416
	(103)	(189)	(159)
Cord volume	3.4	8.6	5.2
	(1.3)	(2.4)	(2.0)
Board-foot volume	377	603	226
	(351)	(437)	(232)
Tree value, dollars	21.93	47.27	25.34
	(18.67)	(21.60)	(9.93)
Rate of value increase, percent	NA	NA	0.097
			(0.051)

Table 2B.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 5.1–8.0 INCHES; STOCKING 41–60 PERCENT (26 PLOTS)			
Basal area per acre, ft^2	51.9	69.4	17.5
	(6.1)	(4.9)	(5.0)
No. of trees	221	213	−8
	(50)	(47)	(7)
Average d.b.h., inches	6.7	7.9	1.2
	(0.9)	(0.8)	(0.2)
D.b.h., inches, at 50% of basal area	7.8	9.1	1.3
	(2.1)	(2.1)	(0.4)
Stocking percent	51.5	65.2	13.8
	(5.2)	(5.2)	(4.7)
Stocking percent of acceptable trees	39.5	49.6	10.1
	(8.9)	(9.4)	(3.6)
Cubic-foot volume	663	1055	393
	(234)	(250)	(102)
Cord volume	8.3	13.2	4.9
	(2.9)	(3.1)	(1.3)
Board-foot volume	687	1499	812
	(630)	(943)	(632)
Tree value, dollars	45.02	75.44	30.42
	(21.8)	(33.51)	(13.94)
Rate of value increase, percent	NA	NA	0.058
			(0.021)

Table 2C.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 8.1–11.0 INCHES; STOCKING 41–60 PERCENT (39 PLOTS)			
Basal area per acre, ft^2	58.8	69.0	10.2
	(6.3)	(8.8)	(5.4)
No. of trees	119	112	-7
	(23)	(23)	(8)
Average d.b.h., inches	9.6	10.7	1.1
	(0.9)	(1.0)	(0.2)
D.b.h., inches, at 50% of basal area	9.8	11.0	1.2
	(1.7)	(1.8)	(0.2)
Stocking percent	51.4	58.4	7.0
	(5.3)	(7.5)	(4.5)
Stocking percent of acceptable trees	45.7	51.9	6.3
	(7.2)	(9.6)	(4.1)
Cubic-foot volume	1014	1260	245
	(177)	(225)	(105)
Cord volume	12.7	15.7	3.1
	(2.2)	(2.8)	(1.3)
Board-foot volume	2317	3304	987
	(939)	(1054)	(512)
Tree value, dollars	100.35	140.99	40.65
	(58.38)	(73.88)	(22.73)
Rate of value increase, percent	NA	NA	0.035
			(0.015)

Table 2D.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned		
	Present	Ten years	Ten-year growth
MEAN DIAMETER 11.1–15.0 INCHES; STOCKING 41–60 PERCENT (28 PLOTS)			
Basal area per acre, ft^2	63.6	75.2	11.6
	(7.8)	(8.2)	(2.1)
No. of trees	80	77	−3
	(14)	(13)	(2)
Average d.b.h., inches	12.2	13.5	1.3
	(0.9)	(1.0)	(0.2)
D.b.h., inches, at 50% of basal area	13.7	15.1	1.4
	(2.0)	(2.2)	(0.3)
Stocking percent	51.9	59.8	7.9
	(6.2)	(6.4)	(1.6)
Stocking percent of acceptable trees	47.4	54.6	7.2
	(8.6)	(9.4)	(1.7)
Cubic-foot volume	1252	1516	264
	(313)	(360)	(68)
Cord volume	15.6	18.9	3.3
	(3.9)	(4.5)	(0.9)
Board-foot volume	4264	5686	1422
	(1439)	(1505)	(431)
Tree value, dollars	184.88	264.24	79.37
	(95.79)	(112.93)	(28.68)
Rate of value increase, percent	NA	NA	.0364
			(0.013)

Table 3A.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 3.0-5.0 INCHES; STOCKING 61-80 PERCENT (10 PLOTS)							
Basal area per acre ft^2	55.4 (5.5)	74.2 (7.3)	18.8 (4.9)	12.0 (8.3)	43.5 (5.5)	62.9 (8.9)	19.4 (4.4)
No. of trees	564 (84)	529 (88)	−35 (16)	124 (71)	440 (116)	427 (113)	−13 (4)
Average d.b.h., inches	4.3 (0.5)	5.1 (0.6)	0.8 (0.2)	4.3 (1.1)	4.4 (0.6)	5.3 (0.8)	1.0 (0.2)
D.b.h., inches, at 50% of basal area	4.2 (0.5)	5.1 (0.8)	0.9 (0.3)	NA	4.3 (0.7)	5.4 (1.0)	1.0 (0.4)
Stocking percent	68.5 (4.4)	84.4 (5.0)	15.9 (4.5)	14.9 (10.0)	53.6 (7.4)	70.6 (9.4)	17.0 (3.5)
Stocking percent of acceptable trees	61.2 (12.7)	75.2 (15.8)	13.9 (5.5)	10.4 (12.0)	50.9 (9.8)	66.9 (12.2)	16.0 (3.7)
Cubic-foot volume	229 (140)	546 (338)	316 (217)	9 (21)	221 (134)	526 (329)	306 (209)
Cord volume	2.9 (1.7)	6.8 (4.2)	4.0 (2.7)	0.1 (0.3)	2.8 (1.7)	6.6 (4.1)	3.8 (2.6)
Board-Foot volume	98 (160)	181 (274)	83 (144)	0 (0)	98 (160)	201 (303)	103 (180)
Tree value, dollars	13.09 (8.55)	30.98 (20.35)	17.89 (12.74)	0.46 (1.12)	12.62 (8.18)	30.13 (20.62)	17.50 (13.31)
Rate of value increase, percent	NA	NA	0.086 (0.025)	NA	NA	0.086 (0.021)	NA

Table 3B.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 5.1-8.0 INCHES; STOCKING 61-80 PERCENT (37 PLOTS)							
Basal area per acre, ft^2	70.1 (6.9)	84.9 (6.2)	14.8 (4.7)	17.4 (8.6)	52.7 (8.3)	69.4 (8.9)	16.7 (3.5)
No. of trees	295 (68)	270 (63)	−25 (14)	88 (49)	207 (70)	200 (67)	−6 (3)
Average d.b.h., inches	6.7 (0.9)	7.7 (0.9)	1.0 (0.2)	6.6 (2.5)	7.1 (1.2)	8.2 (1.2)	1.2 (0.2)
D.b.h., inches, at 50% of basal area	7.3 (1.4)	8.3 (1.4)	1.0 (0.2)	NA	7.6 (1.5)	8.9 (1.5)	1.2 (0.2)
Stocking percent	69.9 (5.4)	80.7 (5.6)	10.8 (4.4)	18.0 (8.9)	51.9 (7.8)	64.9 (9.1)	13.0 (3.2)
Stocking percent of acceptable trees	60.6 (9.6)	69.5 (9.9)	8.8 (3.7)	9.5 (9.0)	51.1 (7.8)	63.9 (8.7)	12.8 (3.0)
Cubic-foot volume	909 (270)	1305 (285)	396 (117)	142 (106)	767 (234)	1170 (245)	402 (104)
Cord volume	11.4 (3.4)	16.3 (3.6)	4.9 (1.5)	1.8 (1.3)	9.6 (2.9)	14.6 (3.1)	5.0 (1.3)
Board-foot volume	991 (676)	1801 (957)	809 (558)	105 (223)	886 (640)	1815 (1031)	929 (583)
Tree value, dollars	60.52 (28.64)	90.31 (36.16)	29.78 (14.95)	8.52 (9.07)	52.00 (25.22)	85.54 (35.34)	33.53 (13.59)
Rate of value increase, percent	NA	NA	0.044 (0.020)	NA	NA	0.055 (0.021)	NA

Table 3C.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 8.1-11.0 INCHES; STOCKING 61-80 PERCENT (72 PLOTS)							
Basal area per acre, ft^2	80.3 (6.8)	91.2 (8.8)	11.0 (4.6)	17.2 (6.7)	63.1 (5.7)	76.7 (5.9)	13.7 (1.5)
No. of trees	163 (27)	150 (24)	−13 (8)	44 (23)	119 (26)	116 (25)	−3 (1)
Average d.b.h., inches	9.6 (0.7)	10.6 (0.8)	1.1 (0.1)	9.3 (3.4)	10.0 (1.2)	11.2 (1.3)	1.2 (0.1)
D.b.h., inches at, 50% of basal area	10.3 (1.6)	11.4 (1.6)	1.1 (0.2)	NA	11.3 (1.6)	12.6 (1.6)	1.2 (0.2)
Stocking percent	70.4 (5.8)	77.5 (7.2)	7.2 (3.8)	15.6 (6.0)	54.7 (4.9)	64.5 (5.2)	9.7 (1.2)
Stocking percent of acceptable trees	62.5 (10.2)	68.9 (12.1)	6.4 (3.6)	9.0 (7.3)	53.4 (6.8)	62.9 (7.7)	9.5 (1.6)
Cubic-foot volume	1509 (294)	1799 (353)	290 (102)	256 (141)	1253 (246)	1593 (277)	340 (60)
Cord volume	18.9 (3.7)	22.5 (4.4)	3.6 (1.3)	3.2 (1.8)	15.7 (3.1)	19.9 (3.5)	4.3 (0.8)
Board-foot volume	3488 (1374)	4684 (1624)	1196 (579)	343 (433)	3145 (1351)	4593 (1623)	1448 (490)
Tree value, dollars	140.73 (61.01)	190.74 (81.18)	50.02 (24.07)	19.76 (19.49)	120.97 (57.45)	181.39 (81.02)	60.42 (27.80)
Rate of value increase, percent	NA	NA	0.031 (0.008)	NA	NA	0.042 (0.011)	NA

Table 3D.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 11.1-15.0 INCHES; STOCKING 61-80 PERCENT (30 PLOTS)							
Basal area per acre, ft^2	86.6 (9.0)	98.2 (9.7)	11.5 (2.5)	19.6 (10.6)	67.0 (8.9)	79.6 (8.9)	12.5 (1.1)
No. of trees	109 (12)	102 (11)	−7 (3)	27 (15)	83 (15)	81 (15)	−2 (1)
Average d.b.h., inches	12.1 (1.1)	13.3 (1.1)	1.2 (0.1)	11.5 (3.3)	12.3 (1.6)	13.6 (1.6)	1.3 (0.1)
D.b.h., inches, at 50% of basal area	13.3 (1.7)	14.5 (1.7)	1.2 (0.1)	NA	13.8 (2.1)	15.1 (2.1)	1.3 (0.2)
Stocking percent	70.6 (6.2)	78.2 (6.7)	7.5 (1.8)	16.0 (8.3)	54.6 (6.4)	63.2 (6.4)	8.6 (0.8)
Stocking percent of acceptable trees	64.6 (9.6)	71.3 (10.8)	6.7 (2.2)	10.5 (8.2)	54.1 (6.7)	62.6 (6.8)	8.5 (0.9)
Cubic-foot volume	1808 (381)	2096 (415)	288 (62)	342 (209)	1467 (325)	1780 (341)	313 (35)
Cord volume	22.6 (4.8)	26.2 (5.2)	3.6 (0.8)	4.3 (2.6)	18.3 (4.1)	22.3 (4.3)	3.9 (0.4)
Board-foot volume	6128 (1926)	7753 (2072)	1625 (520)	972 (872)	5156 (1770)	6923 (1823)	1767 (409)
Tree value, dollars	278.12 (115.22)	368.39 (145.86)	90.28 (41.84)	49.01 (59.44)	229.11 (94.15)	329.09 (131.03)	99.98 (41.64)
Rate of value increase, percent	NA	NA	0.029 (0.009)	NA	NA	0.038 (0.008)	NA

Table 4A.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned				Thinned to B-Level		
	Present	Ten years	Ten year growth	Cut	Present	Ten years	Ten year growth
MEAN DIAMETER 3.0-5.0 INCHES; STOCKING 81-100 PERCENT (8 PLOTS)							
Basal area per acre, ft^2	74.1 (4.9)	95.8 (7.1)	21.6 (5.5)	23.9 (4.7)	50.2 (1.7)	76.1 (6.5)	25.9 (6.4)
No. of trees	646 (60)	562 (37)	-84 (28)	230 (61)	416 (30)	400 (29)	-16 (3)
Average d.b.h., inches	4.6 (0.2)	5.6 (0.2)	1.0 (0.2)	4.4 (0.5)	4.7 (0.2)	5.9 (0.3)	1.2 (0.3)
D.b.h., inches, at 50% of basal area	5.0 (0.7)	6.1 (0.8)	1.1 (0.3)	NA	5.5 (0.9)	6.7 (1.2)	1.2 (0.4)
Stocking percent	86.9 (5.7)	103.6 (7.2)	16.7 (4.8)	28.7 (5.1)	58.2 (1.1)	80.3 (6.0)	22.2 (5.7)
Stocking percent of acceptable trees	67.9 (14.5)	78.7 (17.8)	10.8 (5.6)	10.9 (13.9)	57.0 (2.8)	79.0 (6.6)	22.0 (5.8)
Cubic-foot volume	468 (191)	882 (178)	414 (220)	106 (122)	363 (101)	817 (195)	455 (226)
Cord volume	5.9 (2.4)	11.0 (2.2)	5.2 (2.7)	1.3 (1.5)	4.5 (1.3)	10.2 (2.4)	5.7 (2.8)
Board-foot volume	272 (246)	527 (440)	254 (294)	143 (159)	129 (149)	525 (578)	395 (488)
Tree value, dollars	27.08 (12.50)	48.80 (11.33)	21.72 (11.33)	8.04 (9.12)	19.04 (5.31)	45.06 (9.86)	26.03 (10.75)
Rate of value increase, percent	NA	NA	0.069 (0.046)	NA	NA	0.092 (0.041)	NA

Table 4B.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 5.1–8.0 INCHES; STOCKING 81–100 PERCENT (42 PLOTS)							
Basal area per acre, ft^2	88.1 (8.0)	97.0 (11.1)	8.9 (7.7)	31.2 (7.9)	56.9 (6.3)	72.9 (6.1)	16.0 (3.0)
No. of trees	378 (75)	324 (65)	−54 (28)	187 (60)	191 (50)	186 (48)	−5 (2)
Average d.b.h., inches	6.6 (0.7)	7.5 (0.8)	0.9 (0.2)	5.7 (1.0)	7.6 (1.1)	8.7 (1.1)	1.1 (0.2)
D.b.h., inches, at 50% of basal area	7.4 (1.6)	8.3 (1.7)	0.9 (0.3)	NA	8.3 (1.8)	9.4 (1.9)	1.2 (0.2)
Stocking percent	88.3 (6.4)	92.9 (8.9)	4.6 (7.2)	33.7 (7.7)	54.6 (5.1)	66.8 (5.5)	12.2 (2.7)
Stocking percent of acceptable trees	77.1 (11.2)	80.8 (13.9)	3.7 (7.0)	22.5 (10.9)	54.6 (5.1)	66.8 (5.5)	12.2 (2.7)
Cubic-foot volume	1131 (351)	1469 (377)	338 (150)	236 (179)	895 (260)	1284 (251)	388 (85)
Cord volume	14.1 (4.4)	18.4 (4.7)	4.2 (1.9)	2.9 (2.2)	11.2 (3.3)	16.0 (3.1)	4.9 (1.1)
Board-foot volume	1225 (1205)	2020 (1514)	795 (605)	136 (241)	1088 (1120)	2159 (1525)	1071 (632)
Tree value, dollars	80.87 (55.60)	108.53 (66.23)	27.66 (18.51)	15.04 (15.01)	65.84 (52.15)	104.07 (67.33)	38.25 (20.33)
Rate of value increase, percent	NA	NA	0.032 (0.019)	NA	NA	0.052 (0.022)	NA

Table 4C.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 8.1-11.0 INCHES; STOCKING 81-100 PERCENT (58 PLOTS)							
Basal area per acre, ft^2	102.8 (6.5)	111.3 (6.3)	8.5 (4.0)	35.8 (6.5)	67.1 (4.3)	80.4 (4.4)	13.3 (1.6)
No. of trees	211 (37)	186 (31)	−25 (10)	100 (31)	111 (28)	108 (27)	−3 (1)
Average d.b.h., inches	9.5 (0.9)	10.6 (1.0)	1.0 (0.2)	8.3 (1.3)	10.8 (1.6)	11.9 (1.6)	1.2 (0.1)
D.b.h., inches, at 50% basal area	10.7 (1.3)	11.7 (1.3)	1.0 (0.2)	NA	12.1 (1.6)	13.3 (1.7)	1.2 (0.1)
Stocking percent	90.2 (5.5)	94.7 (5.1)	4.5 (3.3)	33.1 (6.1)	57.1 (2.9)	66.5 (3.3)	9.4 (1.3)
Stocking percent of acceptable trees	81.8 (10.1)	86.0 (10.6)	4.1 (3.2)	24.8 (9.3)	57.0 (2.9)	66.4 (3.3)	9.4 (1.3)
Cubic-foot volume	1997 (356)	2254 (357)	257 (94)	585 (192)	1412 (234)	1751 (252)	339 (57)
Cord volume	25.0 (4.5)	28.2 (4.5)	3.2 (1.2)	7.3 (2.4)	17.6 (2.9)	21.9 (3.2)	4.2 (0.7)
Board-foot volume	4763 (1923)	6128 (2044)	1365 (718)	783 (722)	3981 (1590)	5712 (1820)	1731 (604)
Tree value, dollars	204.24 (114.19)	257.67 (126.30)	53.43 (32.46)	45.29 (46.80)	158.95 (80.41)	230.84 (106.79)	71.90 (34.32)
Rate of value increase, percent	NA	NA	0.025 (0.011)	NA	NA	0.039 (0.011)	NA

Table 4D.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 11.1-15.0 INCHES; STOCKING 81-100 PERCENT (30 PLOTS)							
Basal area per acre, ft^2	108.5 (7.0)	118.2 (6.7)	9.7 (2.2)	37.7 (7.3)	70.8 (3.9)	82.8 (4.1)	12.1 (1.2)
No. of trees	139 (19)	126 (16)	−13 (5)	60 (19)	79 (14)	78 (13)	−2 (1)
Average d.b.h., inches	12.0 (0.9)	13.2 (0.9)	1.2 (0.1)	11.2 (2.5)	12.9 (1.1)	14.1 (1.2)	1.2 (0.1)
D.b.h., inches, at 50% of basal area	13.5 (1.5)	14.6 (1.6)	1.1 (0.2)	NA	14.3 (1.5)	15.6 (1.6)	1.3 (0.2)
Stocking percent	88.8 (5.7)	94.4 (5.2)	5.6 (1.7)	31.6 (5.9)	57.2 (2.9)	65.4 (3.1)	8.2 (0.8)
Stocking percent of acceptable trees	83.4 (8.4)	88.7 (9.0)	5.3 (1.9)	26.4 (7.0)	57.0 (3.7)	65.2 (4.0)	8.2 (0.9)
Cubic-foot volume	2341 (434)	2607 (464)	266 (64)	726 (217)	1615 (289)	1924 (328)	309 (54)
Cord volume	29.3 (5.4)	32.6 (5.8)	3.3 (0.8)	9.1 (2.7)	20.2 (3.6)	24.0 (4.1)	3.9 (0.7)
Board-foot volume	7804 (2115)	9534 (2284)	1731 (620)	1995 (1035)	5808 (1585)	7631 (1785)	1822 (543)
Tree value, dollars	364.30 (189.90)	462.60 (213.85)	98.30 (35.87)	104.75 (93.86)	259.55 (118.15)	365.58 (147.57)	106.02 (36.55)
Rate of value increase, percent	NA	NA	0.027 (0.009)	NA	NA	0.037 (0.010)	NA

Table 5A.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 3.0-5.0 INCHES; STOCKING OVER 100 PERCENT (7 PLOTS)							
Basal area per acre, ft^2	112.4 (26.9)	110.8 (14.2)	-1.5 (16.1)	64.4 (26.8)	47.8 (4.5)	69.7 (9.5)	22.0 (7.0)
No. of trees	1012 (181)	767 (154)	-245 (138)	654 (193)	359 (52)	348 (48)	-10 (4)
Average d.b.h., inches	4.5 (0.2)	5.2 (0.3)	0.7 (0.2)	4.2 (0.3)	5.0 (0.4)	6.1 (0.4)	1.1 (0.2)
D.b.h., inches, at 50% of basal area	4.9 (0.5)	5.5 (0.7)	0.6 (0.3)	NA	6.3 (1.6)	7.6 (1.9)	1.3 (0.5)
Stocking percent	133.7 (31.3)	124.7 (17.7)	-9.1 (19.5)	80.4 (31.2)	53.4 (3.5)	72.0 (8.6)	18.6 (6.5)
Stocking percent of acceptable trees	116.6 (47.2)	106.0 (37.7)	-10.5 (18.8)	65.0 (43.7)	51.6 (6.4)	69.8 (11.6)	18.2 (6.8)
Cubic-foot volume	497 (192)	739 (245)	242 (166)	89 (102)	408 (120)	792 (157)	383 (99)
Cord volume	6.2 (2.4)	9.2 (3.1)	3.0 (2.1)	1.1 (1.3)	5.1 (1.5)	9.9 (2.0)	4.8 (1.2)
Board-foot volume	702 (688)	783 (789)	81 (125)	59 (110)	643 (620)	1139 (1123)	496 (525)
Tree value, dollars	37.72 (30.07)	55.05 (31.16)	17.33 (9.06)	4.69 (5.39)	33.03 (28.42)	65.04 (45.54)	32.02 (17.63)
Rate of value increase, percent	NA	NA	0.050 (0.030)	NA	NA	0.079 (0.022)	NA

Table 5B.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 5.1-8.0 INCHES; STOCKING OVER 100 PERCENT (26 PLOTS)							
Basal area per acre, ft^2	115.2 (12.5)	114.9 (11.1)	-0.3 (6.0)	56.6 (12.4)	58.6 (7.0)	74.6 (6.1)	16.0 (2.6)
No. of trees	476 (80)	379 (58)	-97 (39)	308 (80)	168 (39)	163 (38)	-4 (2)
Average d.b.h., inches	6.7 (0.6)	7.5 (0.7)	0.8 (0.2)	5.9 (0.6)	8.1 (0.9)	9.3 (0.9)	1.2 (0.2)
D.b.h., inches, at 50% of basal area	7.7 (1.1)	8.5 (1.2)	0.8 (0.2)	NA	8.9 (1.3)	10.2 (1.3)	1.2 (0.2)
Stocking percent	114.7 (10.9)	109.8 (8.5)	-4.9 (6.0)	59.8 (12.2)	54.9 (5.8)	66.8 (5.7)	11.9 (2.3)
Stocking percent of acceptable trees	98.5 (16.3)	93.9 (16.6)	-4.6 (5.6)	43.6 (15.3)	54.9 (5.8)	66.8 (5.7)	11.9 (2.3)
Cubic-foot volume	1572 (407)	1830 (382)	258 (99)	522 (245)	1050 (240)	1463 (244)	413 (91)
Cord volume	19.7 (5.1)	22.9 (4.8)	3.2 (1.2)	6.5 (3.1)	13.1 (3.0)	18.3 (3.0)	5.2 (1.1)
Board-foot volume	1549 (896)	2283 (1140)	734 (506)	367 (390)	1182 (797)	2470 (1078)	1289 (516)
Tree value, dollars	100.91 (35.65)	124.13 (40.50)	23.22 (11.95)	31.01 (18.66)	69.91 (25.18)	114.00 (34.18)	44.09 (16.32)
Rate of value increase, percent	NA	NA	0.022 (0.011)	NA	NA	0.052 (0.021)	NA

Table 5C.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 8.1-11.0 INCHES; STOCKING OVER 100 PERCENT (27 PLOTS)							
Basal area per acre, ft^2	129.4 (15.2)	125.4 (21.1)	-4.0 (18.1)	60.9 (14.0)	68.5 (4.5)	82.2 (3.7)	13.8 (2.2)
No. of trees	272 (58)	212 (48)	-59 (38)	165 (52)	107 (34)	105 (33)	-3 (1)
Average d.b.h., inches	9.4 (0.8)	10.5 (1.0)	1.0 (0.2)	8.4 (0.9)	11.2 (1.9)	12.4 (2.0)	1.2 (0.1)
D.b.h., inches, at 50% of basal area	10.3 (1.5)	11.3 (1.5)	1.0 (0.2)	NA	12.4 (2.4)	13.6 (2.4)	1.2 (0.1)
Stocking percent	113.9 (13.4)	107.1 (17.5)	-6.8 (15.4)	56.1 (12.9)	57.8 (2.5)	67.5 (3.3)	9.7 (1.9)
Stocking percent of acceptable trees	105.9 (13.2)	100.2 (20.1)	-5.7 (12.9)	48.1 (12.4)	57.8 (2.5)	67.5 (3.3)	9.7 (1.9)
Cubic-foot volume	2556 (484)	2618 (617)	62 (306)	1058 (298)	1499 (258)	1856 (243)	357 (60)
Cord volume	32.0 (6.1)	32.7 (7.7)	0.8 (3.8)	13.2 (3.7)	18.7 (3.2)	23.2 (3.0)	4.5 (0.7)
Board-foot volume	5936 (2051)	6851 (2507)	916 (1207)	1506 (761)	4429 (1772)	6172 (2075)	1743 (710)
Tree value, dollars	263.77 (111.32)	297.71 (126.31)	33.94 (52.50)	74.61 (30.07)	189.16 (94.36)	275.62 (122.72)	86.46 (34.78)
Rate of value increase, percent	NA	NA	0.011 (0.024)	NA	NA	0.041 (0.012)	NA

Table 5D.—Mean and standard deviation (in parentheses) for present and future growth by stand characteristic and treatment

Stand Characteristic	Unthinned			Cut	Thinned to B-Level		
	Present	Ten years	Ten year growth		Present	Ten years	Ten year growth
MEAN DIAMETER 11.1-15.0 INCHES; STOCKING OVER 100 PERCENT (12 PLOTS)							
Basal area per acre, ft^2	142.8 (16.9)	145.2 (13.4)	2.4 (4.2)	69.1 (15.8)	73.8 (4.3)	83.9 (3.7)	10.2 (3.0)
No. of trees	170 (30)	144 (24)	-26 (10)	97 (37)	72 (22)	71 (21)	-1 (1)
Average d.b.h., inches	12.5 (1.4)	13.7 (1.4)	1.2 (0.2)	11.8 (2.4)	14.1 (2.5)	15.2 (2.4)	1.1 (0.3)
D.b.h., inches, at 50% of basal area	15.1 (2.4)	16.1 (2.3)	1.0 (0.2)	NA	15.6 (2.4)	16.7 (2.3)	1.0 (0.3)
Stocking percent	114.7 (11.2)	114.4 (8.9)	-0.3 (3.3)	56.3 (11.8)	58.4 (2.0)	65.3 (2.7)	6.9 (2.1)
Stocking percent of acceptable trees	100.3 (14.4)	100.0 (13.2)	-0.3 (3.3)	41.9 (14.8)	58.4 (2.0)	65.3 (2.7)	6.9 (2.1)
Cubic-foot volume	3137 (701)	3266 (648)	128 (105)	1320 (586)	1817 (227)	2094 (190)	277 (79)
Cord volume	39.2 (8.8)	40.8 (8.1)	1.6 (1.3)	16.5 (7.3)	22.7 (2.8)	26.2 (2.4)	3.5 (1.0)
Board-foot volume	11360 (4394)	12326 (3894)	967 (676)	4226 (3564)	7133 (1793)	8681 (1443)	1548 (534)
Tree value, dollars	670.97 (394.71)	738.41 (396.28)	67.44 (51.77)	304.47 (372.45)	366.50 (147.41)	468.50 (161.06)	102.00 (42.69)
Rate of value increase, percent	NA	NA	0.012 (0.010)	NA	NA	0.027 (0.013)	NA

Dale, Martin E.; Lutz, David E. **A field guide to quantity and value growth of upland oak.** NE-GTR-114. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1986. 32 p.

Information is presented on the average yield and expected growth response of upland oak stands in Pennsylvania. Forest survey data were used to classify oak stands into 20 broad size-stocking classes. For each class, tables provide the expected quantity and value of wood before and after thinning treatments. Future stand development is given in terms of volume and value 10 years later with or without thinning treatments. Rate of value increase over the 10-year period is shown for each size-stocking class with or without a thinning treatment.

ODC 56:562:652.3:562.22

Keywords: Yield; volume increment; value; thinnings