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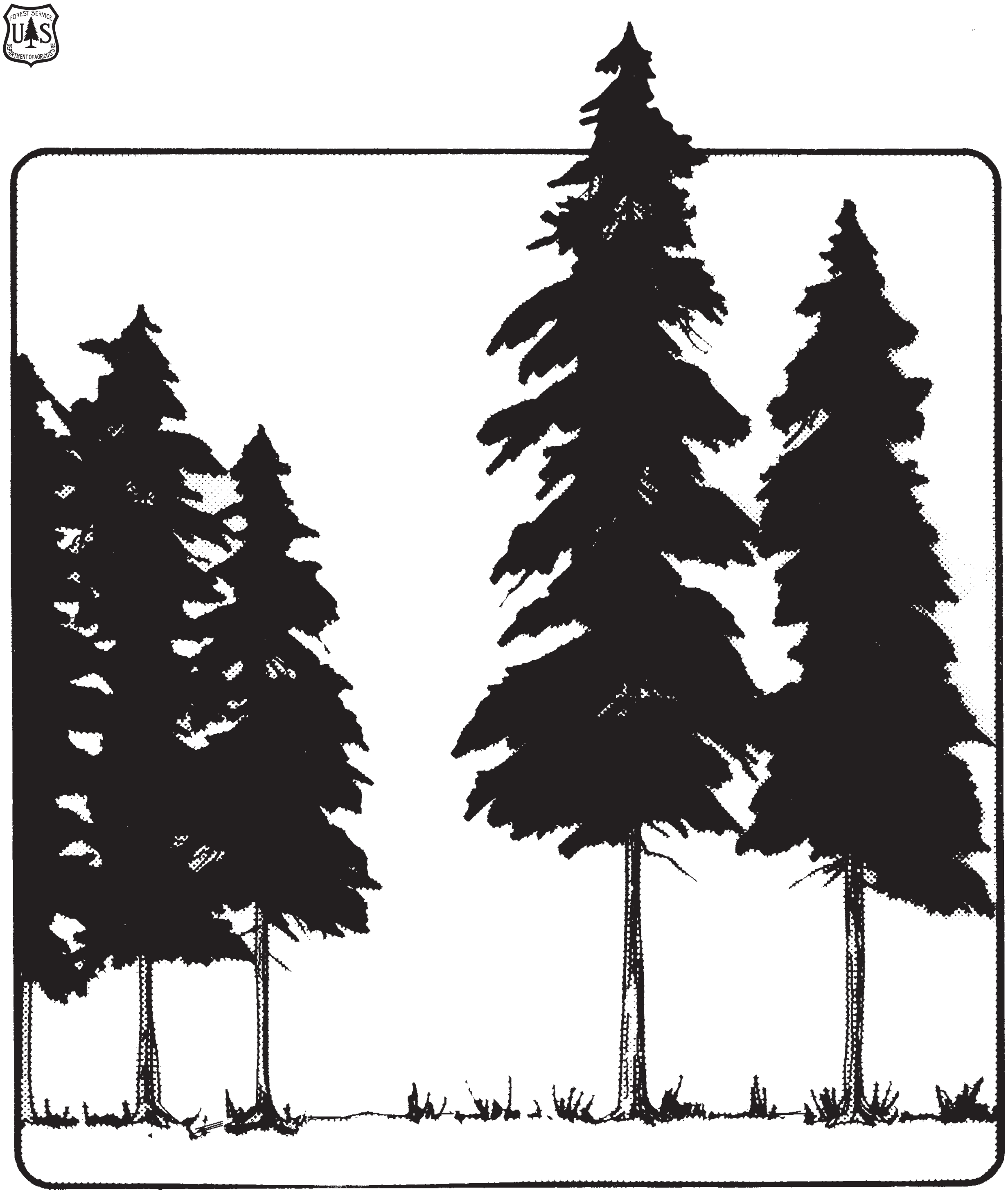
Levels-of-Growing-Stock Cooperative Study in Douglas-fir: Report No. 15–Hoskins: 1963–1998

David D. Marshall and Robert O. Curtis



Levels-of-growing-stock study treatment schedule, showing percentage of gross basal area increment of control plots to be retained in growing stock

	Treatment							
Thinning	1	2	3	4	5	6	7	8
First	10	10	30	30	50	50	70	70
Second	10	20	30	40	50	40	70	60
Third	10	30	30	50	50	30	70	50
Fourth	10	40	30	60	50	20	70	40
Fifth	10	50	30	70	50	10	70	30

Background

Public and private agencies are cooperating in a study of eight thinning regimes in young Douglas-fir stands. Regimes differ in the amount of basal area allowed to accrue in growing stock at each successive thinning. All regimes start with a common level of growing stock established by a conditioning thinning.

Thinning interval is controlled by height growth of crop trees, and a single type of thinning is prescribed.

Nine study areas, each involving three completely random replications of each thinning regime and an unthinned control, have been established in western Oregon and Washington, U.S.A., and on Vancouver Island, British Columbia, Canada. Site quality of these areas ranges from II through IV.

This is a progress report on this cooperative study.

Levels-of-Growing-Stock Cooperative Study in Douglas-Fir:

Report No. 15–Hoskins: 1963–1998

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Abstract

Marshall, David D.; Curtis, Robert O. 2001. Levels-of-growing-stock cooperative study in Douglas-fir: report no.15-Hoskins: 1963–1998. Res. Pap. PNW-RP-537. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 80 p.

The cooperative levels-of-growing-stock (LOGS) study in Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) was begun to study the relations between growing stock, growth, cumulative wood production, and tree size in repeatedly thinned stands. This report summarizes results from the Hoskins installation through age 55. Growing stock has been allowed to accumulate for 19 years since the last treatment thinning was applied in this high site class II natural stand. Volume and diameter growth were strongly related to growing stock. Basal area growth-growing stock relations were considerably weaker. Differences in tree size and volume distribution were considerable. Culmination of mean annual increment has not occurred for any of the treatments, although the control has culminated for total stem cubic volume and is near culmination for merchantable cubic volume. Only small differences are seen in growth percentages between thinning treatments. Results demonstrate potential flexibility in managing Douglas-fir to reach a range of objectives.

Keywords: Thinning, growing stock, growth and yield, stand density, Douglas-fir, *Pseudotsuga menziesii*, series-Douglas-fir LOGS.

Summary

The cooperative levels-of-growing-stock (LOGS) study in Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) was begun in the early 1960s to study the relations between growing stock, growth, cumulative wood production, and tree size in repeatedly thinned stands. This report summarizes results for the LOGS installation most advanced in development–the Hoskins installation in the Oregon Coast Range–through age 55 (19 years after the last thinning treatment was applied). The stand is of natural origin with an estimated site index of 134 feet (site class II). Site index and height growth trends have been stable on the control plots since about age 27, and estimated site index on thinned treatments has increased an average of about 15 feet since the initial cut. Volume and diameter growth were strongly related to growing stock; basal area less so. Relative growth (growth percentage) has remained similar among the thinning treatments to date. Substantial mortality in the controls has reduced their net growth. The lighter thinning treatments have produced volumes similar to the controls as growing stock has accumulated after the last treatment thinning. The different levels of growing stock have produced marked differences in tree size distribution. Although net total stem volume mean annual increment apparently has culminated on the controls, merchantable volume has not. Culmination has not been reached on any of the thinning treatments. Past results from the LOGS studies have generally been consistent with varying rates of development by site class. Thus, these results may indicate the expected future development of other LOGS installations. Results demonstrate tradeoffs between managing for tree size and production in short rotations but suggest potential advantages in wood production and other benefits from extended rotations and accumulation of growing stock.

Other LOGS (Levels-of-Growing-Stock) Reports

Williamson, Richard L.; Staebler, George R. 1965. A cooperative level-of-growing-stock study in Douglas-fir. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 12 p.

Describes purpose and scope of a cooperative study investigating the relative merits of eight different thinning regimes. Main features of six study areas installed since 1961 in young stands also are summarized.

Williamson, Richard L.; Staebler, George R. 1971. Levels-of-growing-stock cooperative study on Douglas-fir: report no. 1–Description of study and existing study areas. Res. Pap. PNW-111. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 12 p.

Thinning regimes in young Douglas-fir stands are described. Some characteristics of individual study areas established by cooperating public and private agencies are discussed.

Bell, John F.; Berg, Alan B. 1972. Levels-of-growing stock cooperative study on Douglas-fir: report no. 2–The Hoskins study, 1963-70. Res. Pap. PNW-130. Portland, OR; U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 19 p.

A calibration thinning and the first treatment thinning in a 20-year-old Douglas-fir stand at Hoskins, Oregon, are described. Growth for the first 7 years after thinning was greater than expected.

Diggle, P.K. 1972. The levels-of-growing-stock cooperative study in Douglas-fir in British Columbia (report no. 3–Cooperative L.O.G.S. study series). Inf. Rep. BC-X-66, Victoria, BC: Canadian Forestry Service, Pacific Forest Research Centre. 46 p.

Describes the establishment and installation of the two LOGS studies established on Vancouver Island at Shawnigan Lake and Sayward Forest.

Williamson, Richard L. 1976. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 4–Rocky Brook, Stampede Creek, and Iron Creek. Res. Pap. PNW-210. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 39 p.

The USDA Forest Service maintains three of nine installations in a regional, cooperative study of influences of levels of growing stock (LOGS) on stand growth. The effects of calibration thinnings are described for the three areas. Results of first treatment thinning are described for one area.

Berg, Alan B.; Bell, John F. 1979. Levels-of-growing-stock cooperative study on Douglas-fir: report no. 5–The Hoskins study, 1963-75. Res. Pap. PNW-257. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 29 p.

Growth data are presented for the first 12 years of management of young Douglas-fir growing at eight levels of growing stock. The second and third treatment periods are described.

Young Douglas-fir stands transfer growth from many to few trees. Some of the treatments have the potential to equal the gross cubic-foot volume of the controls during the next treatment periods.

Arnott, J.T.; Beddows, D. 1981. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 6–Sayward Forest, Shawnigan Lake. Inf. Rep. BC-X-223. Victoria, BC: Canadian Forestry Service, Pacific Forest Research Centre. 54 p.

Data are presented for the first 8 and 6 years at Sayward Forest and Shawnigan Lake, respectively. The effects of the calibration thinnings are described for these two installations on Vancouver Island, British Columbia. Results of the first treatment thinning at Sayward Forest for a 4-year response period also are included.

Tappeiner, John C.; Bell, John F.; Brodie, J. Douglas. 1982. Response of young Douglas-fir to 16 years of intensive thinning. Res. Bull. 38. Corvallis, OR: Forest Research Laboratory, School of Forestry, Oregon State University. 17 p.

Williamson, Richard L.; Curtis, Robert O. 1984. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 7–Preliminary results; Stampede Creek, and some comparisons with Iron Creek and Hoskins. Res. Pap. PNW-323. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station. 42 p.

Results of the Stampede Creek LOGS study in southwest Oregon are summarized through the first treatment period, and results are compared with two more advanced LOGS studies and are generally similar.

Curtis, Robert O.; Marshall, David D. 1986. Levels-of-growing-stock cooperative study in Douglas-fir; report no. 8–The LOGS study: twenty-year results. Res. Pap. PNW-356. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 113 p.

Reviews history and status of LOGS study and provides new analyses of data, primarily from the site II installations. Growth is strongly related to growing stock. Thinning treatments have produced marked differences in volume distribution by tree size. At the fourth treatment period, current annual increment is still about double mean annual increment. Differences among treatments are increasing rapidly. There are considerable differences in productivity among installations, beyond those accounted for by site differences. The LOGS study design is evaluated.

Curtis, Robert O. 1987. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 9–Some comparisons of DFSIM estimates with growth in the levels-of-growing-stock study. Res. Pap. PNW-RP-376. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 34 p.

Initial stand statistics for the LOGS study installations were projected by the DFSIM simulation program over the available periods of observation. Estimates were compared with observed volume and basal area growth, diameter change, and mortality. Overall agreement was reasonably good, although results indicate some biases and a need for revisions in the DFSIM program.

Marshall, David D.; Bell, John F.; Tappeiner, John C. 1992. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 10–The Hoskins study, 1963-83. Res. Pap. PNW-RP-448. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 65 p.

Results of the Hoskins study are summarized through the fifth and final planned treatment period. To age 40, thinnings in this low site I stand resulted in large increases in diameter growth with reductions in basal area and cubic volume growth and yield. Growth was strongly related to level of growing stock. All treatments are still far from culmination of mean annual increment in cubic feet.

Curtis, Robert O. 1992. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 11–Stampede Creek: a 20-year progress report. Res. Pap. PNW-RP-442. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 47 p.

Results of the first 20 years of the Stampede Creek study in southwest Oregon are summarized. To age 53, growth in this site III Douglas-fir stand has been strongly related to level of growing stock. Marked differences in volume distribution by tree sizes are developing as a result of thinning. Periodic annual increment is about twice mean annual increment in all treatments, indicating that the stand is still far from culmination.

Curtis, Robert O. 1994. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 12–The Iron Creek study: 1966-89. Res. Pap. PNW-RP-475. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 67 p.

Results of the Iron Creek study in the Gifford Pinchot National Forest, southern Washington, are summarized through age 42 (completion of the 60 feet of height growth comprising the planned course of the experiment). Volume growth of this mid-site II plantation has been strongly related to growing stock; basal area growth much less so. Different growing-stock levels have produced marked differences in the size distribution and in crown dimension. Periodic annual volume increment at age 42 is two to three times mean annual increment in all treatments.

Hoyer, Gerald E.; Andersen, Norman A.; Marshall, David D. 1996. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 13–The Francis study: 1963-90. Res. Pap. PNW-RP-488. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 91 p.

Results of the Francis study, begun at age 15, are summarized together with results from additional first-thinning treatments started at age 25. To age 42, total cubic-foot volume growth on this mid-site II plantation has been strongly related to level of growing stock. Close dollar values among several alternatives suggest that diverse stand structure objectives can be attained at age 42 with little difference in wood product-value per acre.

Curtis, Robert O.; Marshall, David D.; Bell, John F. 1997. LOGS: a pioneering example of silvicultural research in coast Douglas-fir. Journal of Forestry. 95(7): 19-25.

Provides a general overview of the LOGS cooperative and presents the major results to date.

Curtis, Robert O.; Marshall, David D. 2001. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 14–Stampede Creek. Res. Pap. PNW-RP-543. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 77 p.

Results of the Stampede Creek study are summarized from establishment at total age 33 through the final planned treatment period at age 63 in a estimated site class III stand in southwest Oregon. Results to date are generally similar to the higher site LOGS installations, although development is slower. Volume growth is strongly related to growing stock, but basal area growth is weaker. Thinning has resulted in marked differences in tree size distribution and periodic annual increment is still two to three times greater than mean annual increment.

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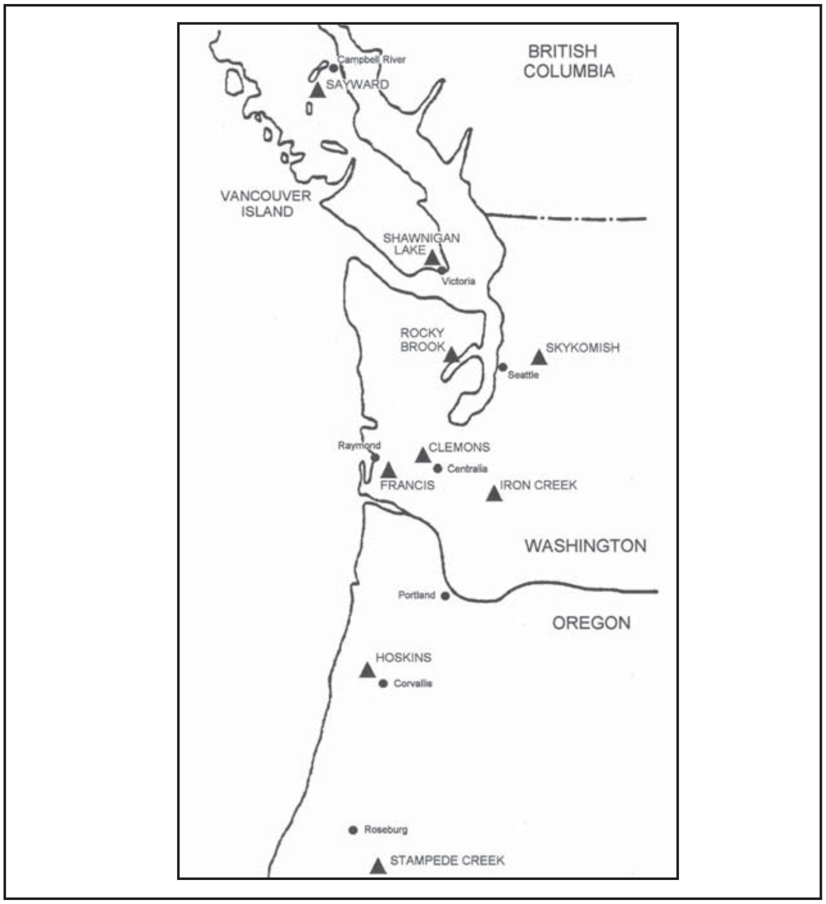

Figure 1—Locations of the nine installations of the levels-of-growing-stock cooperative study in Douglas-fir.

Introduction

The Hoskins levels-of-growing-stock (LOGS) installation is one of nine installations in a regional thinning study established in young Douglas-fir (*Pseudotsuga menziesii* (Mirb.) Franco) stands according to a common work plan (Curtis and others 1997, Williamson and Staebler 1971) (fig. 1). This study is a cooperative effort involving the Canadian Forest Service, the British Columbia Ministry of Forests, Oregon State University, USDA Forest Service, Washington State Department of Natural Resources, and Weyerhaeuser Company. The objective of the study is to compare growth-growing stock relations, cumulative wood production, and tree size development under eight thinning regimes begun before the onset of severe competition and differing in the amount of growing stock they retain after thinning. The original study plan was developed at Weyerhaeuser Company, Centralia, Washington. Procedural details were developed by the Pacific Northwest Research Station, USDA Forest Service, Portland, Oregon.

Detailed progress reports on individual installations (fig. 1) are contained in the series of LOGS publications listed at the beginning of this report. Curtis and Marshall (1986) give an overall summary of results for the first 20 years of the study. To date, all but two of the lowest productivity site installations have completed the prescribed treatment schedules and have been put on a maintenance remeasurement schedule.

The Hoskins LOGS study was established in 1963 by Oregon State University in western Oregon on lands owned by Starker Forests of Corvallis, Oregon, and is the most developed of the LOGS installations. Intermediate results for this installation were reported by Bell and Berg (1972) for the calibration (1963-66) and the first treatment (1966-70) periods, Berg and Bell (1979) for the second (1970-73) and third (1973-75) treatment periods, Tappeiner and others (1982) for the fourth treatment period (1975-79), and Marshall and others (1992) for the fifth and final treatment period (1979-83). This report provides an update for the Hoskins installation to 1998 (stand age 55), including development over the 15 years since the final treatment period (Marshall and others 1992) and 19 years since the final thinning in 1979.

Objectives

The LOGS cooperative studies evolved from work in the late 1950s by George Staebler (1959, 1960). Staebler argued that thinning would transfer increment to the remaining faster growing trees and increase relative growth (or growth percentage) through reduction of growing stock, while largely eliminating mortality losses. He also recognized that the implied assumption of near-constant gross increment over a wide range of stocking had not been tested. The objectives of the LOGS studies, as stated in the 1962 plan,[1] were "to determine how the amount of growing stock retained in repeatedly thinned stands for Douglas-fir affects cumulative wood production, tree size, and growth-growing stock ratios." Treatments were designed to include a wide range of growing stock so that the results would show "how to produce any combination of factors deemed optimum from a management standpoint." The study was not designed as a test of specific operational thinning regimes but was intended to define the quantitative relation between growth and growing stock for a closely controlled initial stand condition and kind of thinning.

Methods

Description of Study Area

The Hoskins LOGS study was established in a uniform, even-aged 20-year-old Douglas-fir stand that had regenerated naturally after wildfire in the Oregon Coast Range. The stand is near Hoskins, Oregon (fig. 2), about 22 mi west of Corvallis (fig. 2) in Benton County (sec. 27 of T. 10 S., R. 7 W., Willamette Meridian). The breast height age, based on boring 54 trees (two per plot) during plot establishment in 1963, was 13 years. On the unthinned control plots, the initial number of trees ranged from 1,610 to 1,885 per acre, initial basal area from 120 to 160 ft^2 per acre, and initial average diameter from 3.6 to 4.2 in. Heights-to-live-crown were uniform and near 8 ft at the time of plot establishment, and crown ratios were about 80 percent. All trees in the plots were Douglas-fir.

Annual precipitation in the area is about 65 to 75 in and falls primarily as rain. The temperature averages 50 °F with 160 to 190 frost-free days per year (Knezevich 1975).

The soils are described by Knezevich (1975) as deep, well-drained silty clay loams of the Apt series that formed in colluvium from mixed sedimentary and igneous rocks. The surface layer is about 10 in thick and a very dark grayish-brown silty clay loam. The subsoil is about 60 in deep and a dark brown, dark yellowish-brown, or strong brown silty clay and clay. The water-holding capacity ranges from 7 to 10 in. Slopes range from 10 to 40 percent on a southerly aspect at an elevation of about 1,000 ft on the upper one-third of the slope.

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[1] Staebler, G.R.; Williamson, R.L. 1962. Plan for a level-of-growing-stock study in Douglas-fir. Unpublished study plan. On file with: Forestry Sciences Laboratory, 3625-93rd Avenue SW, Olympia, WA 98512.

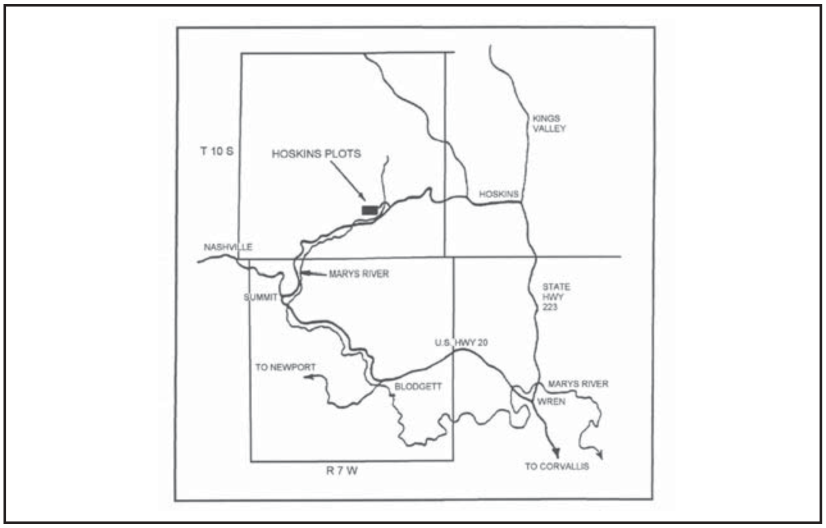

Figure 2—Location of the Hoskins levels-of-growing-stock installation.

Initially there was no understory vegetation in the area due to the dense overstory. The thinned plots have since developed a range in amount and species present in the understory. Major species present in the thinned plots include sword-fern (*Polystichum munitum* (Kaulf.) Presl) and salal (*Gaultheria shallon* Pursh) on the lighter thinning treatments, ocean-spray (*Holodiscus discolor* (Pursh) Maxim) in the intermediate densities, and hazel (*Corylus cornuta var. californica* (DC.) Sharp) on the most heavily thinned (lowest density) plots. Since the early 1990s, the control plots have developed a small amount of understory. The climax plant association is *Tsuga/Gaultheria/Polystichum* (Franklin 1979).

The estimated site index, based on the controls, is about 134 ft at 50 yr breast height age, or a high site class II according to King (1966).

Experimental Design

This experiment compares eight thinning treatments, designed to achieve a wide range in growing stock. Each of the eight treatments and an unthinned control are replicated three times on 27 1/5-acre square sample plots in a completely randomized design (fig. 3). The experiment consists of five periodic thinnings in each treatment in a split-plot-in-time or repeated-measures design. The experiment was designed to last for five treatment periods after an initial calibration period. The final treatment period was completed at Hoskins after the 1983 growing season.

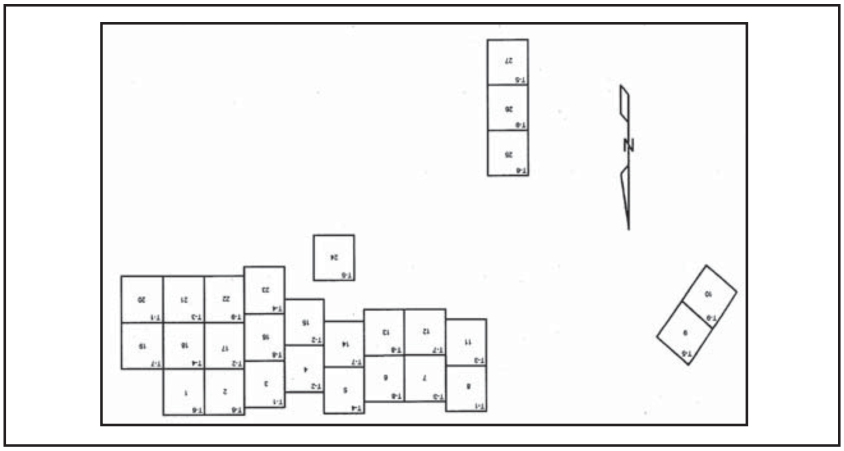

Figure 3—Arrangement of plots in the Hoskins LOGS installation.

The criteria for initial stand selection were:

1. A high degree of uniformity in stocking and site quality over an area sufficient to accommodate the approximately 9-acre installation.
2. Stand 20 to 40 ft in top height.
3. Stand vigorous and of density such that individual tree development had not been strongly influenced by competition, as evidenced by live crown extending over most of the bole.
4. At least 80 percent of the basal area in Douglas-fir.

The Hoskins installation met all these criteria, although not all the plots are contiguous. Because of space limitations, five plots had to be located on closely adjacent but similar areas. Buffer strips were maintained around the installation but not between plots.

Stand Treatments

The prescribed treatments were rigidly controlled to provide for compatibility among installations on different sites.

Selection of crop trees—Crop trees were selected before the initial calibration thinning at a rate of 16 per plot (80 per acre). These trees were well formed and vigorous, with at least 13.5 ft between adjacent crop trees and four crop trees on each plot quarter. Crop trees were numbered 1 through 16 and painted with a white ring at breast height to distinguish them from noncrop trees, which were painted with other colors representing the treatments. The study plan called for crop trees to be retained on the treated plots until all noncrop trees had been cut. This was not necessarily the case, as will be discussed below under the description of the thinning treatments.

Calibration thinning—All 24 plots assigned to receive thinning treatments also received a calibration or preparatory thinning. This initial thinning was intended to reduce the variation in the original growing stock and allow the trees time to adjust, thereby resulting in more uniform growth potential for all the treated plots (see Marshall and others 1992 for more discussion on the results of the calibration thinning).

The study plan called for stands to be thinned to an initial spacing based on the D+ rule (Smith and others 1997: 125) as follows:

$$S = 0.6167*D + 8 \ ,$$

where S is the average square spacing in feet and D is the quadratic mean d.b.h. (diameter at breast height), in inches, of the remaining trees. The calibration thinning was controlled by the specifications that the average d.b.h. of the leave trees be within ±15 percent of the installation mean and the leave tree basal areas be within ±3 percent of the mean, as recommended by the study plan for stands where the estimated average d.b.h. of leave trees was greater than 4.5 in, as at Hoskins. (Stands of smaller diameter were controlled by using numbers of trees instead of basal area.)

The calibration thinning was a precommercial thinning done as a training exercise by a state of Oregon Forestry Department emergency crew. The trees were felled and the crowns lopped in place. The crew used axe handles to break off all dead branches on live trees (5 to 6 ft off the ground) to facilitate marking.

Thinning treatments—Plots were thinned at intervals of 10 ft of crop tree height growth (Staebler 1960). This standard was intended to give close control of growing stock and adjust thinning intervals to rate of height growth and crown expansion. Treatment thinnings were made at Hoskins in 1966, 1970, 1973, 1975, and 1979 at total ages of 23, 27, 30, 32, and 36 years, respectively. For unknown reasons, the 1975 measurement and treatment were premature, occurring after only about half of the required periodic height growth of 10 ft. This may have resulted in some inconsistent results in periodic annual increment trends for this short period.

Thinning treatments were defined in terms of gross basal area growth on the controls and predetermined percentages of the control gross basal area increment to be retained for each thinning regime (see table on inside front cover and table 1). This assumed that gross basal area growth of the controls represented the productive capacity of the site. Specifications were designed to produce a wide range in densities.

Basal area to be left after thinning on each plot was calculated with the following formula:

$$BA_p = BA_{p-1} + GBAG(P_{tp}) \ ,$$

where BA_p = basal area (square feet/acre) retained after thinning at the beginning of the treatment period (p), BA_{p-1} = basal area (square feet/acre) at the beginning of the preceding treatment period (p-1), GBAG = average gross basal area growth on the controls (that is, the increase in basal area of the live trees plus the mortality) during the preceding period, and P_{tp} = predetermined percentage of gross basal area growth on the controls to be retained for the respective period (p) and treatment (t) (see table on inside front cover).

Table 1—Treatments defined by percentage of gross basal area increment of control retained after thinning (calibration thinning excluded)

	Thinning				
Treatment	First	Second	Third	Fourth	Fifth
	Percent retention				
Fixed:					
1	10	10	10	10	10
3	30	30	30	30	30
5	50	50	50	50	50
7	70	70	70	70	70
Increasing:					
2	10	20	30	40	50
4	30	40	50	60	70
Decreasing:					
6	50	40	30	20	10
8	70	60	50	40	30
Unthinned:					
C	—	—	—	—	—

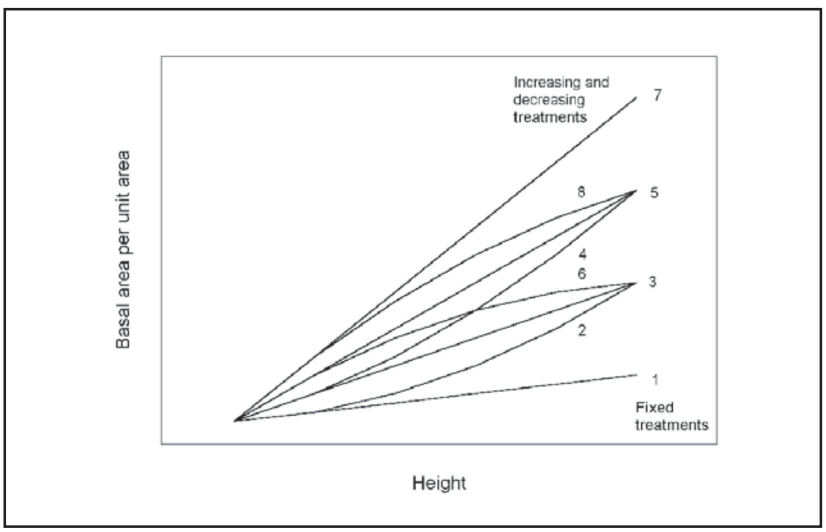

Figure 4—Idealized trends in basal area for the eight thinning regimes in the LOGS study.

The expected trends in residual basal area created by the eight treatments are shown in figure 4.

The eight treatments all accumulated basal area growing stock throughout the experiment (that is, all treatments increased in basal area) but at fixed, increasing, or decreasing rates. The four fixed-percentage treatments (1, 3, 5, and 7) always retained growing stock at four constant percentages of the control plots' gross basal area growth. The levels are 10, 30, 50, and 70 percent, representing heavy to light thinnings, respectively. The variable-percentage treatments represent two increasing- and two decreasing-percentage treatment regimes. The increasing treatments accumulated growing stock slowly at first through heavier cuts and then more rapidly with lighter subsequent cuts. The percentages of growing stock retained progressed from 10 to 50 percent and from 30 to 70 percent for treatments 2 and 4, respectively. The decreasing treatments did just the opposite, accumulating growing stock faster at first through light initial thinnings and then at decreasing rates through heavier cuts, with retained percentages progressing from 50 to 10 and from 70 to 30 for treatments 6 and 8, respectively.

The thinning guidelines for tree removal were:

1. No crop trees were to be cut until all noncrop trees had been cut. In actuality, some crop trees were replaced (see discussion below on crop tree selection).
2. The average diameters of trees removed at each thinning (d) were to approximate average diameter of the noncrop trees before thinning (D) (that is, d/D = 1.0 for the noncrop trees only) so long as noncrop trees were available for cutting. This resulted in d/D ratios of less than 1.0 for all trees and approximated a crown thinning.
3. After all noncrop trees had been cut, average diameter of cut trees should approximate average diameter of all remaining trees.
4. Trees removed in a thinning were to be distributed across the entire diameter range of trees available for cutting.

The actual range of treatment mean d/D ratios at Hoskins was from 0.83 (fourth treatment thinning in treatment 4) to 1.03 (fourth treatment thinning in treatment 2) and averaged 0.93 for all thinnings.

The intention was to cut no crop trees until all noncrop trees had been harvested. In reality, this did not happen at Hoskins. Of the 384 crop trees initially selected on the treated plots, 23 (6 percent) were replaced early during the study, primarily for slow growth (one was cut after it developed a dead top). These replacements were distributed throughout the treatments. Of the replaced crop trees, two survived through the fifth treatment period after being replaced, one died (treatment 7), and the rest were cut in the period after being replaced. During the last two treatment periods, 17 and 3 crop trees were cut in treatments 1 and 2, respectively, after all noncrop trees had been cut. In addition, one crop tree was cut from both treatments 3 and 5 for unknown reasons. In the control plots, two crop trees died during the study and one was later replaced. See discussion in Marshall and others (1992) for a comparison of growth rates of crop trees and the 80 largest trees.

During the five treatment thinnings, trees were bucked and unmerchantable material and tops were left on the plots. Merchantable logs were removed by horse and tractor (by winching to skid trails). Logging damage was minimal.

Data Collection and Summarization

Immediately after the calibration thinning (1963), and at all subsequent measurement dates (1966, 1970, 1973, 1975, 1979, 1983, 1988, 1993, and 1998), diameters of all tagged trees were measured to the nearest 0.1 in for trees 1.6 in and larger. Heights were measured on a sample of these trees at the same time (sample size differed but was not less than 12 trees per plot and usually was more) distributed across the range of diameters. Height to the base of live crown also was measured on all height sample trees beginning in 1983. Heights and height-to-live-crown were measured on most of the felled trees. The heights-to-crown-base were estimated in 1963 from the dead branch "pruning" at plot establishment.

Volumes are summarized for total stem cubic feet (CVTS), merchantable cubic feet to a 6-in top diameter inside bark (CV6), and for Scribner board feet (SV632). Individual tree volumes were computed by using equations requiring diameters and heights for each tree. Missing tree heights were computed from height-diameter curves fit to each measurement by combining plot data for each treatment and using the methods of Flewelling (1994). Tree volumes in total stem cubic feet inside bark (CVTS) were computed with the Bruce and DeMars (1974) equation from measured diameters and actual or predicted tree heights. Merchantable cubic-foot volume (to a 6-in top diameter) was computed by using tarif equations (Brackett 1973, Chambers and Foltz 1979). Scribner board-foot volume was computed with a Douglas-fir taper equation[2] and Scribner volume factors (Bell and Dilworth 1997; table 1). For each tree, the taper equation was used to compute the small-end diameter inside bark of each log. A log length of 32 ft was used with a minimum top log length of 16 ft to a 6-in top diameter inside bark. For each log, the specific Scribner volume factor for the log's small-end diameter was used to multiply by the log length to get Scribner log volume. The individual log volumes were summed to get a tree volume. Per-acre estimates for each plot were obtained by adding up the volumes for the trees on the plot and multiplying by the plot "blow-up" or expansion factor (1.0/plot area).

Basal area and volume growth are defined as periodic annual increment (PAI) and mean annual increment (MAI). Net PAI is computed as the difference between the live standing volume at the end of the period (before thinning treatments) and the live standing volume at the start of the period (after thinning treatments), which is divided by the period length. Gross PAI also includes the volume in mortality during the period. Net MAI is the total volume of the live stand plus the cumulative volume removed in thinnings, divided by the stand age. Gross MAI adds the cumulative volume of mortality to the live and thinning volumes. Diameter growth is summarized as both net PAI and as the growth on trees surviving the period (Curtis and Marshall 1989).

Analyses

The original study plan specified analysis of variance (ANOVA) as the method of analysis. This analysis was done for the specified five treatment periods and the results presented by Marshall and others (1992). Since the last treatment period, growing stock has been allowed to accumulate and comparisons of the ANOVA are less meaningful. Also, many aspects of the experiment are more meaningfully presented and interpreted through simple graphic comparisons, which will be given in the following sections.

The underlying numerical values are summarized in a series of tables given in the appendix (tables 2-26). All tables are in English units with the stand development tables for each treatment (tables 20-26) also given in metric units.

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[2] Flewelling, J.W. 1994. Stem form equation development notes. Northwest Taper Cooperative. Unpublished report based on the methods of Flewelling and Raynes (1993). On file with: Dr. James Flewelling, 26724 51st Place S, Kent, WA 98032.

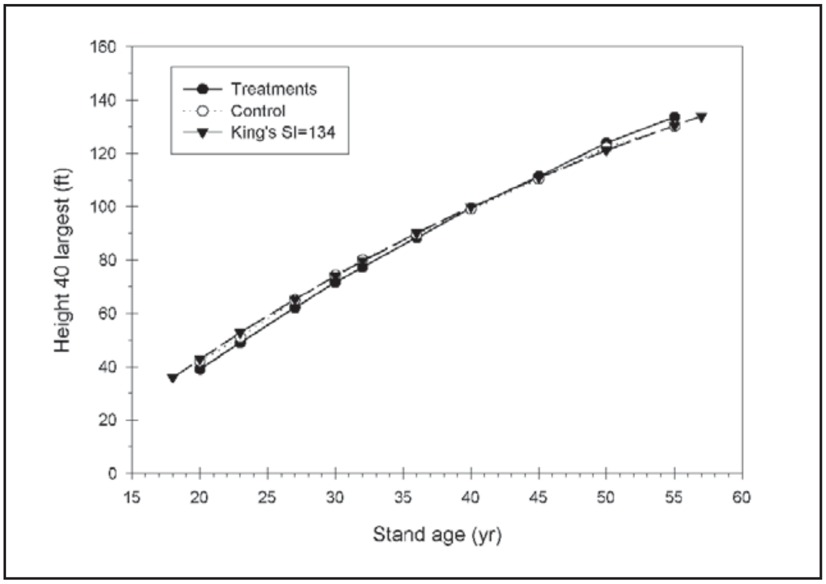

Figure 5—Observed H40 trend of the treatments (mean of eight thinning treatments) and control compared with trends predicted by King (1966).

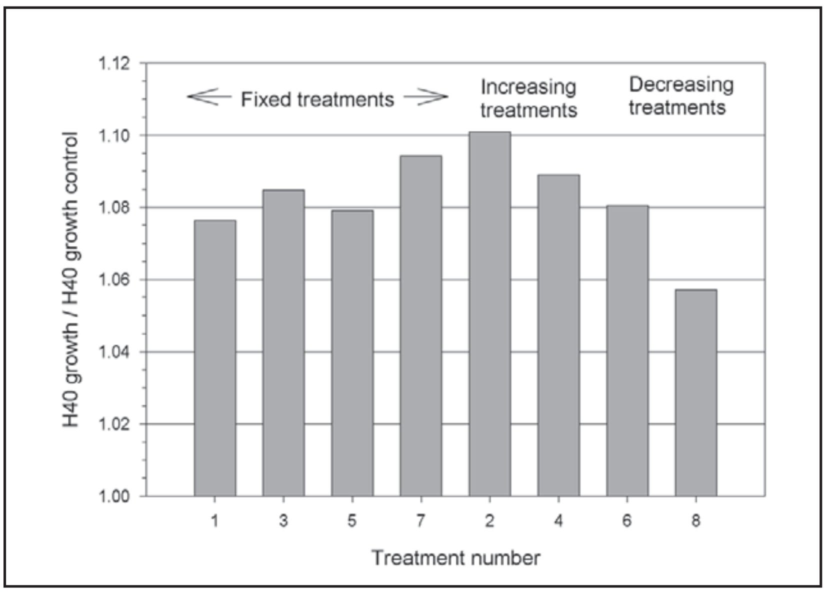

Figure 6—Thirty-five-year increment in H40 expressed as a ratio of H40 increment of the controls, by treatment.

Results

Live Stand Development

Top height (H40) and site index—Top height, defined as the mean height of the 40 largest trees per acre by d.b.h., is a useful measure of height development and was used as a basis for computing site index (table 2). From the initial stand tables, it appears that the calibration thinning removed some of the top-height trees and significantly ($p = 0.002$) reduced the initial top height of the thinned treatments compared to the control (fig. 5). Between 1963 and 1998, top-height growth of the thinned treatments significantly ($p = 0.0007$) exceeded the top height growth on the controls, with a mean difference of 8 percent (range, 4 to 10 percent) (fig. 6). There was no relation between the thinning

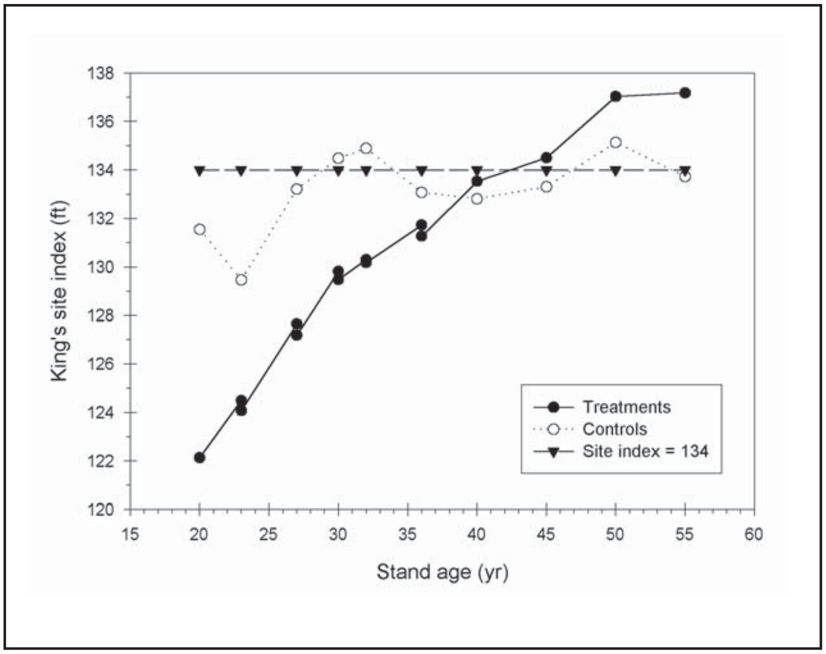

Figure 7—Thirty-five-year trends in estimated site index (King 1966) for the control and treatments (mean of eight thinning treatments).

treatments and height growth. In 1998, the top height of the control was 3 ft less than the average of the treatments, although this difference was not significant ($p = 0.13$). Site index estimates for the control plots seem to have stabilized since stand age 27 (breast height age 20) at about 134 ft (fig. 7). Those for the thinned plots have increased since the calibration thinning and now have an average site index of 137 ft.

Mean diameters of the top height trees (largest 40 per acre) are shown in table 3.

Trees per acre—The calibration thinning reduced the number of trees per acre (TPA) from an average of 1,718 (range, 1,595 to 1,885) on the controls to 330 on the treated plots (range, 305 to 395) (fig. 8, table 4). The range in initial TPA on the thinned plots reflects differences in average diameters and the fact that calibration density was controlled by basal area. The calibration cut removed mostly trees from the lower diameter classes but also may have cut some of the largest trees (fig. 9, table 5). In the 35 years after establishment, TPA on the controls was reduced 82 percent, to an average of 307, by suppression-related mortality (fig. 8a). Mortality on the 24 treated plots has been low, ranging from 9.5 percent of the initial trees on the lightest thinning treatment (treatment 7) to 0.6 percent on the heaviest thinning treatment (treatment 1). On treatments 3 through 8, 80 percent of the mortality has occurred since the last thinning. The thinning treatments have produced a range in TPA from 202 to 52 at stand age 55 (fig. 8b).

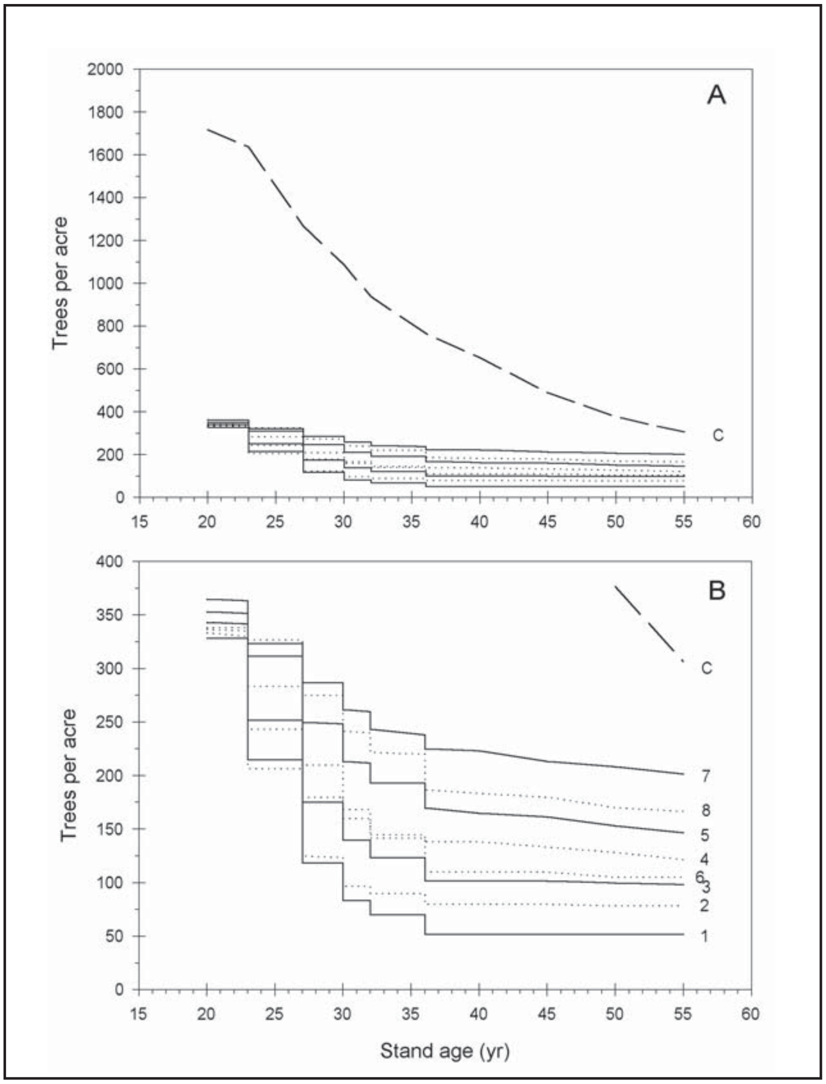

Figure 8—Trends of live trees per acre over stand age, by treatment: (**A**) control, and (**B**) treatments.

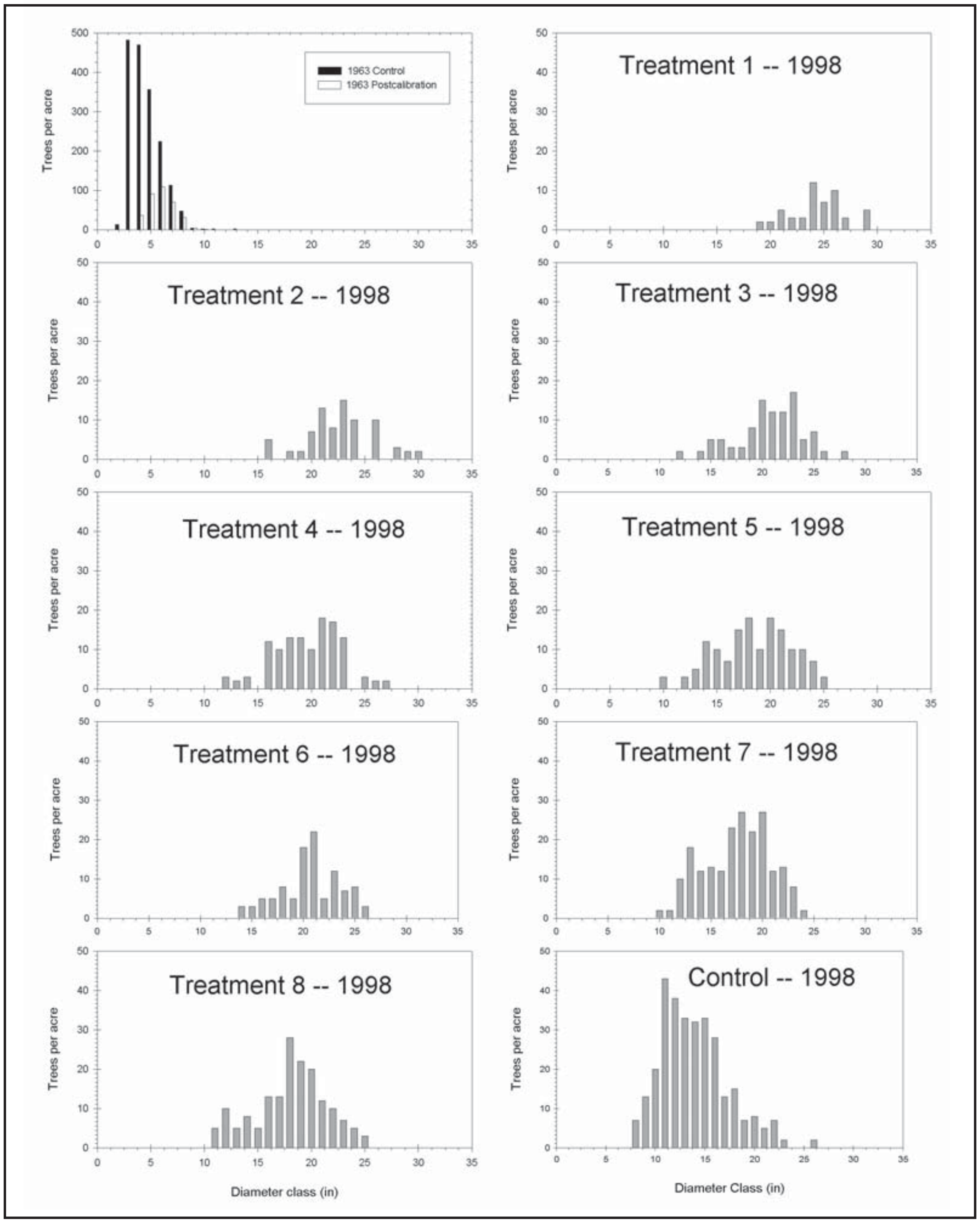

Figure 9—Frequency distribution of trees per acre by 1-inch d.b.h. classes, by treatment, after the calibration thinning and in 1998.

Basal area per acre—The initial basal area on the control plots averaged 138.0 ft^2/acre. By stand age 55, the control plots had increased to 299.9 ft^2/acre. Most of this increase (97 percent) occurred by stand age 40, after which mortality increased sharply and resulted in decreased basal area growth (fig. 10, table 6).

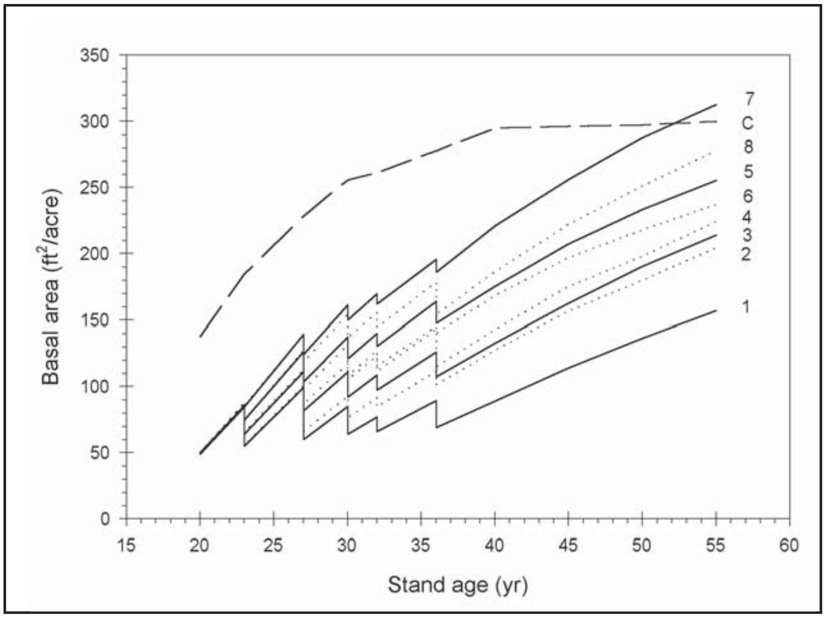

Figure 10—Trends in basal area per acre over stand age, by treatment.

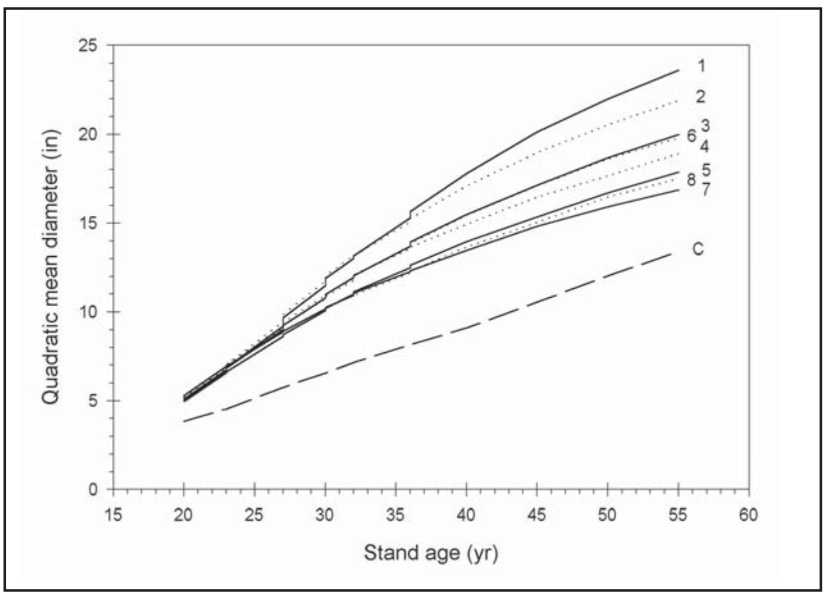

Figure 11—Trends in quadratic mean diameter over stand age, by treatment.

Basal area controlled the calibration thinning which reduced the 24 thinned plots to a uniform 49.8 ft^2/acre (standard deviation of 0.9 ft^2/acre). By stand age 55, the basal areas ranged from 157.2 ft^2/acre on the heaviest thinning regime (treatment 1) to 312.9 ft^2/acre on the lightest thinning (treatment 7) (fig. 10). As of the last measurement, treatment 7 has 4.3 percent more basal area than the control. If the control maintains its low net growth rates (less than 1 ft^2 • acre^{-1} • year^{-1}), treatment 7 is on a trajectory to increase this difference; and treatment 8 could have a basal area very close to the control at the time of the next scheduled measurement, 5 years hence.

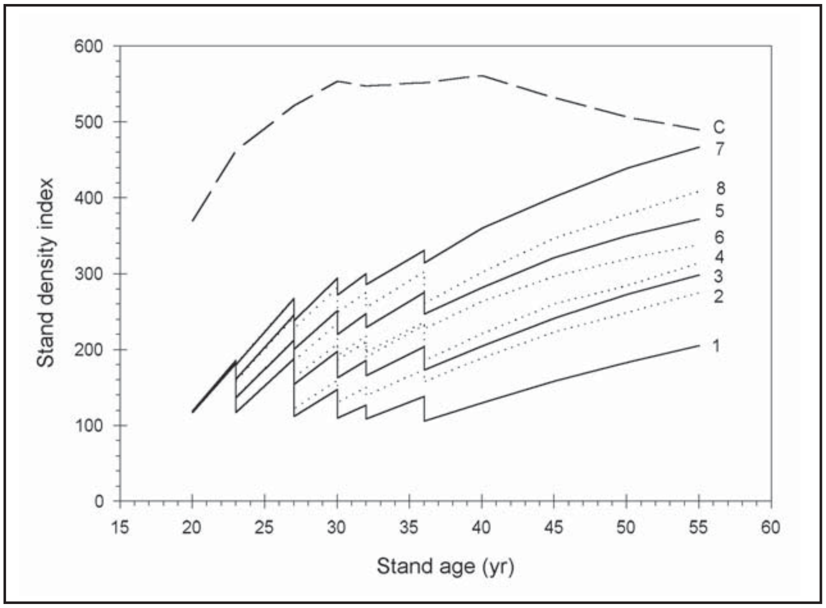

Figure 12—Trends in stand density index (Reineke 1933) over stand age, by treatment.

Quadratic mean diameter—Prior to the calibration thinning, quadratic mean diameter at breast height (QMD) (Curtis and Marshall 2000) averaged 3.8 in on the control plots (table 7). The calibration thinning increased the QMD to an average of 5.2 in on the 24 treated plots. Thus, the d/D ratio (average diameter of the thinned trees/average diameter of all trees before thinning) of the calibration thinning was about 0.90, causing the 1.4-in increase in QMD. At stand age 55, the QMD of the control plot was 13.5 in, compared to 16.9 in for the lightest thinning (treatment 7) and 23.6 in for the heaviest thinning (treatment 1) (fig. 11).

Relative density measures—Many diameter-based measures of relative stand density have been developed, with most more or less equivalent. Two widely used measures of density in the Douglas-fir region are Reineke's (1933) stand density index (SDI)

$$SDI = TPA*(QMD/10)^{1.605} ,$$

and Curtis' (1982) relative density index (RD)

$$RD = BAPA/QMD^{0.5} ,$$

where BAPA is the basal area per acre.

Trends over time in stand density, measured as SDI and RD, are shown in figures 12 and 13, respectively. The initial stand, based on the controls, had an SDI of 364 and a RD of 71. After increasing rapidly for the first 10 years, SDI reached a plateau between ages 30 and 40. The maximum SDI of the stand seems to be 558, which occurred at stand ages 30 and 36. The maximum RD was 100 and occurred at stand age 30. These

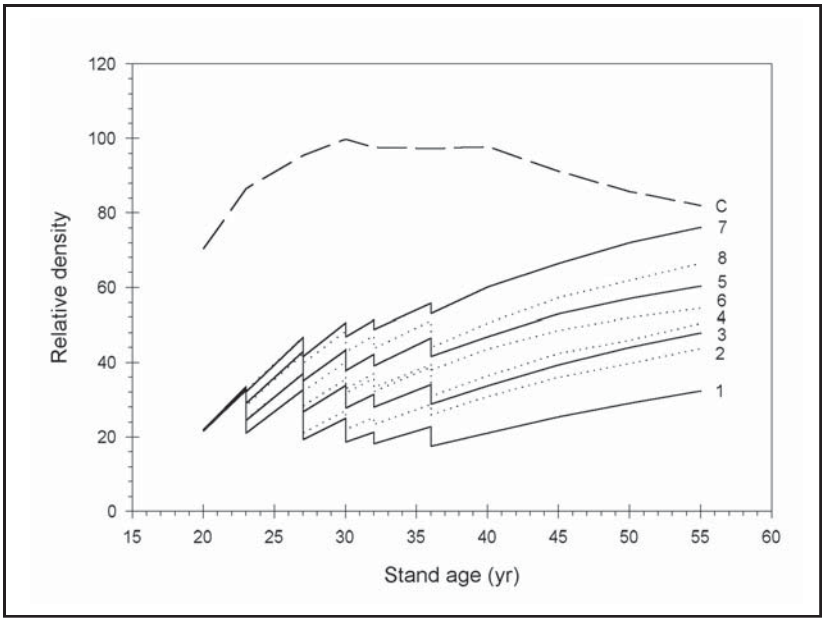

Figure 13—Trends in Curtis (1982) relative density index over stand age, by treatment.

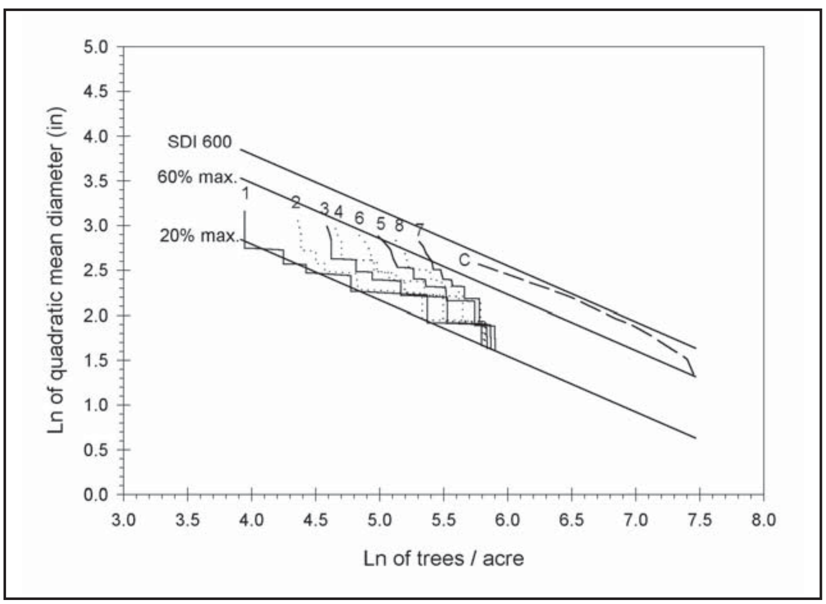

Figure 14—Stand density management diagram (after Long and others 1988) for 35-year stand development, by treatment.

values were apparently unstable, and after the maximum was reached, SDI and RD decreased to values of 497 and 82 at the last measurement.

The calibration thinning reduced the stand to SDI 116 and RD 22. At the last measurement, values for thinned treatments ranged from SDI 469 and RD 76 for the lightest thinning (treatment 7) to SDI 206 and RD 32 for the heaviest thinnings (treatment 1).

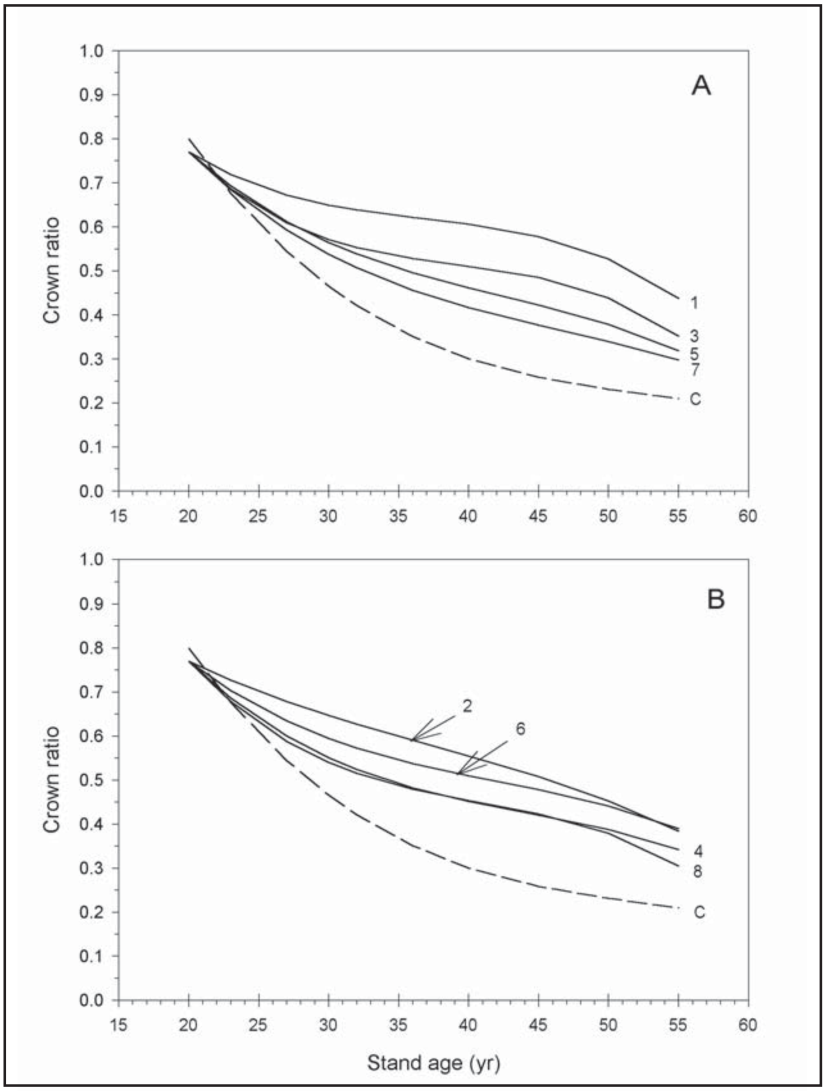

Figure 15—Trends in crown ratio (CR40) over stand age, by treatment: (**A**) fixed treatments, and (**B**) variable treatments.

Figure 14 shows development of the control and treatments on a stand density management diagram (after Long and others 1988). For reference, this diagram has the published maximum SDI value of 600 and a line at 60 percent of maximum SDI representing the approximate lower limit of self-thinning (where competition-related mortality is expected to begin) (Long 1985). The suppression mortality of the controls have produced a typical self-thinning trajectory up to a measured maximum SDI of 558. After this, the control falls away from the maximum size-density line for the last four measurements. Thinnings maintained all the treatments between 20 and 60 percent of published maximum SDI. Since the last thinning, density has increased, and the highest density plots (treatments 5, 6, 7, and 8) have reached or exceeded the approximate lower limit of self-thinning (60 percent of the published maximum SDI of 600) and have begun experiencing mortality.

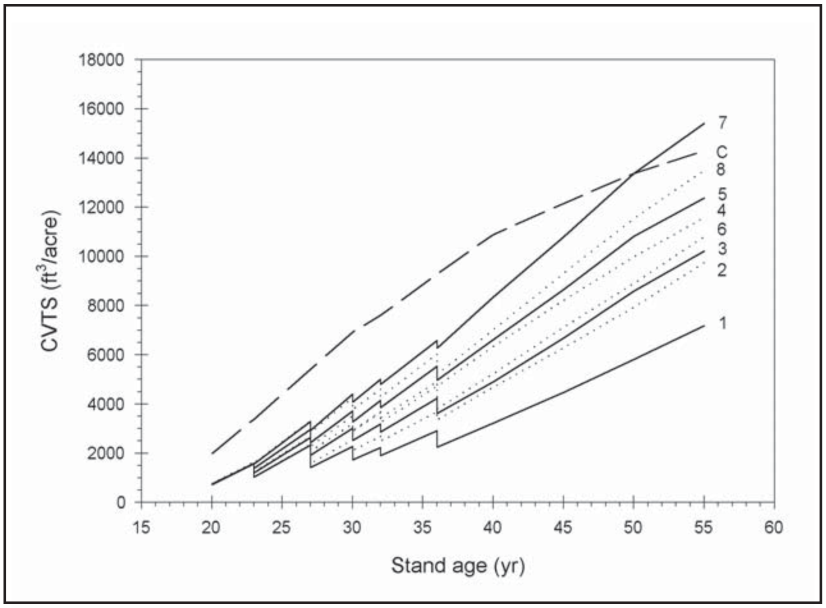

Figure 16—Trends in standing total stem cubic-foot volume (CVTS) per acre over stand age, by treatment.

Crown ratio—Stand heights (H40) and crown ratios (CR40) of the largest 40 trees per acre by d.b.h. (8 per plot) were calculated as means of the measured or estimated values of all trees in this category. Missing tree heights were estimated from the height-diameter curve for treatment and measurement. Missing crown ratios were computed by using the Douglas-fir height-to-crown base model in Zumrawi and Hann (1989) calibrated from an intercept correction based on measured values available at each measurement. The CR40s computed for each treatment were smoothed over stand age with a third-degree polynomial weighted by the number of measured crowns at each measurement.

The average crown ratio of the 40 largest trees by diameter (CR40) was 0.8 on the control plots at the time of plot establishment. The calibration cut slightly decreased the CR40 to 0.77. Subsequent crown recession was rapid, and by the next measurement, 3 years later, average CR40 was 0.68 (fig. 15). By stand age 34, CR40 on the control was below 0.40 and at the last measurement was 0.21. Even though the trees were quite open after the calibration, crown recession continued in the thinned treatments, although at a slower rate than in the controls. As expected, CR40 is related to the level of growing stock, with the higher stocking levels having shorter live crowns. The lightest thinning (treatment 7) reached a CR40 of 0.40 at about stand age 44 and is currently at 0.30. The heaviest thinning (treatment 1) had a CR40 of 0.43 at the last measurement. Although the heavier thinning treatments have shown a much slower rate of crown recession during the thinnings, they are resuming higher rates of crown recession as growing stock accumulates after the last thinning treatment.

Standing total stem volume per acre—The initial total stem volume (CVTS) of the control plots was 1,996 ft^3/acre (table 8) with only 138 ft^3/acre of that in merchantable volume to a 6-in top (CV6). At the last measurement, the controls contained 14,312 ft^3/acre in CVTS and 12,924 ft^3/acre in CV6. The calibration thinning removed an estimated 1,248 ft^3/acre in CVTS and about 69 ft^3/acre in CV6. The control has had more standing

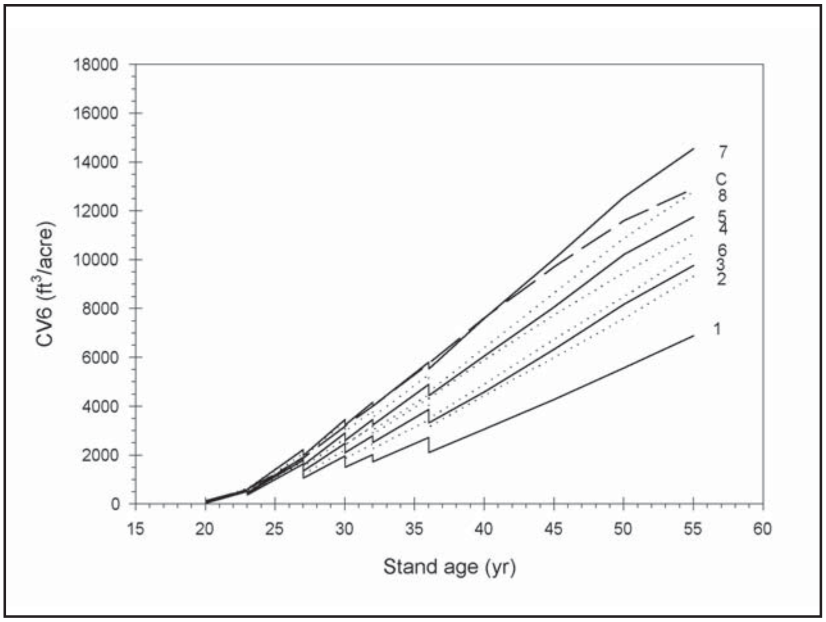

Figure 17—Trends in standing merchantable cubic-foot volume to a 6-inch top (CV6) over stand age, by treatment.

CVTS than all thinning treatments up to stand age 50 (fig. 16). By stand age 50, the lightest thinning (treatment 7) had the same standing CVTS as the control, and at the last measurement, treatment 7 contained nearly 8 percent more CVTS than the control. The control still contained nearly 50 percent more CVTS than the heaviest thinning (treatment 1).

Standing merchantable volume per acre—At the end of the calibration period (3 years after the calibration cut), the thinned plots and control had similar standing CV6. Subsequent thinning has reduced standing CV6 volumes of all treatments, except the lightest (treatment 7), to less than the control (fig. 17, table 9). Treatment 7 surpassed the controls at about age 40. At the last measurement, the control contained nearly 47 percent more standing merchantable volume than the heaviest thinning (treatment 1), whereas the lightest thinning (treatment 7) contained 13 percent more than the control and the next lightest thinning (treatment 8) had nearly the same volume as the control.

Standing Scribner volume per acre—Scribner board-foot volumes (SC6) are shown in table 10.

Mortality and cut—Numbers, diameters, basal areas, and volumes of mortality trees and cut trees are shown in tables 11 and 12.

Cumulative Volume Production

Cumulative volume production is standing live volume plus volume removed in all previous thinnings. Volume removed in the calibration thinning is not included.

Total stem volume—Cumulative total production of the controls in net total cubic volume (CVTS) exceeded the net cumulative production of all thinning treatments (not including the volume removed in the calibration thinning) until stand age 45, when cumulative

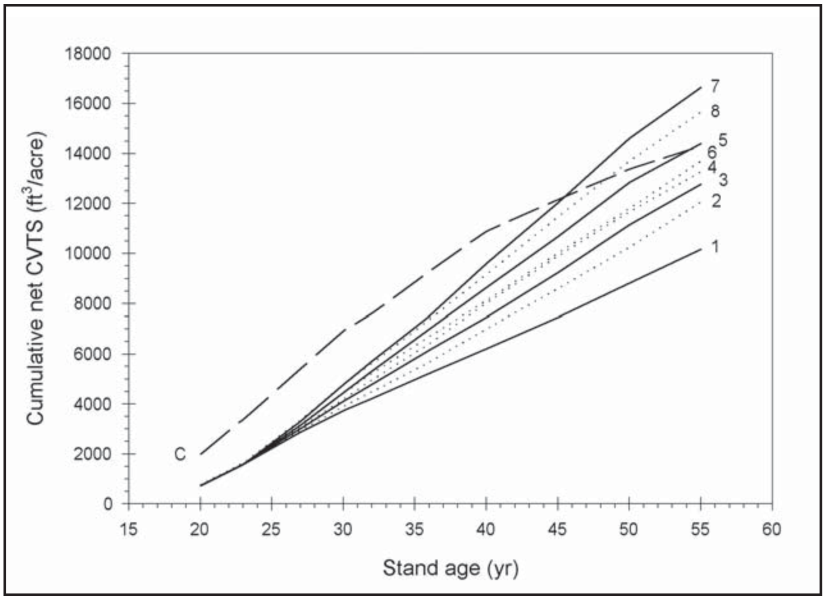

Figure 18—Trends in cumulative net total stem cubic-foot volume (CVTS) per acre production (standing volume + thinnings) over stand age, by treatment. Volumes for thinning treatments do not include about 1,248 ft^3/acre in the calibration thinning.

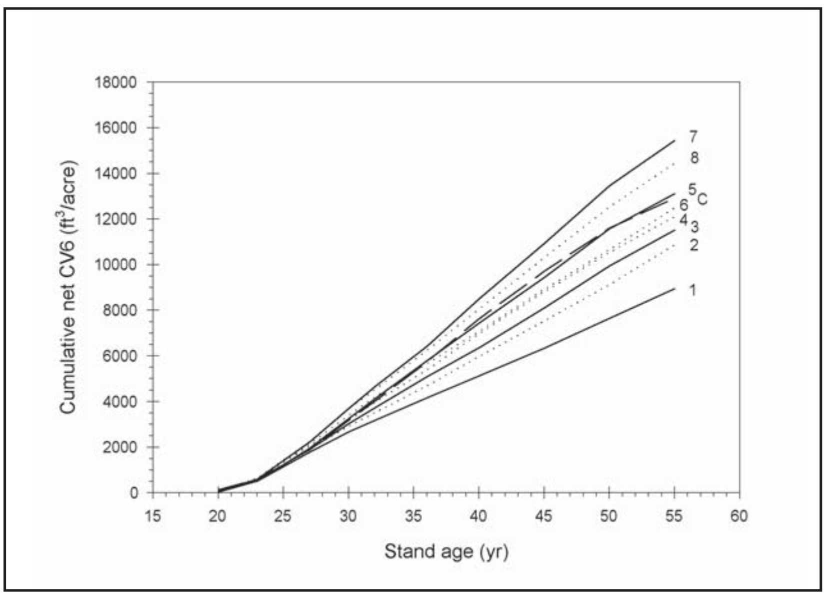

Figure 19—Trends in cumulative net merchantable cubic-foot volume (CV6) per acre production (live standing + thinnings) over stand age, by treatment. Volumes for thinning treatments do not include about 69 ft^3/acre in the calibration thinning.

production of the lightest thinnings (treatments 7 and 8) exceeded the controls (fig. 18). By stand age 55, treatment 7 had about 16 percent more net total stem volume than the control, and treatment 8 had about 9 percent more. At the last measurement, the control had similar cumulative volumes to the three lightest thinnings (treatments 5, 8, and 7). If the approximately 1,248 ft^3/acre removed in the calibration thinning is included, only the three heaviest thinnings (treatment 1, 2, and 3) would not meet or exceed the

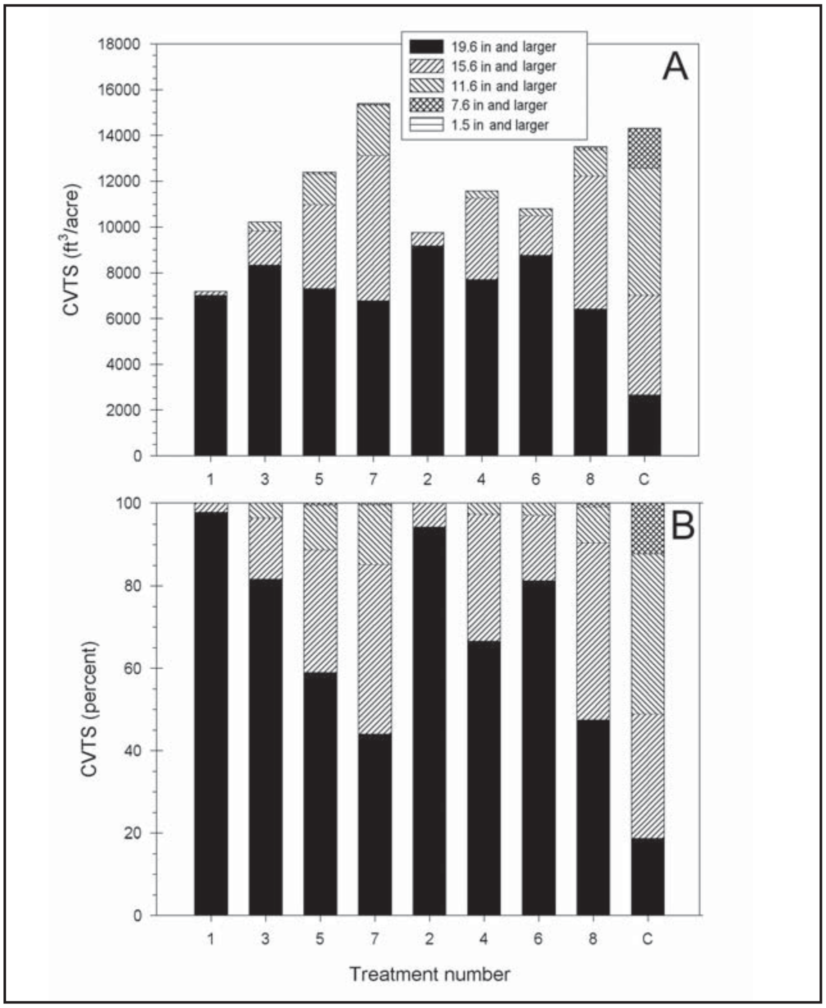

Figure 20—Distribution of standing live total cubic-foot volume (CVTS), by tree diameter size class and treatment in 1998: (**A**) volume, and (**B**) percentage of total volume.

cumulative volume on the control. For all the thinning treatments, volume production decreases with decreasing growing stock.

Merchantable volume—Cumulative net merchantable cubic volume (CV6) production of the lightest thinning (treatments 7 and 8) have exceeded the cumulative production of the control since the calibration thinning (fig. 19). By stand age 55, treat-ment 7 had nearly 20 percent more net merchantable volume than the control, whereas treatment 8 had nearly 12 percent more. Since the initial thinning treatment, the net volume production on the control has been similar to that of treatment 5. Inclusion or exclusion of the approximately 69 ft^3/acre removed in the calibration would not alter the rankings. For the thinning treatments, volume production decreases with decreasing growing stock.

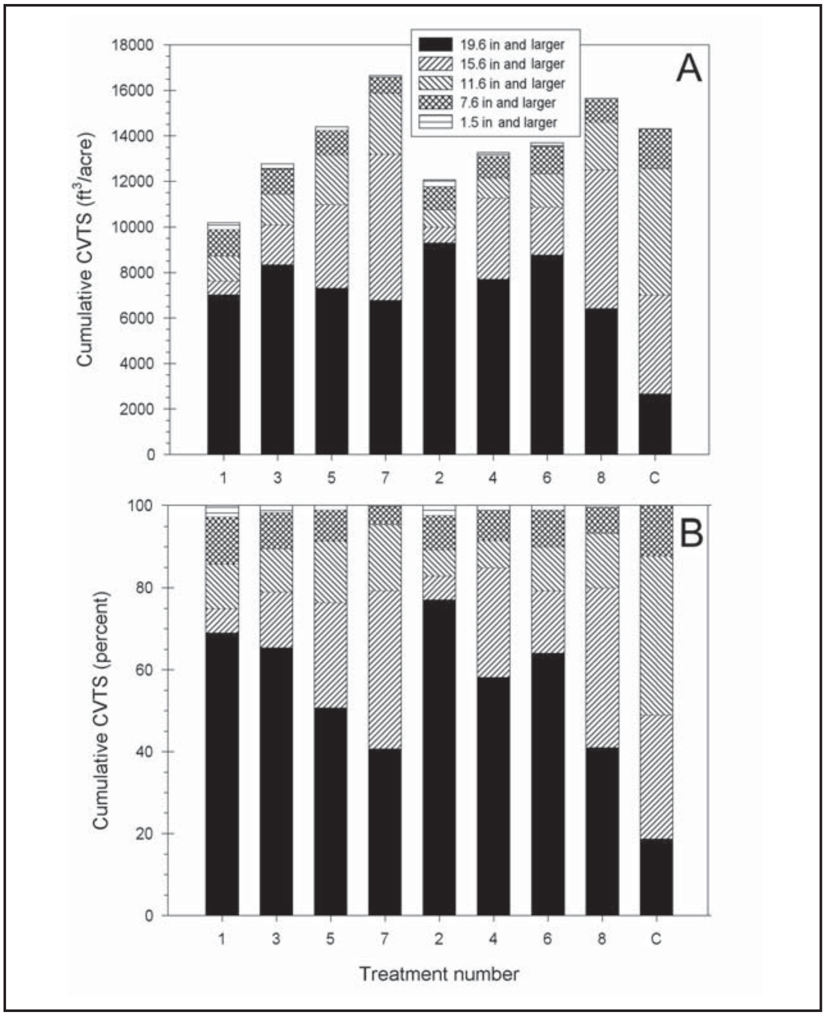

Figure 21—Distribution of cumulative net production (standing live + thinnings) of total cubic-foot volume (CVTS), by tree diameter size class and treatment in 1998: (**A**) volume, and (**B**) percentage of total volume. Does not include about 1,249 ft^3/acre removed in the calibration thinning.

Volume Distribution by Tree and Log Size Classes

Currently there are no live standing trees, or volume, smaller than the 7.6-in diameter class on any of the treatments or the controls. All thinning treatments have over 85 percent of their standing live cubic-foot volume (CVTS) in trees 15.6 in or larger, compared to about 50 percent for the controls (fig. 20, table 13). Nearly all standing volume on the thinning treatments is in trees greater than 11.6 in. On the control, the 11.6- to 15.6-in class contains about 37 percent of the volume, and the 7.6- to 11.6-in class contains about 13 percent. Comparing figures 20 and 21 shows that the trees removed in all thinning treatments contributed relatively small volumes, which came mostly from trees with d.b.h. of less than 12 in.

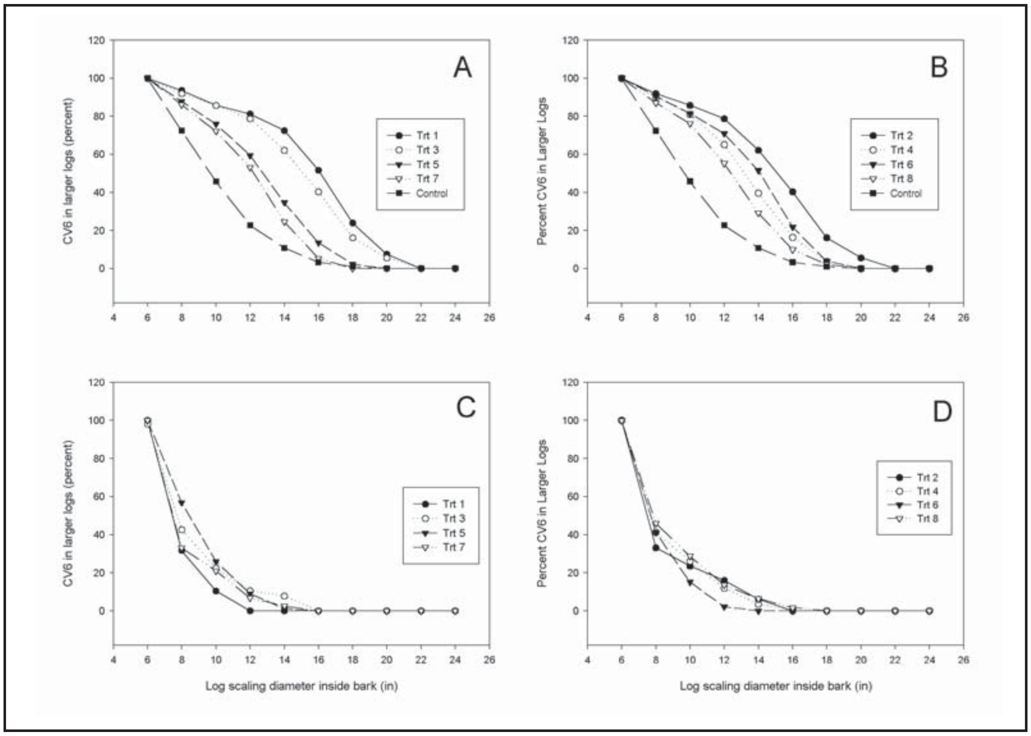

Figure 22—Percentage of distribution of live merchantable volume, by log diameter class: (**A**) cubic volume (CV6) in fixed treatments and control in 1998, (**B**) cubic volume (CV6) in variable treatments and control in 1998, (**C**) cubic volume removed in fixed treatments, and (**D**) cubic volume removed in thinnings in variable treatments.

Figure 22 and tables 14 and 15 show the distribution of merchantable cubic-foot volume in 32-ft logs by scaling diameter (diameter inside bark at the small end of the log with a minimum log length of 16 ft). Tables 16 and 17 show corresponding values for Scribner board-foot volumes. The heavier treatments produced a greater percentage of volume in larger diameter logs. The heaviest thinning treatments (treatments 1, 2, and 3) have from 50 to 30 percent of their standing volume in logs with scaling diameters 16 in or greater (minimum diameter for special mill grade), although quality premiums from these larger logs would be reduced by the number and size of branches along the bole (fig. 22a) (Christensen 1997).

Periodic and Mean Annual Increments

Net periodic annual increment (PAI) for basal areas and volumes was calculated from the differences in live standing basal areas and volumes at the start and end of the growth period. The gross PAI is the net PAI plus any mortality that occurred during the period. Mortality has been minor in the thinning treatments, and thus gross PAI and net PAI (excluding mortality) are nearly the same for the treatments. Mortality has been substantial on the controls so that both net and gross PAI are presented for the controls.

The analysis of variance on PAI through the fifth and final treatment period (Marshall and others 1992) showed that gross periodic annual growth in basal area, volume, and quadratic mean diameter did not depart significantly from linear trends across the range of growing stock levels of the eight treatments (excluding the control). Graphical

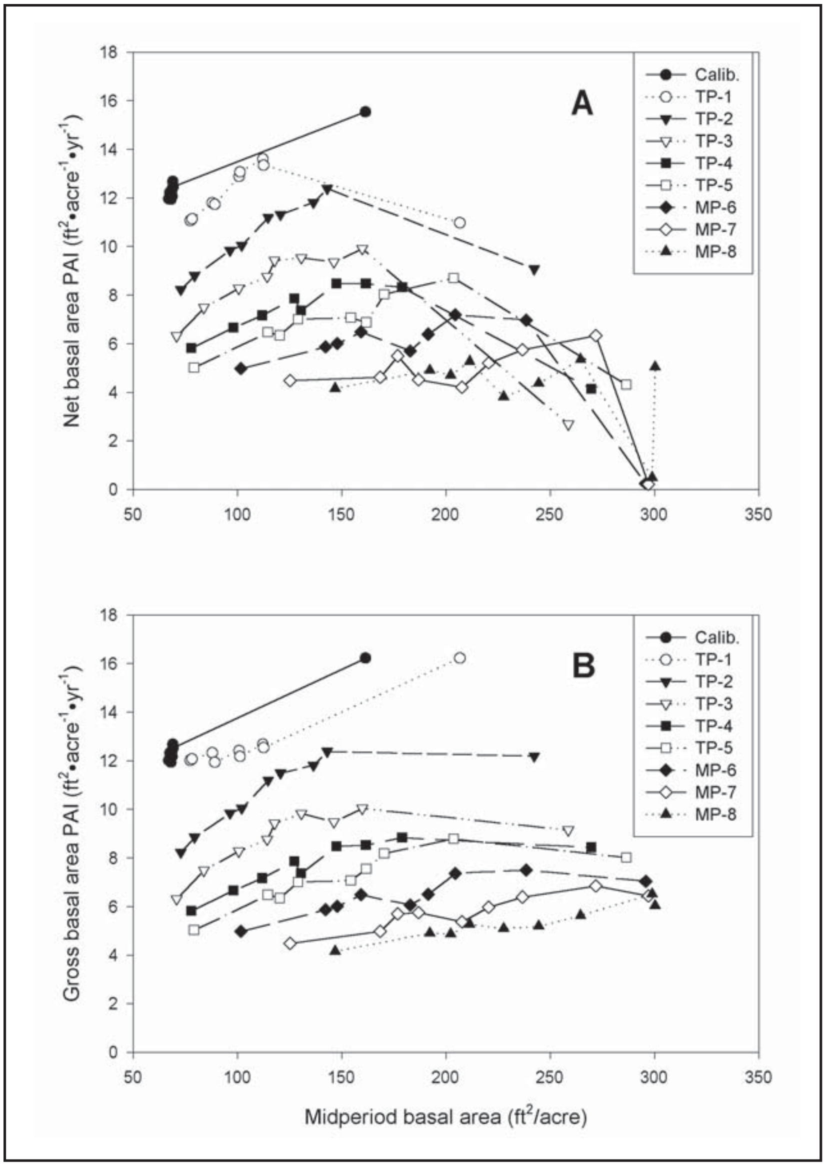

Figure 23—Basal area periodic annual increment in relation to midperiod basal area, by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) gross.

analysis allows for the inclusion of the controls and the expected curvilinear relation between growth and growing stock for a wider range of growing-stock values.

Basal area PAI—Figure 23 shows gross growth versus growing stock defined as basal area per acre, and figure 24 shows growth in relation to relative density (Curtis 1982). Net and gross PAI in basal area growth were nearly identical and approximately linear across the range of growing stock for the eight thinning treatments. The maximum PAI occurred at the lightest thinning treatment (treatment 7) with mortality causing a decrease in net PAI for the control. For gross basal area growth (figs. 23b and 24b), the control's PAI was similar to that of the lightest thinning treatment (treatment 7) in all but the

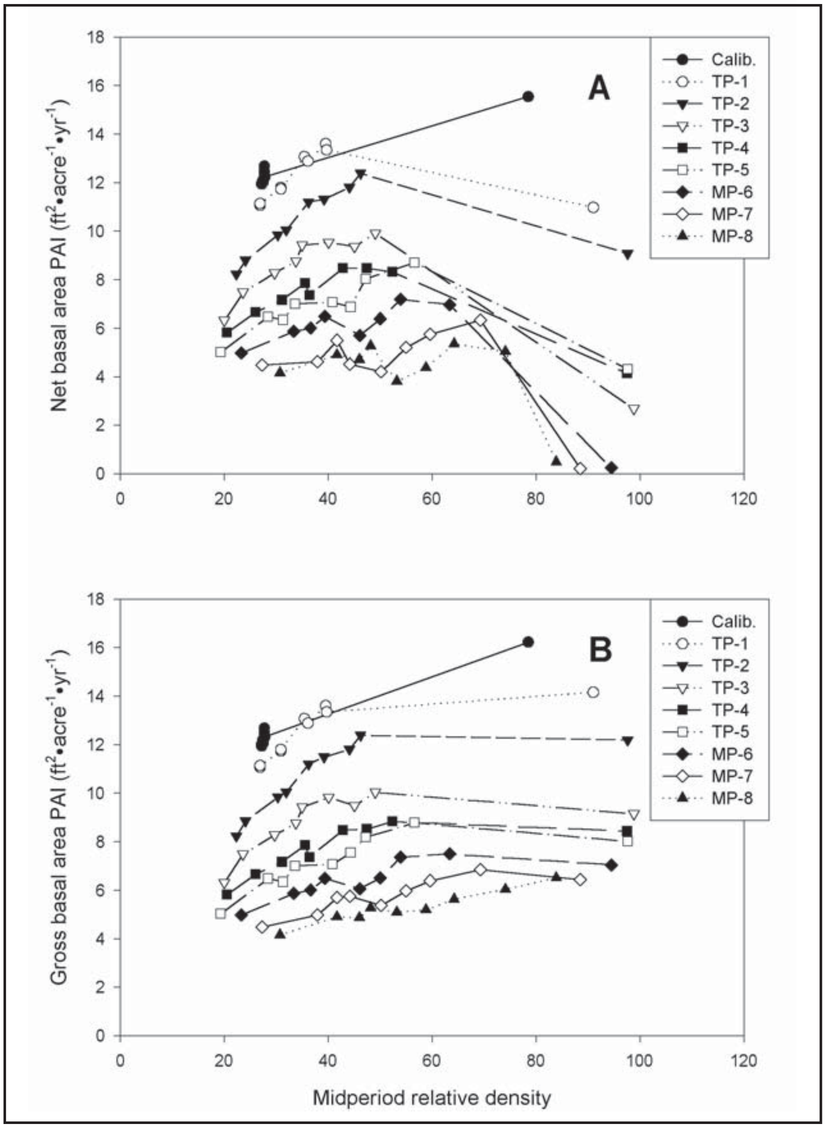

Figure 24—Basal area periodic annual increment in relation to midperiod relative density (Curtis 1982), by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) gross.

calibration and first treatment period. Mortality in the controls reduced net growth (figs. 23a and 24b) to levels at or below the growth of all the thinning treatments after the calibration period, which caused a peak in net PAI at the higher densities of the lightest thinning treatments.

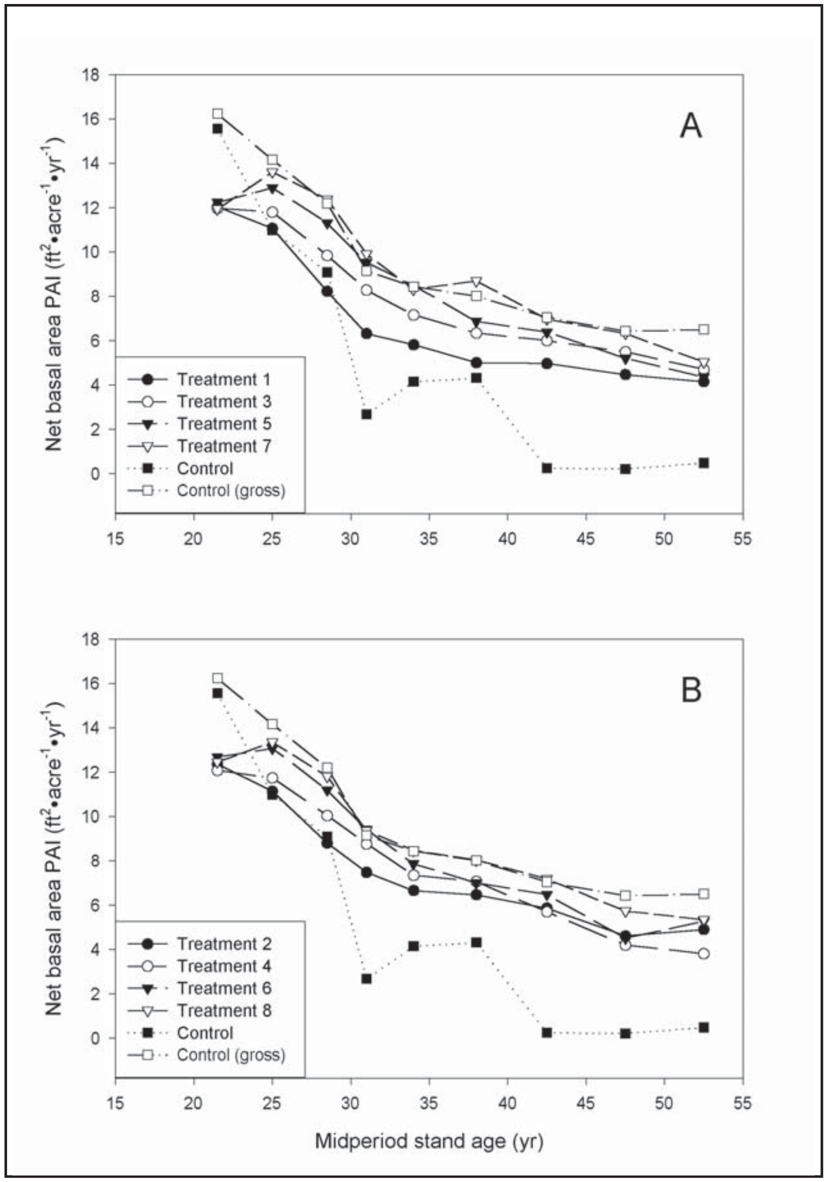

Figure 25—Net basal area periodic annual increment in relation to stand age, by treatment: (**A**) fixed percentage treatments and control (net and gross), and (**B**) variable percentage treatments and control (net and gross).

The reduction in growing stock by the calibration thinning reduced the calibration period PAI of the thinned treatments by about 15 percent from the controls (fig. 25). Other than the first treatment period where the lighter thinning treatments showed an increase in PAI over the calibration period, PAI has decreased for all treatments over time. Heavy mortality in the controls reduced net PAI of the control to near zero for the last three periods.

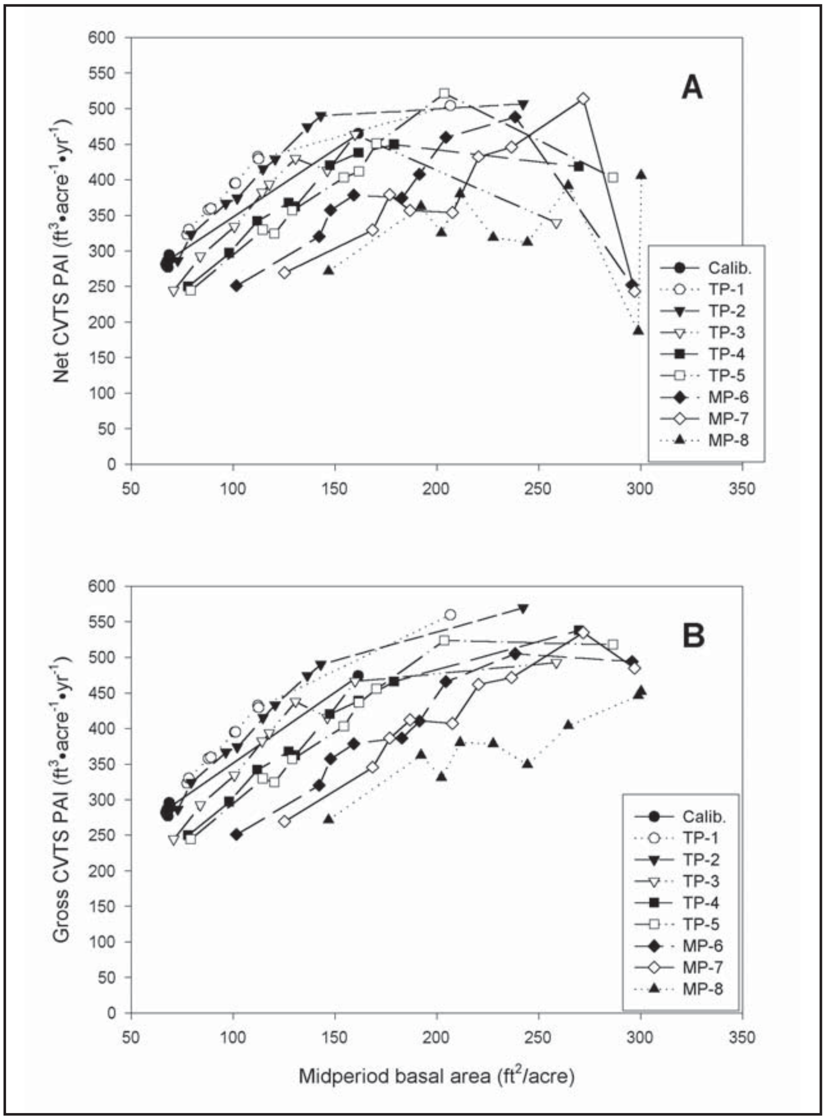

Figure 26—Total stem cubic-foot-volume (CVTS) periodic annual increment in relation to midperiod basal area, by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) gross.

Total volume (CVTS) PAI and MAI—Figure 26 shows net and gross total stem cubic-foot-volume (CVTS) PAI versus growing stock defined as basal area per acre, and figure 27 shows PAI in relation to relative density (Curtis 1982). As with basal area, there was little difference between net and gross PAI for the eight thinning treatments. The PAI trend also is generally linear across the range of growing stock levels of the eight thinning treatments. Volume PAI, however, maintained a stronger relation (steeper slope) between growth and growing stock than did basal area. For all but the first two treatment

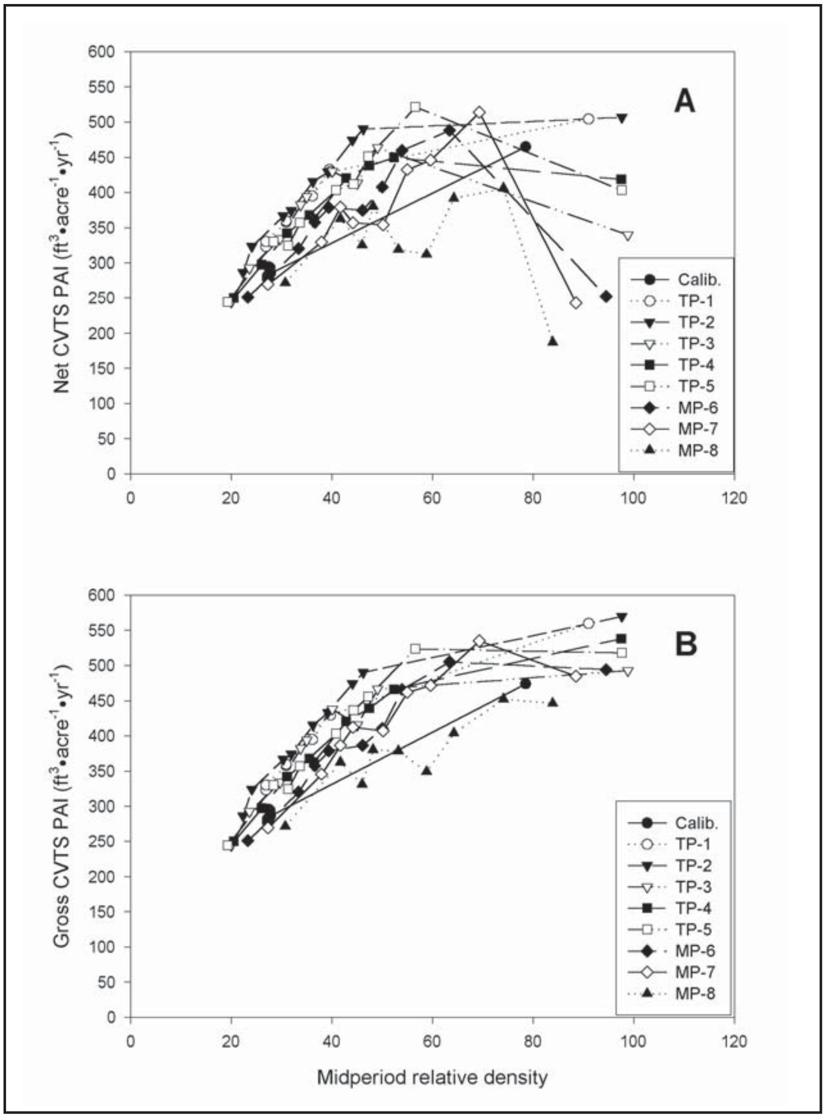

Figure 27—Total stem cubic-foot-volume (CVTS) periodic annual increment in relation to midperiod relative density (Curtis 1982), by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) gross.

periods, net PAI peaked with the highest density thinning treatment (7) as mortality reduced the net growth of the controls (figs. 26a and 27a). Gross PAI increased with growing stock, up to and including the control (figs. 26b and 27b). In the early periods, inclusion of the higher growing stock levels of the controls gave a curvilinear relation. In the later periods, as growing stock of the thinning treatments increased, gross PAI of the light thinning (treatment 7) was similar to the control, and there was a more nearly linear

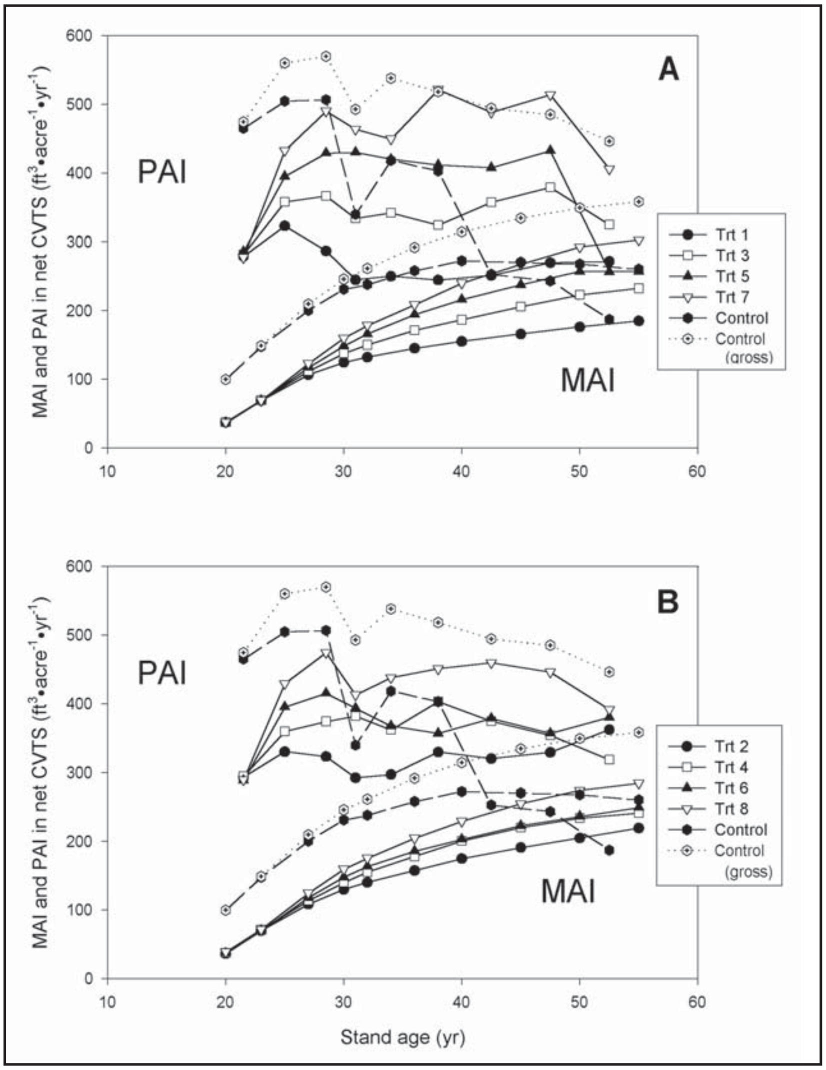

Figure 28—Mean annual increment (MAI) and periodic annual increment (PAI) in net total stem cubic-foot volume (CVTS) in relation to stand age and treatment: (**A**) fixed percentage treatments and control (net and gross), and (**B**) variable percentage treatments and control (net and gross).

relation between gross PAI and growing stock across the range of growing stock represented by all treatments and the control. Net PAI showed an increase for the first two to three periods after the calibration thinning and has been generally decreasing since (fig. 28).

The MAI continues to increase for all treatments and seems to have culminated at age 42 for net growth on the control, but it is not close to culmination for any of the thinning treatments. Over all thinning treatments, PAI values average about 40 percent greater than MAI, although PAI is decreasing on all but the two heaviest thinnings (treatments 1 and 2).

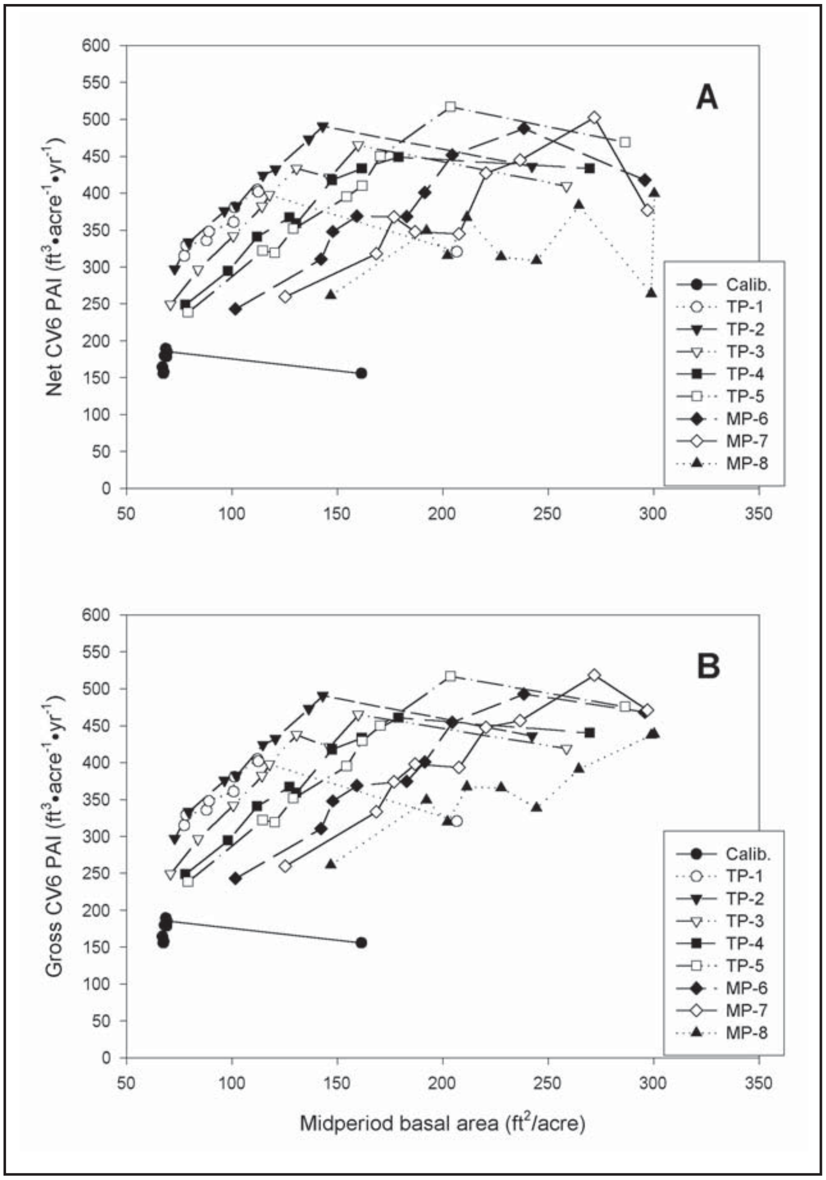

Figure 29—Merchantable cubic-foot-volume (CV6) periodic annual increment in relation to midperiod basal area, by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) gross.

Merchantable volume (CV6) PAI and MAI—Net and gross merchantable volume (CV6) growth shows trends similar to those for total stem volume. The difference was in the early periods when there was little merchantable volume in the controls and the growth rate of trees on controls was low, which slowed recruitment while the higher growth rate of trees on the treatments plot brought trees into merchantability sooner. This caused net growth of the lighter thinning treatments to exceed the control for the first two periods. In later periods, all the trees reached the merchantability limits, and mortality on the control caused net growth to be less than the higher density treatments (figs. 29a and 30a). Figure 29 shows growth versus growing stock defined as basal area per acre, and figure 30 shows growth in relation to relative density (Curtis 1982).

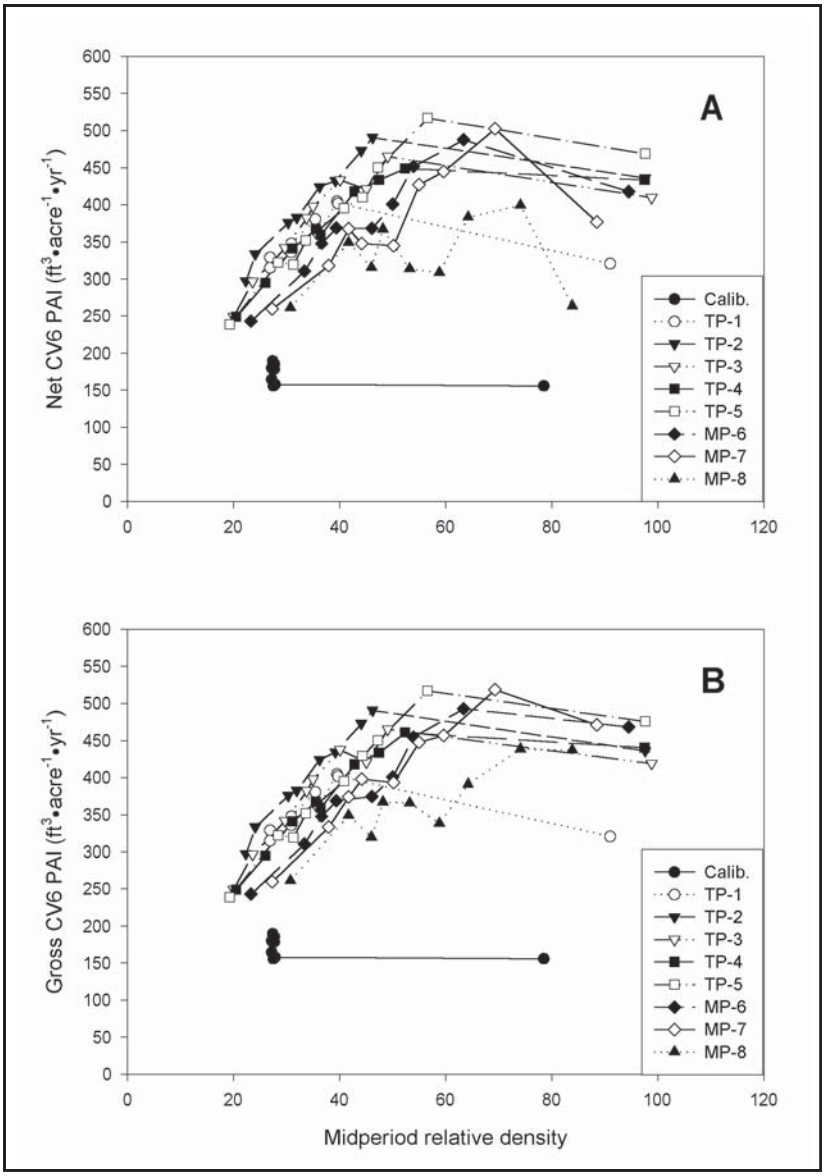

Figure 30—Merchantable cubic-foot-volume (CV6) periodic annual increment in relation to midperiod relative density (Curtis 1982), by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) gross.

Net MAI in merchantable volume has not culminated for any treatment or the control (net or gross), although values suggest that net growth on the control will culminate in the next period (about 12 years later than for total stem volume). As with total stem volume, all treatments except the two lightest thinnings are decreasing in PAI but less than for total stem volume (fig. 31).

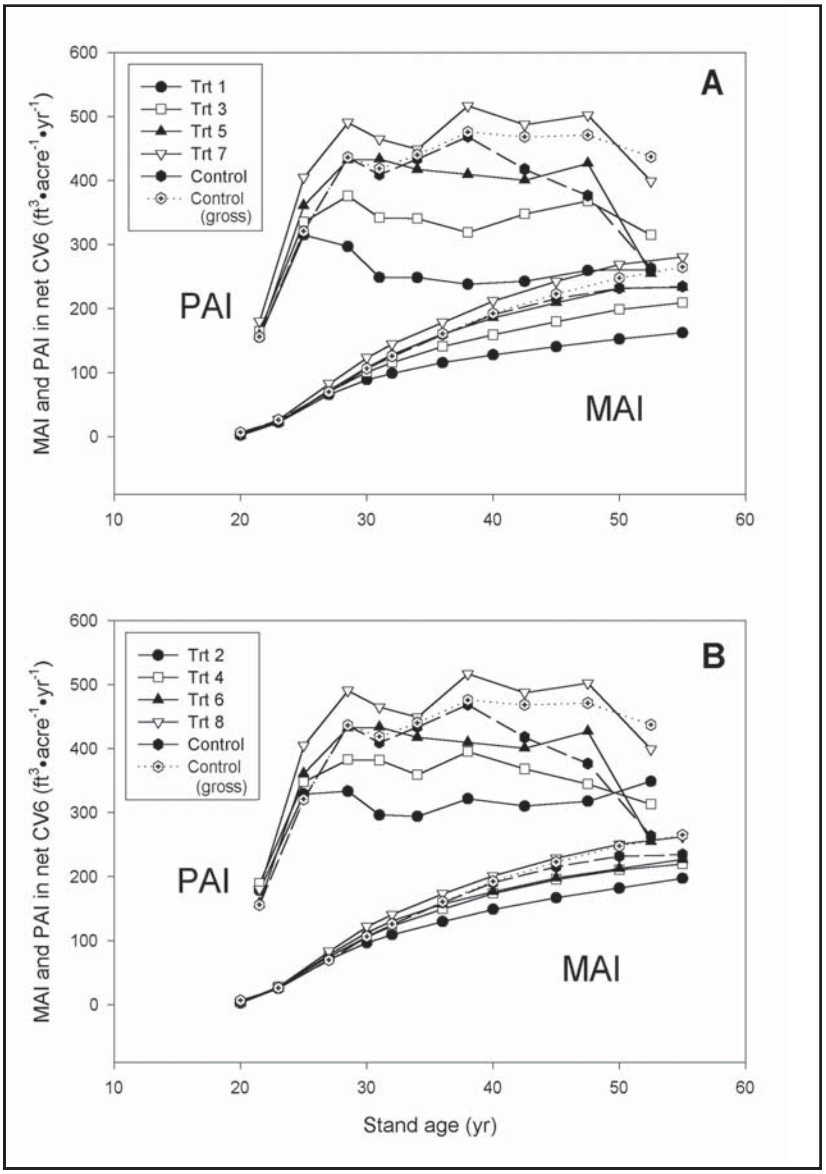

Figure 31—Mean annual increment (MAI) and periodic annual increment (PAI) in net merchantable cubic-foot volume to a 6-in top diameter inside bark (CV6) in relation to stand age and treatment: (**A**) fixed percentage treatments and control (net and gross), and (**B**) variable percentage treatments and control (net and gross).

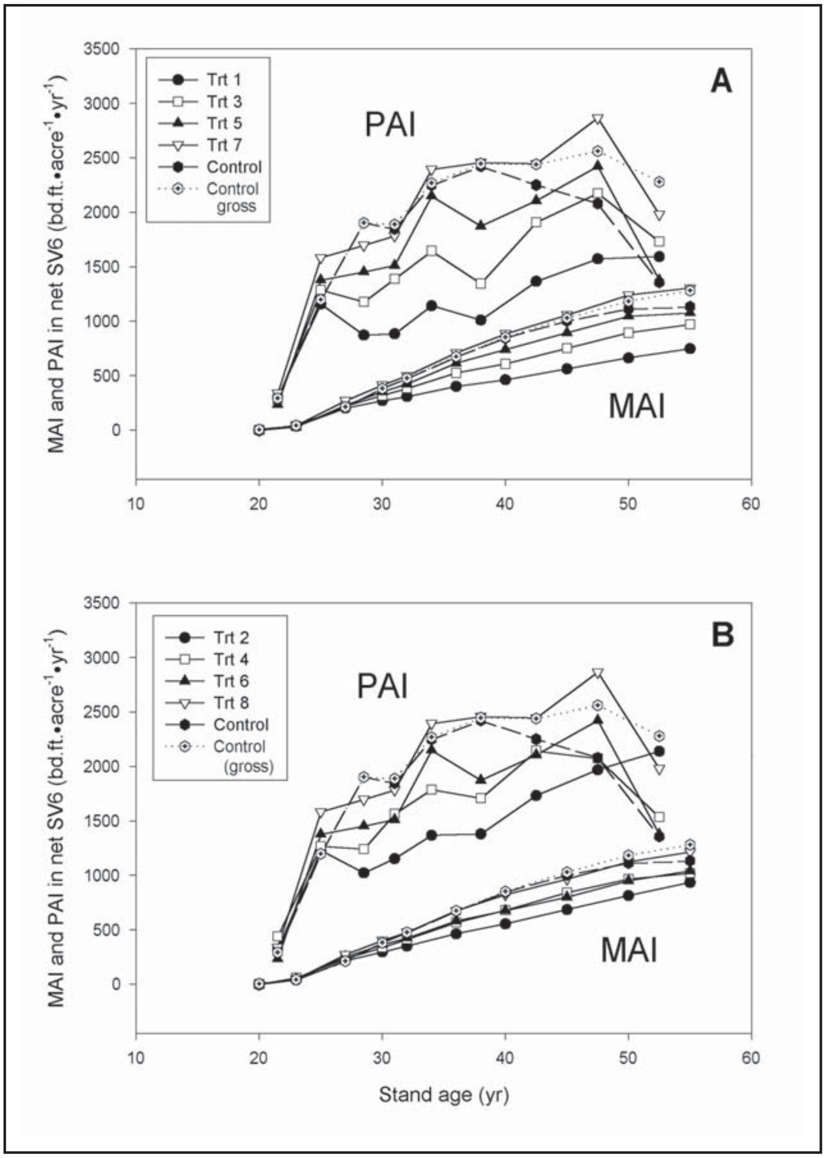

Figure 32—Mean annual increment (MAI) and periodic annual increment (PAI) in net Scribner board-foot volume (SV6) in relation to stand age and treatment: (**A**) fixed percentage treatments and control (net and gross), and (**B**) variable percentage treatments and control (net and gross).

Scribner volume (SV6) PAI and MAI—Figure 32 shows the MAI/PAI trends for net Scribner board-foot volume as measured to a 6-in top in 32-ft logs (16-ft top log minimum). Although these trends appear more erratic than for merchantable cubic volume as logs jump to successively larger diameter classes, the MAI trends for all treatments are still increasing.

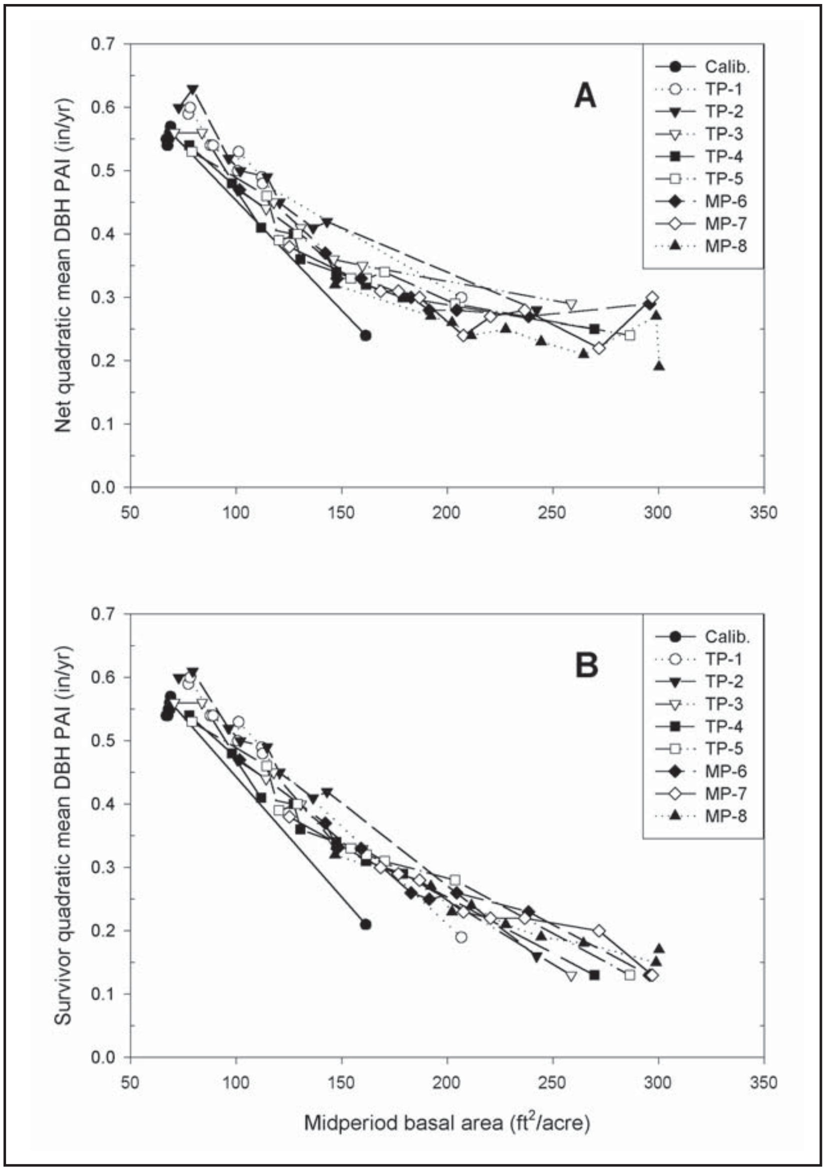

Figure 33—Periodic annual quadratic mean diameter growth in relation to midperiod basal area, by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) survivor.

Diameter PAI—Average growth in quadratic mean diameter of surviving trees increased 165 percent on the thinned plots after the calibration thinning compared to unthinned control. Diameter growth continues to be strongly related to growing stock. Figure 33 shows growth versus growing stock defined as basal area per acre, and figure 34 shows

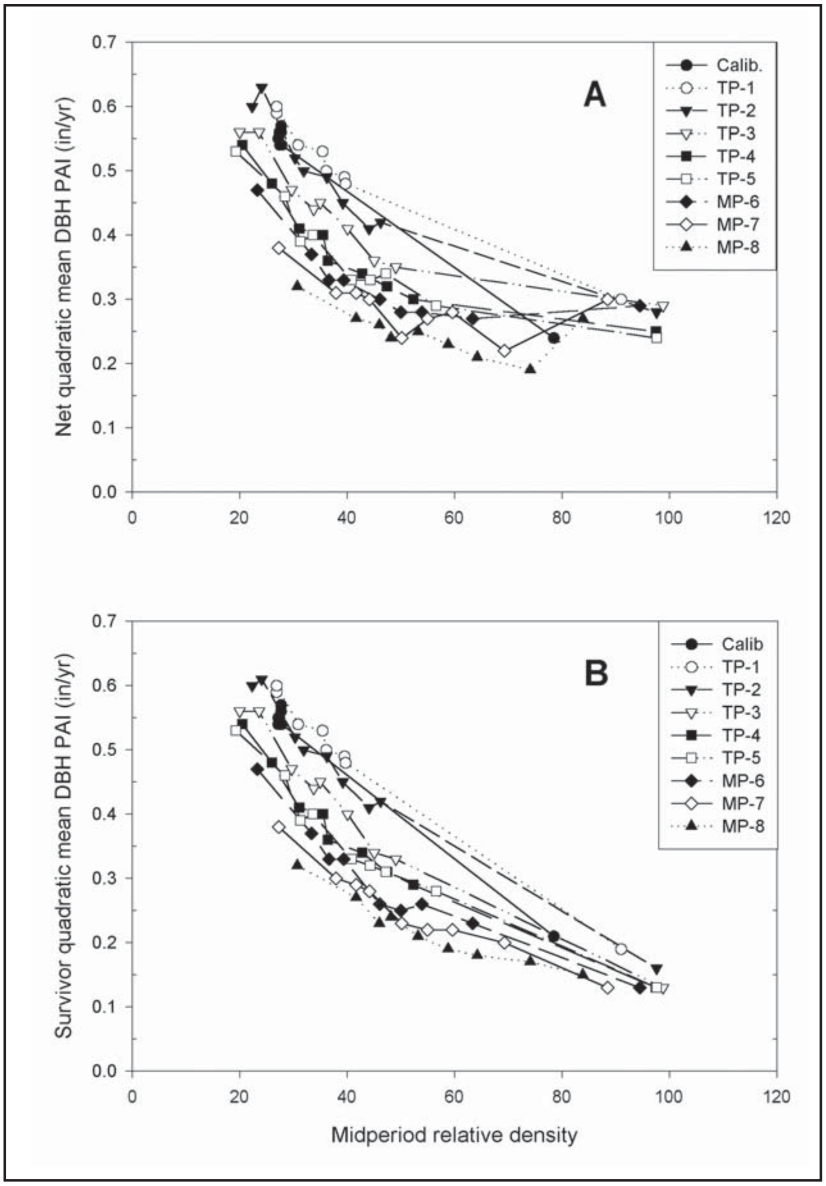

Figure 34—Periodic annual quadratic mean diameter growth in relation to midperiod relative density (Curtis 1982), by period (TP = treatment period and MP = measurement period): (**A**) net, and (**B**) survivor.

growth in relation to relative density (Curtis 1982). There was little difference between net and survivor growth for the thinned plots. Net growth on the control was about twice the survivor growth, because of mortality in smaller trees. Growth on the controls was relatively constant, while diameter growth for all thinning treatments decreased with age (fig. 35). The increased growth at lower stocking and its relation to growing stock also is evident in the largest trees (fig. 36).

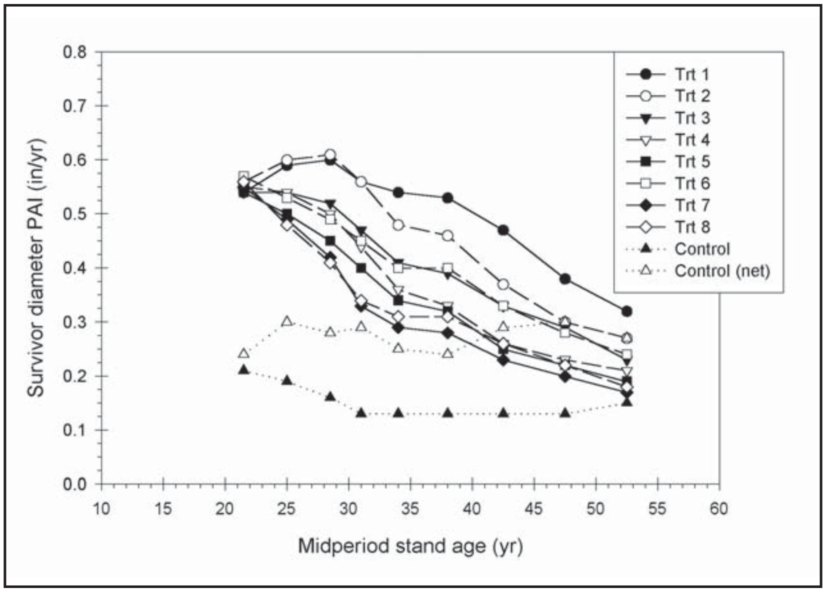

Figure 35—Periodic annual survivor quadratic mean diameter growth by treatment and stand age (includes net periodic growth of the controls).

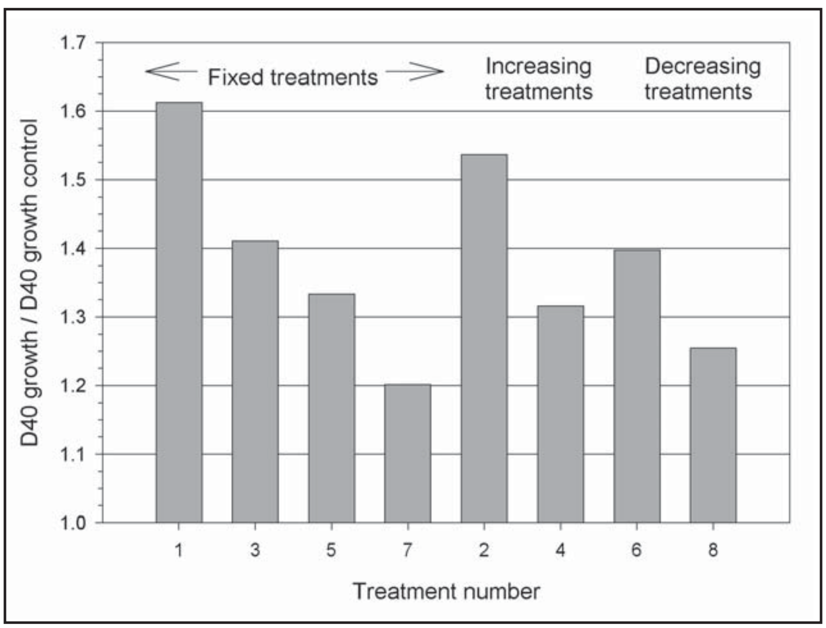

Figure 36—Thirty-five-year diameter increments of the 40 largest trees per acre, by treatment, expressed as a ratio to the increment on the controls.

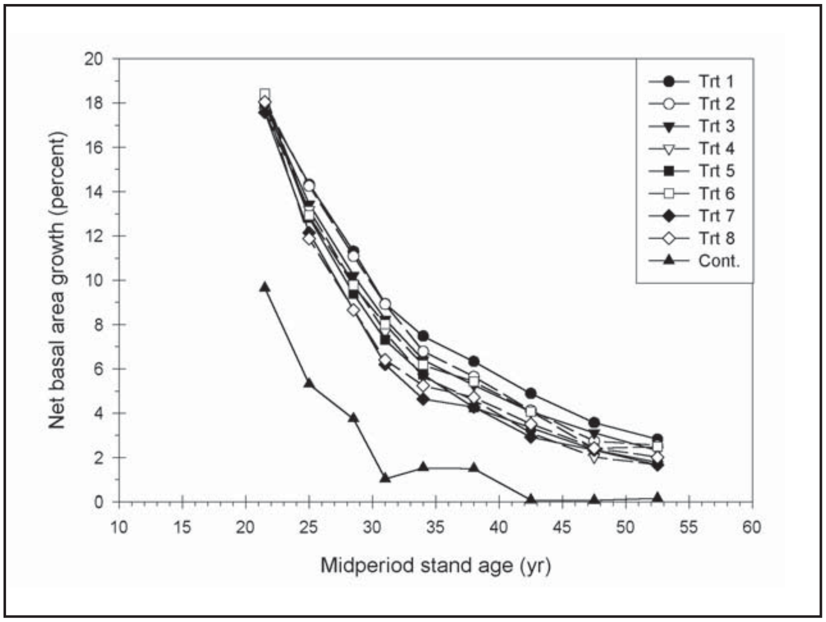

Figure 37—Trends in net basal area growth percentage over time, by treatment.

Growth Percentage

Growth percentage is an expression of growth relative to growing stock. The argument that one should seek maximum return (growth) on growing stock, one expression of which is net growth percentage, had an important place in the thinking that led to the LOGS study.

Values of growth percentage for a growth period were calculated as:

$$\text{growth percentage} = 100\left[\frac{PAI_p}{(X_{p-1} + X_p)/2}\right],$$

where PAI is the periodic annual increment and X_{p-1} and X_p are the growing stock at the beginning and end of the growth period, respectively.

Basal area growth percent—For all treatments and the control, net basal area growth percentage declined over time (fig. 37) from initial values after the calibration of about 18 and 9.5 percent, respectively. The growth percentages of the thinning treatments were similar, with differences among the treatments of less than 2.8 percentage points for all periods. The higher density treatments had lower growth percentages at a given age, even though their growth rates (PAI) were higher because of their greater growing stock (larger denominator). On the controls, mortality reduced the net growth and therefore the growth percentage.

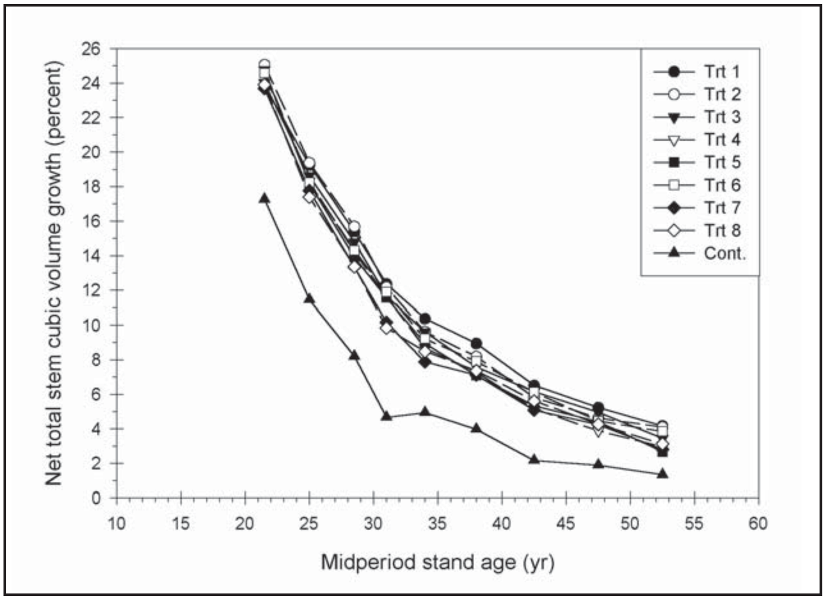

Figure 38—Trends in net total stem cubic-volume (CVTS) growth percentage over time, by treatment.

Total volume (CVTS) growth percentage—Like basal area, net total stem volume growth percentage also declines over time (fig. 38). Initial values for the thinning treatments and the control were about 24.5 and 17 percent, respectively. Period differences among the thinning treatments were less than 2.5 percentage points. As with basal area, the treatments with greater growing stock had lower growth percentages, and mortality in the control reduced the growth percentage, although less so than for basal area. At stand age 55, all the thinning treatments have growth percentages of less than 5 percent and the control is now 2 percent.

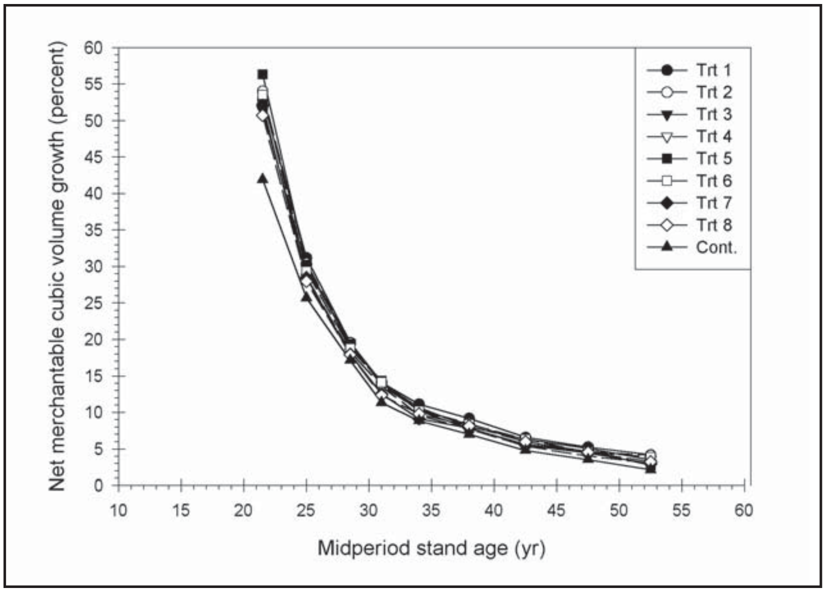

Figure 39—Trends in net merchantable cubic-volume (CV6) growth percentage over time, by treatment.

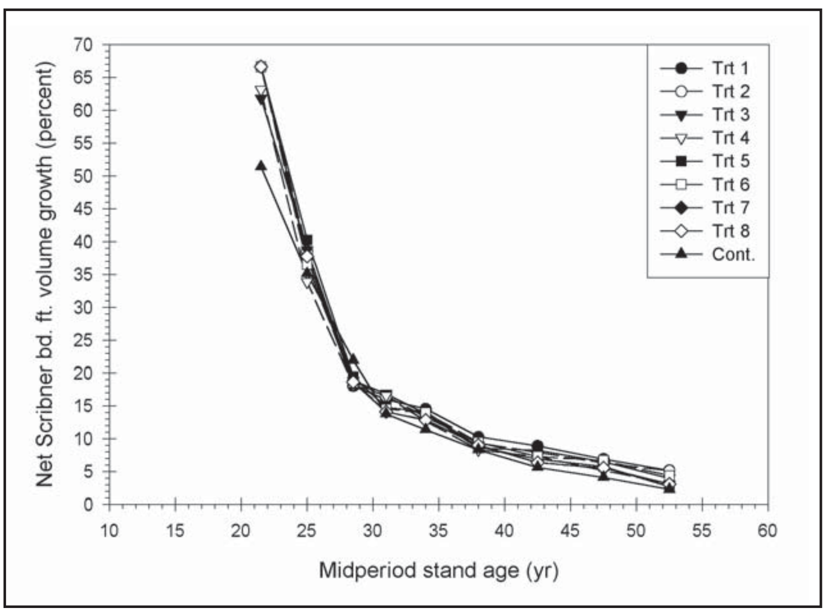

Figure 40—Trends in net Scribner board-foot-volume (SV6) growth percent over time, by treatment.

Merchantable volume (CV6) growth percentage—Net growth percentages of merchantable volume decrease with age and have less spread between treatments than those for total stem volume (fig. 39), with all thinning treatments within 2 percentage points for each period. The initial growth percentages for the thinning treatments were about double the values for CVTS (between about 50 and 55 percent), but they were nearly the same in later periods because all trees grew into the merchantable size class. There also was less difference between the growth percentage of the control and the thinning treatments than for CVTS, which reflects the initially small amount of growing stock (little merchantable volume) and the high merchantable growth rates on the heavier thinnings.

Scribner volume (SV6) growth percentage—Net growth percentages of Scribner volume (SV6) decrease with age and have a spread between treatments similar to CV6 (fig. 40), with all thinning treatments within 2 percentage points. The initial growth percentages were about 25 percent greater than for CV6 but were similar for the measurement period. There also was less difference between the growth percentage of the control and the treatments, which reflects the initially small amount of growing stock (little merchantable volume) and the high merchantable growth rates on the heavier thinnings.

Discussion

Because of its age and high site index, the Hoskins LOGS installation is the most advanced in development of all the LOGS installations. As of the 1998 remeasurement, it had completed 19 years of growth since the final treatment thinning and was at an age some would consider for a final harvest. Curtis and Marshall (1986) and subsequent reports in the LOGS series have shown that the installations are, in general, developing similarly, though at different rates corresponding to differences in site quality. These results therefore suggest that the other installations may develop similarly as they accumulate growing stock after the last thinning treatment.

Stand Development

After age 25, the estimated site index on the control plots stabilized at around 134 ft (50-year base). Fluctuations above and below this of about 1 ft represent measurement error and probably weather factors. Before age 25, however, site index estimates were lower. Any differences in height at these young ages can result in large differences in estimated site. Also, the King (1966) site curves were constructed for unmanaged natural stands, and estimates of site index in thinned stands are influenced by changes in stand structure. Thus, these changes are not indications of changes in the productive capacity of the site.

Mortality has been considerable on the high-density controls but minimal for all thinning treatments. The control plots began experiencing mortality about the time of plot establishment at a density level of about 60 percent of the published maximum SDI. However, it appears that the actual maximum SDI for the Hoskins site is 558, less than the published value of 600. As the plots have developed since the maximum was reached, the controls seem to be tracking a self-thinning slope less than would be suggested by the Reineke (1933) slope of -0.623. As densities on the thinned plots have been allowed to accumulate after the last thinning treatment, indications are that competition mortality may be beginning in the lightest thinning treatments but before the lower limit of self-thinning (60 percent of maximum SDI) is reached, thereby giving further evidence that the actual maximum self-thinning line for Hoskins would be lower and have a different slope than the published curves (Long and others 1988).

Basal Area Growth

Both net and gross growth increased in a generally linear trend with growing stock through the range of the thinned treatments, with the maximum basal area growth occurring at the densest treatment. For gross growth, the treatments with the highest densities had growth similar to the control. Suppression-related mortality markedly reduced the net growth rates on the controls to near zero in the last two growth periods.

Thinned plots have had little mortality to date. In the latest periods, growing stock on the lightest thinning (treatment 7) has caught up to the controls.

The low net basal area growth on the controls produced a nearly constant basal area of 300 ft^2/acre for the last 19 years, while basal areas on the thinning treatments continued to increase. This has resulted in a crossover in standing basal area, with the lightest thinning (treatment 7) having an average of 12 ft^2/acre more basal area than the controls at stand age 55 (19 years after the last thinning treatment).

Volume Growth

Like basal area growth, net and gross volume growth have increased with growing stock in a generally linear trend across the range of growing stock of the thinning treatments. The relation for volume was considerably stronger. This was expected given the strong prolonged height growth pattern of Douglas-fir and the importance of height growth in determining volume growth, as shown by Curtis and Marshall (1986) for the LOGS studies. Unlike gross basal area growth, however, gross total stem volume growth has not demonstrated a maximum within the range of growing stock attained by the thinned treatments. This includes the later measurement periods where growing stock of the lightest thinning matched the control's growing stock. Mortality in the control reduced net volume growth below that of the densest thinning treatment.

Both gross and net merchantable cubic-foot volume have shown maximum growth at the lightest thinning treatments in the early periods. Greater merchantable growth on these plots compared to the controls or more heavily thinned treatments was due to the trees in the thinned plots reaching the merchantability limits faster than the control, while the higher growing stock kept stand growth high compared to the lighter thinnnings. In later periods, growth in merchantable volumes behaved much like total stem volume as all of the trees reached the merchantable limit.

Diameter Growth

Diameter growth (PAI) of surviving trees (Curtis and Marshall 1989) is highly related to growing stock and shows a strong decrease with increasing growing stock. After the initial calibration thinning, quadratic mean diameter growth (PAI) of the surviving trees in the thinned treatments showed a quick and dramatic increase of about 2.5 times over the controls. Although net diameter growth was greater than the growth on the surviving trees (reflecting the increase in average diameter from mortality in small trees), the levels of both growth rates on the controls remained relatively consistent. Diameter growth on the thinning treatments decreased after the first periods as growing stock increased and crown ratio decreased in subsequent periods. This has resulted in a shallower slope to the diameter growth to growing stock curve, but the diameter growth for the heaviest thinning (treatment 1) is still two times growth of the control, which now has growth rates similar to the lightest thinnings treatment of similar density.

Mean Annual Increment

Net PAIs for total stem cubic volume (CVTS) for the thinning treatments currently exceed their MAI values by about 1.4 times, and MAI of the control appears to have culminated at about 42 years. Gross volume PAI for the control is still much greater than MAI; the difference reflects the heavy and increasing suppression-related mortality on the control. Net merchantable cubic volume (CV6) PAIs for the thinning treatments exceed MAI by about 1.5 times, and the net PAI for the control is about 10 percent higher than the MAI, which appears likely to reach culmination in the next period. Moving to higher merchantable standards, such as Scribner board-foot volume, seems to further extend culmination age. For the thinning treatments, the net board-foot PAIs averaged about 170 percent of the MAI with the control PAI about 120 percent of the MAI.

Cumulative Volume and Tree Size

Thinnings produced more volume in large trees and larger logs, compared to the control. At the last remeasurement (stand age 55), over 85 percent of the standing live volume on the thinned plots was in trees 15.6 in and larger compared to 49 percent on the controls (fig. 20), which had all volume in trees at least 7.6 in. Most thinning volume was in smaller trees (fig. 21). In the lighter thinnings, this was mostly trees 7.6 in and smaller, while in the heavier treatments, volume in the 11.6-in-and-larger diameter class was removed.

As of stand age 55, 50 percent of the 32-ft log volume (CV6) had a scaling diameter on the control of less then 10 in (fig. 22). For the heaviest thinning treatment (1), this value was about 16 in, and in the lightest thinning treatment (7), it was about 12 in. About 80 percent of the thinning volume came from logs 7 in or less.

Growth Percentage

Contrary to expectations at the time the experiment was begun, differences in growth percentages among thinning treatments are relatively small, generally less than 3 percent. This occurred because of the strong relation between stocking levels and volume growth. Reduced stand growth associated with lower stocking levels more or less offsets the effect of reduced volume in the divisor of the growth percentage expression.

Thinning increased and maintained higher growth percentage values of the thinning treatments over the control for basal area, CVTS, and initial merchantable volumes (CV6 and SV6). Differences in growth percentages among CVTS, CV6, and SV6 were generally less at recent measurements than at earlier measurements (fig. 41). This occurred because, as trees become larger, values of CVTS, CV6, and SV6 become more nearly proportional.

The trends in decreasing relative growth with time were primarily a result of PAI decreasing with age rather than stocking differences. By the last treatment period (age 50-55 years), the growth percentages were generally around 3 to 5 percent for volume growth of the treatments. This is, of course, volume growth percentage and not value growth percentage, which one would expect might be greater.

Management Implications

Benefits of Thinning

The LOGS studies were not designed to test operational thinning regimes; the frequent and light thinnings were used to provide close control of growing stock and would not be operationally feasible in most situations. The information gained from the LOGS studies is useful, however, in designing thinning regimes.

One of the primary objectives of the LOGS studies was to determine how growth is related to growing stock in young Douglas-fir stands. A concept often cited at the time the study was designed is referred to as the “Langsaeter hypothesis” (fig. 42), which suggests that similar gross increment can be obtained over a wide range of growing stock. To date, the LOGS studies have not supported this hypothesis in young Douglas-fir; they have not shown a clear plateau. After thinning treatments were stopped and

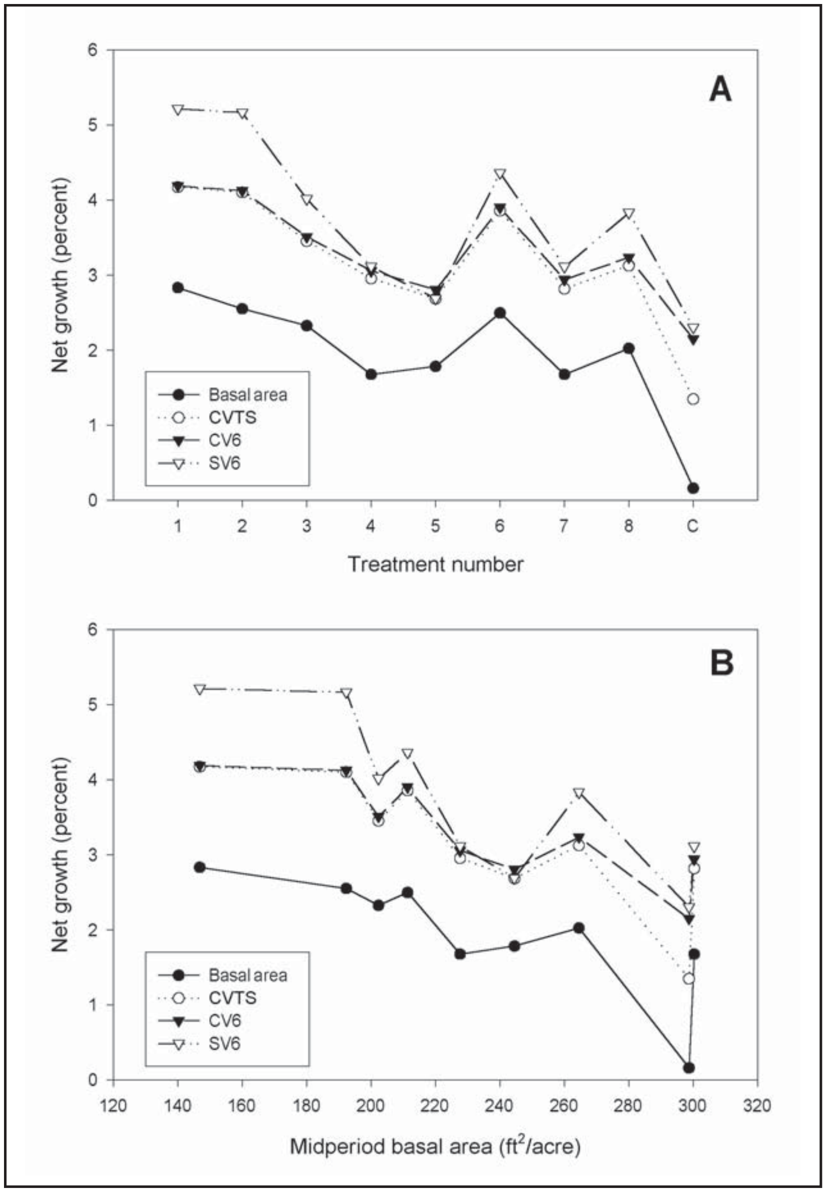

Figure 41—Net growth percentages in basal area, CVTS, CV6, and SV6 in the 1993-98 growth period: (**A**) by treatment, and (**B**) in relation to midperiod basal area.

additional growing stock accumulated on the thinned plots, maximum growth still occurred at the highest growing stock levels within the range of thinning treatments, which is the lightest thinning (treatment 7). This is expected to continue until the thinnings accumulate enough growing stock to be impacted by suppression mortality and height growth rates are reduced (Curtis and Marshall 1986). The findings reported here for this installation (figs. 26b and 27b), the most advanced in development of the LOGS sites, suggest that this may be beginning to happen. Continued observations will be required to see if, with the onset of mortality in the denser treatments, they develop an extended plateau or a peak in growth over growing stock.

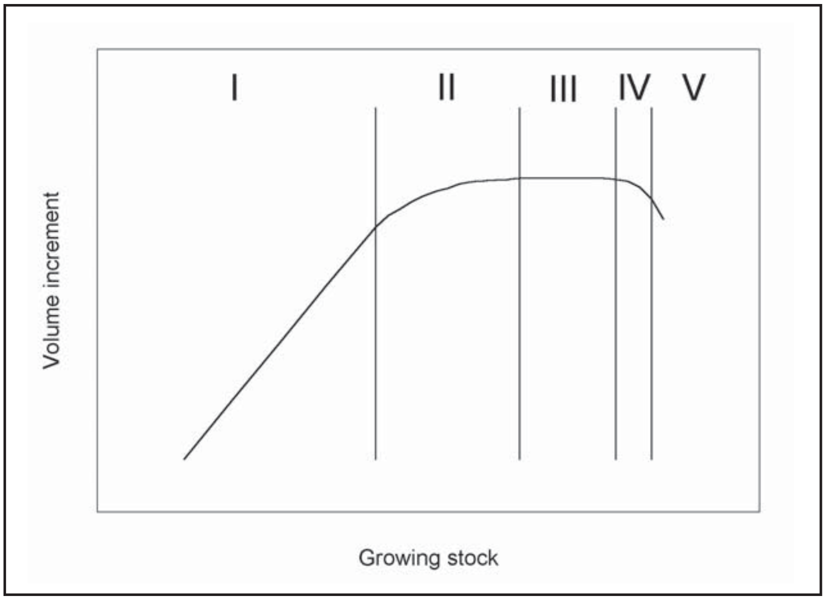

Figure 42—Relation between volume increment and growing stock as hypothesized by Langsaeter (from Braathe 1957), with density types I-V denoted.

These results are consistent with findings from other long-term thinning studies that show that thinning in Douglas-fir does not greatly increase cubic volume production. Although small gains in volume may be attained, the major benefits from thinning are from the following:

- Production of larger trees with correspondingly greater value per cubic foot
- Ability to forestall or salvage most mortality and enhance stand vigor
- Ability to produce wood while maintaining forest cover for extended periods
- Enhancement of aesthetic and wildlife values, with concomitant possible reductions in user conflicts

Given initial spacing comparable to that achieved by the calibration cut, and relative freedom from nonsuppression mortality, little additional volume production is gained by repeated thinning of initially well-stocked stands until the stands approach relative densities near the lower margin of the zone of competition-related mortality. This corresponds roughly to an SDI of about 400 or an RD of about 60. Hence, the full benefits of commercial thinning will be obtained only on moderate to long rotations (>50 years on this high productivity site).

Two caveats need to be kept in mind as results of thinned vs. control and among LOGS installations are compared:

1. LOGS installations were placed in stands carefully selected for uniformity and full stocking. Conditions on the thinned plots were little different from those existing on thousands of precommercially thinned acres. But the controls were in general denser and more uniform than many unthinned stands and relatively free of hardwoods. One therefore would expect higher volume production in early life on the controls than in

many unthinned stands, and gross volume gains from thinning therefore are probably underestimated by simple comparisons of thinning vs. control treatments (Curtis and others 1997).

2. Hoskins had an initially large number of trees compared to other LOGS installations. One therefore would expect early volume growth on the control to be high and the control to reach its upper density limit and undergo substantial mortality earlier than in installations with a lower initial stocking.

Considerations of wildlife habitat or premiums for large diameters could, of course, alter these generalizations. And, the ability to control species composition through thinning also may have benefits not obvious in the uniform single-species-stand experiment reported here.

Rotations and Timing of Final Thinnings

The trends of net volume PAI and MAI-total, merchantable cubic, and Scribner-show clearly that at age 55, this high productivity site stand is still considerably short of culmination. A longer rotation would give increased volume and value production, increased employment, and enhanced wildlife and aesthetic values. There clearly is conflict among these possible objectives and the relatively short rotations that stem from conventional financial analyses.

The clear relations between stocking and volume increment suggest that–from a timber production standpoint–even–aged stand management regimes usually should aim to produce relative densities near or slightly below the lower margin of the zone of competition-related mortality at time of final harvest. Thinning should be timed in relation to the rotation to meet this objective.

Evaluation of the Study

The Hoskins study specifically and the other LOGS plots generally have been providing valuable information on the development of young Douglas-fir for two and a half decades. The installations have provided a clean and consistently measured data set for several modeling projects. Further observations at Hoskins will provide important information on the long-term growth response to thinning in terms of MAI trends and stand development, as densities build up subsequent to the cessation of thinning and the start of competition-related mortality in the thinning treatments.

Overall analysis across the nine LOGS installations and integration with results of other thinning and spacing studies probably will best be done through generalized stand modeling. This is still in the future. There are, however, a number of more limited topics, not adequately covered in this summary report, that we hope to address in the near future. These include an expanded analysis and discussion of PAI and MAI trends and their significance, and an examination of relations between crown development, treatment regime, and stand density.

Metric Equivalents

1 inch (in) = 2.54 centimeters
1 foot (ft) = 0.3048 meter
1 mile (mi) = 1.6093 kilometers
1 acre = 0.405 hectare
1 square foot (ft^2) = 0.09290 square meter
1 cubic foot (ft^3) = 0.02832 cubic meter
1 square foot per acre (ft^2/acre) = 0.2293 square meter per hectare
1 cubic foot per acre (ft^3/acre) = 0.06997 cubic meter per hectare
1 tree per acre = 2.471 trees per hectare
(^oF-32)/1.8 = ^oC

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Appendix

Table 2—Heights of the 40 largest trees per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

		Height at start of period																	
Treatment	Plot	Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Feet																	
Fixed:																			
1	3	39.5	49.2	49.1	61.6	60.2	71.5	69.5	75.0	74.9	86.2	86.0	97.4	97.4	108.9	108.9	121.2	121.2	132.3
	8	40.9	49.3	49.2	63.8	63.6	72.7	70.8	76.8	76.0	88.4	86.8	98.6	98.6	109.9	109.9	119.7	119.7	128.3
	20	39.3	49.5	49.0	62.2	62.0	70.8	70.9	76.4	76.4	87.2	87.1	99.3	99.3	110.6	110.6	123.8	123.8	134.5
	Avg.	39.9	49.3	49.1	62.5	61.9	71.7	70.4	76.1	75.8	87.3	86.6	98.4	98.4	109.8	109.8	121.6	121.6	131.7
3	7	38.6	49.4	49.4	62.8	61.9	71.5	71.2	77.1	76.2	88.4	88.4	98.7	98.7	111.3	111.3	122.9	122.9	133.4
	11	38.0	47.4	47.1	61.0	60.6	70.3	71.5	76.9	76.9	89.1	89.1	98.1	98.1	111.6	111.6	124.4	124.4	133.3
	21	37.7	48.9	48.9	60.7	60.9	72.2	71.9	78.2	78.2	90.2	88.8	98.6	98.6	110.9	110.9	124.0	124.0	131.5
	Avg.	38.1	48.6	48.5	61.5	61.1	71.3	71.6	77.4	77.1	89.2	88.8	98.4	98.4	111.3	111.3	123.8	123.8	132.7
5	9	39.8	50.7	50.7	62.2	62.8	72.6	72.3	78.9	78.9	90.3	90.3	101.0	101.0	112.8	112.8	126.4	126.4	133.6
	24	38.8	49.4	48.7	62.3	62.3	71.7	71.8	78.1	78.1	89.6	89.6	101.8	101.8	114.6	114.6	129.6	129.6	134.3
	27	39.1	48.5	48.5	61.0	60.9	69.5	69.2	76.9	76.4	86.9	86.9	100.3	100.3	111.7	111.7	124.9	124.9	131.6
	Avg.	39.2	49.5	49.3	61.8	62.0	71.3	71.1	77.9	77.8	88.9	88.9	101.0	101.0	113.0	113.0	127.0	127.0	133.2
7	12	39.1	48.6	48.6	62.5	61.6	71.3	71.3	76.8	76.8	88.0	88.0	100.1	100.1	111.7	111.7	125.0	125.0	133.5
	14	38.5	49.8	49.8	63.2	62.6	72.1	72.1	78.2	78.2	89.0	89.0	100.6	100.6	113.3	113.3	124.6	124.6	135.1
	19	38.1	47.5	47.5	60.7	60.8	70.9	70.9	76.6	76.6	88.1	87.7	100.3	100.3	112.1	112.1	124.2	124.2	134.4
	Avg.	38.5	48.6	48.6	62.1	61.7	71.4	71.4	77.2	77.2	88.4	88.2	100.3	100.3	112.3	112.3	124.6	124.6	134.3
Increasing:																			
2	4	37.3	47.2	47.5	60.8	60.4	70.4	70.0	75.5	75.8	86.6	86.4	96.9	96.9	108.4	108.4	121.4	121.4	132.7
	15	39.1	50.5	50.5	65.1	65.5	75.5	75.5	82.3	82.3	92.3	92.1	102.6	102.6	113.0	113.0	124.1	124.1	138.6
	17	38.0	47.7	47.0	61.3	61.9	72.6	72.4	78.3	78.2	89.3	89.3	101.2	101.2	112.4	112.4	123.0	123.0	133.6
	Avg.	38.1	48.4	48.3	62.4	62.6	72.8	72.7	78.7	78.8	89.4	89.3	100.2	100.2	111.3	111.3	122.8	122.8	135.0
4	5	38.7	48.8	48.6	61.3	61.0	70.1	71.0	75.7	75.7	85.9	85.9	97.2	97.2	110.2	110.2	121.5	121.5	128.5
	18	38.8	50.2	49.9	63.8	63.0	73.7	73.7	79.8	79.8	91.8	91.8	102.8	102.8	114.3	114.3	126.4	126.4	138.4
	23	41.9	53.2	52.8	65.6	64.9	75.1	74.9	81.4	81.4	92.5	92.5	103.0	103.0	114.0	114.0	128.3	128.3	138.3
	Avg.	39.8	50.8	50.5	63.5	63.0	73.0	73.2	79.0	79.0	90.1	90.1	101.0	101.0	112.8	112.8	125.4	125.4	135.1
Decreasing:																			
6	1	39.9	49.3	49.1	62.2	62.2	71.3	70.6	76.5	76.5	87.0	87.0	98.7	98.7	109.5	109.5	123.6	123.6	135.0
	2	40.1	48.9	48.9	61.3	61.0	70.7	70.3	76.2	76.2	88.0	87.6	98.6	98.6	111.3	111.3	124.5	124.5	134.8
	25	38.6	48.6	47.9	61.6	61.6	71.8	71.8	77.0	77.0	88.3	87.2	96.9	96.9	108.9	108.9	121.2	121.2	130.6
	Avg.	39.5	48.9	48.6	61.7	61.6	71.3	70.9	76.6	76.6	87.8	87.2	98.1	98.1	109.9	109.9	123.1	123.1	133.4
8	6	39.7	49.3	49.3	63.5	62.9	72.9	72.9	78.9	78.9	89.8	89.5	100.7	100.7	112.8	112.8	123.2	123.2	131.3
	13	40.5	48.3	48.3	61.9	61.9	71.1	71.1	75.9	76.4	88.4	87.2	97.5	97.5	110.6	110.6	123.3	123.3	132.2
	16	39.6	49.4	49.4	63.6	63.6	72.7	72.6	78.1	78.1	88.2	88.0	99.7	99.7	111.2	111.2	123.6	123.6	133.6
	Avg.	39.9	49.0	49.0	63.0	62.8	72.2	72.2	77.6	77.8	88.8	88.2	99.3	99.3	111.5	111.5	123.4	123.4	132.4
Unthinned:																			
C	10	40.7	50.0	50.0	63.1	63.1	72.3	72.3	77.7	77.7	87.0	87.0	95.7	95.7	106.9	106.9	118.5	118.5	125.1
	22	44.1	52.3	52.3	66.4	66.4	76.0	76.0	82.1	82.1	91.5	91.5	102.0	102.0	114.1	114.1	126.3	126.3	134.9
	26	41.6	51.0	51.0	65.4	65.4	74.9	74.9	80.9	80.9	90.3	90.3	99.5	99.5	110.6	110.6	121.9	121.9	130.7
	Avg.	42.1	51.1	51.1	65.0	65.0	74.4	74.4	80.2	80.2	89.6	89.6	99.1	99.1	110.5	110.5	122.2	122.2	130.2

Table 3—Diameters of the 40 largest trees per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

		Diameter at start of period																	
Treatment	Plot	Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Inches																	
Fixed:																			
1	3	7.1	9.2	9.0	11.9	11.2	13.3	13.1	14.3	14.3	16.6	16.4	18.6	18.6	21.1	21.1	23.1	23.1	24.9
	8	7.1	9.1	9.0	11.7	11.6	13.6	13.4	14.6	14.4	16.4	16.3	18.6	18.6	21.0	21.0	23.2	23.2	24.9
	20	6.9	9.0	8.9	11.6	11.3	13.3	13.3	14.4	14.4	16.7	16.1	18.2	18.2	20.3	20.3	22.0	22.0	23.5
	Avg.	7.0	9.1	9.0	11.7	11.4	13.4	13.3	14.4	14.3	16.6	16.3	18.5	18.5	20.8	20.8	22.8	22.8	24.4
3	7	7.2	9.2	9.1	11.7	11.2	12.9	12.7	13.8	13.2	15.0	15.0	16.8	16.8	18.8	18.8	20.6	20.6	21.9
	11	7.0	9.2	9.1	11.8	11.7	13.5	13.2	14.3	14.3	16.2	16.2	18.1	18.1	20.3	20.3	22.2	22.2	23.8
	21	7.3	9.5	9.5	12.2	12.1	13.9	13.7	14.8	14.8	16.5	16.1	17.7	17.7	19.3	19.3	20.6	20.6	21.8
	Avg.	7.2	9.3	9.3	11.9	11.7	13.5	13.2	14.3	14.1	15.9	15.8	17.5	17.5	19.4	19.4	21.1	21.1	22.5
5	9	6.5	8.5	8.5	11.0	11.0	12.7	12.4	13.4	13.4	15.2	15.2	16.8	16.8	18.4	18.4	19.8	19.8	21.1
	24	7.1	9.4	9.3	11.9	11.9	13.7	13.4	14.6	14.6	16.3	16.3	17.8	17.8	19.3	19.3	20.6	20.6	21.2
	27	6.8	8.7	8.7	11.3	11.1	12.6	12.5	13.5	13.5	15.4	15.4	17.2	17.2	19.1	19.1	20.7	20.7	22.1
	Avg.	6.8	8.9	8.8	11.4	11.3	13.0	12.8	13.8	13.8	15.6	15.6	17.3	17.3	19.0	19.0	20.4	20.4	21.4
7	12	7.3	9.3	9.3	11.5	11.2	12.7	12.7	13.5	13.5	15.0	15.0	16.5	16.5	18.0	18.0	19.5	19.5	20.8
	14	7.2	9.3	9.3	11.9	11.9	13.5	13.5	14.4	14.4	15.8	15.8	17.3	17.3	18.8	18.8	20.1	20.1	21.3
	19	7.2	9.2	9.2	11.6	11.4	12.9	12.9	13.7	13.7	15.1	15.1	16.4	16.4	17.9	17.9	19.1	19.1	20.3
	Avg.	7.2	9.3	9.3	11.6	11.5	13.0	13.0	13.8	13.8	15.3	15.3	16.8	16.8	18.2	18.2	19.6	19.6	20.8
Increasing:																			
2	4	6.7	8.7	8.5	11.5	11.1	13.1	13.0	14.3	14.2	16.2	16.1	18.0	18.0	20.1	20.1	21.7	21.7	23.1
	15	7.3	9.6	9.6	12.6	12.5	14.8	14.8	16.2	16.1	18.3	18.0	20.1	20.1	22.4	22.4	24.2	24.2	25.8
	17	7.0	9.1	8.7	11.2	11.0	12.9	12.8	14.0	13.9	16.0	16.0	17.9	17.9	19.9	19.9	21.3	21.3	22.8
	Avg.	7.0	9.1	8.9	11.8	11.6	13.6	13.5	14.8	14.7	16.8	16.7	18.7	18.7	20.8	20.8	22.4	22.4	23.9
4	5	6.8	8.7	8.7	11.2	11.1	12.8	12.6	13.5	13.5	15.3	15.3	16.8	16.8	18.3	18.3	19.6	19.6	20.3
	18	6.7	8.8	8.7	11.3	11.0	12.8	12.8	13.9	13.9	15.8	15.8	17.5	17.5	19.2	19.2	20.7	20.7	22.1
	23	7.7	9.8	9.8	12.5	12.4	14.3	14.1	15.2	15.2	17.0	17.0	18.6	18.6	20.2	20.2	21.6	21.6	22.9
	Avg.	7.1	9.1	9.1	11.7	11.5	13.3	13.2	14.2	14.2	16.0	16.0	17.6	17.6	19.3	19.3	20.6	20.6	21.8
Decreasing:																			
6	1	7.1	9.3	9.3	11.8	11.8	13.6	13.2	14.3	14.3	16.0	15.9	17.8	17.8	19.5	19.5	21.2	21.2	22.6
	2	7.1	9.1	9.1	11.6	11.4	13.2	12.9	14.1	14.1	16.0	15.6	17.3	17.3	19.4	19.4	21.0	21.0	22.5
	25	6.8	8.9	8.9	11.4	11.4	13.1	13.1	14.1	14.1	15.9	15.9	17.6	17.6	19.4	19.4	20.9	20.9	22.2
	Avg.	7.0	9.1	9.1	11.6	11.6	13.3	13.1	14.2	14.2	16.0	15.8	17.6	17.6	19.4	19.4	21.0	21.0	22.5
8	6	7.2	9.4	9.4	11.8	11.6	13.2	13.2	14.1	14.1	15.8	15.7	17.4	17.4	19.2	19.2	20.8	20.8	22.1
	13	7.8	9.9	9.9	12.2	12.0	13.4	13.4	14.1	14.1	15.6	15.2	16.7	16.7	18.3	18.3	19.6	19.6	21.0
	16	7.0	9.0	9.0	11.3	11.3	12.9	12.7	13.6	13.6	15.1	14.9	16.5	16.5	18.1	18.1	19.4	19.4	20.7
	Avg.	7.3	9.4	9.4	11.8	11.6	13.2	13.1	14.0	13.9	15.5	15.3	16.8	16.8	18.5	18.5	20.0	20.0	21.3
Unthinned:																			
C	10	7.3	8.6	8.6	10.2	10.2	11.2	11.2	11.7	11.7	12.7	12.7	13.7	13.7	14.9	14.9	16.0	16.0	17.2
	22	8.0	9.4	9.4	11.3	11.3	12.5	12.5	13.3	13.3	14.7	14.7	16.1	16.1	17.8	17.8	19.4	19.4	21.0
	26	7.4	9.2	9.2	11.1	11.1	12.3	12.3	13.0	13.0	14.1	14.1	15.1	15.1	16.3	16.3	17.5	17.5	18.8
	Avg.	7.6	9.1	9.1	10.9	10.9	12.0	12.0	12.7	12.7	13.8	13.8	15.0	15.0	16.3	16.3	17.6	17.6	19.0

Table 4—Number of trees per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

		Number of trees per acre																	
Treatment	Plot	Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
Fixed:																			
1	3	345	345	210	210	115	115	85	85	70	70	50	50	50	50	50	50	50	50
	8	380	375	225	225	120	120	80	80	70	70	50	50	50	50	50	50	50	50
	20	335	335	210	210	120	120	85	85	70	70	55	55	55	55	55	55	55	55
	Avg.	353	352	215	215	118	118	83	83	70	70	52	52	52	52	52	52	52	52
3	7	390	390	295	295	200	200	160	160	145	145	115	115	115	115	115	110	110	105
	11	340	340	240	240	160	160	125	125	105	105	85	85	85	85	85	85	85	85
	21	300	295	220	220	165	165	135	135	120	120	105	105	105	105	105	105	105	105
	Avg.	343	342	252	252	175	175	140	140	123	123	102	102	102	102	102	100	100	98
5	9	355	355	315	315	250	250	215	215	195	195	175	170	170	165	165	160	160	160
	24	345	345	280	280	230	230	200	200	180	180	165	160	160	160	160	145	145	125
	27	395	390	340	340	270	265	225	220	205	205	170	165	165	160	160	155	155	150
	Avg.	365	363	312	312	250	248	213	212	193	193	170	165	165	162	162	153	153	145
7	12	330	330	330	330	300	300	275	275	260	255	240	235	235	230	230	215	215	210
	14	325	325	310	310	270	270	245	245	230	230	210	210	210	190	190	190	190	190
	19	330	330	330	330	290	290	265	260	240	230	225	225	225	220	220	220	220	205
	Avg.	328	328	323	323	287	287	262	260	243	238	225	223	223	213	213	208	208	202
Increasing:																			
2	4	360	360	220	220	135	135	105	105	95	95	85	85	85	85	85	85	85	85
	15	325	325	185	185	100	100	75	75	70	70	65	65	65	65	65	65	65	65
	17	345	340	215	215	140	135	110	110	105	105	90	90	90	90	90	85	85	85
	Avg.	343	342	207	207	125	123	97	97	90	90	80	80	80	80	80	78	78	78
4	5	390	390	285	285	205	205	180	180	160	160	155	155	155	150	150	145	145	135
	18	320	320	245	245	185	185	165	165	150	150	145	145	145	140	140	130	130	120
	23	290	280	200	200	150	150	135	135	125	125	115	115	115	110	110	110	110	110
	Avg.	333	330	243	243	180	180	160	160	145	145	138	138	138	133	133	128	128	122
Decreasing:																			
6	1	325	325	275	275	210	210	170	170	145	145	115	115	115	115	115	110	110	110
	2	360	360	300	300	225	225	180	180	150	150	115	115	115	115	115	115	115	115
	25	330	330	275	275	295	195	155	155	130	130	100	100	100	100	100	90	90	90
	Avg.	338	338	283	283	210	210	168	168	142	142	110	110	110	110	110	105	105	105
8	6	375	370	360	360	300	300	260	260	240	240	200	195	195	190	190	170	170	170
	13	330	330	320	320	270	270	240	235	220	215	190	185	185	180	180	170	170	160
	16	305	305	300	300	255	255	225	225	205	205	170	170	170	170	170	170	170	170
	Avg.	337	335	327	327	275	275	242	240	222	220	187	183	183	180	180	170	170	167
Unthinned:																			
C	10	1885	1830	1830	1425	1425	1205	1205	1100	1100	885	885	735	735	540	540	410	410	345
	22	1595	1430	1430	1110	1110	965	965	800	800	695	695	600	600	435	435	340	340	265
	26	1675	1650	1650	1280	1280	1090	1090	915	915	720	720	625	625	490	490	380	380	310
	Avg.	1718	1637	1637	1272	1272	1087	1087	938	938	767	767	653	653	488	488	377	377	307

Table 5—Number of trees per acre by 1-in d.b.h. classes, after the calibration (1963) and in 1998, by treatment and age (in parentheses)

D.b.h. class	Treatment 1 Start 1963 (20 hr)	Treatment 1 End 1998 (55 yr)	Treatment 3 Start 1963 (20 yr)	Treatment 3 End 1998 (55 yr)	Treatment 5 Start 1963 (20 yr)	Treatment 5 End 1998 (55 yr)	Treatment 7 Start 1963 (20 yr)	Treatment 7 End 1998 (55 yr)	Treatment 2 Start 1963 (20 yr)	Treatment 2 End 1998 (55 yr)	Treatment 4 Start 1963 (20 yr)	Treatment 4 End 1998 (55 yr)	Treatment 6 Start 1963 (20 yr)	Treatment 6 End 1998 (55 yr)	Treatment 8 Start 1963 (20 yr)	Treatment 8 End 1998 (55 yr)	Control Start 1963 (20 yr)	Control End 1998 (55 yr)
Inches									*Number per acre*									
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0		0	13	0
3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	482	0
4	30	0	43	0	45	0	33	0	43	0	35	0	32	0	32	0	470	0
5	122	0	100	0	105	0	75	0	75	0	78	0	87	0	83	0	357	0
6	105	0	97	0	118	0	92	0	122	0	105	0	117	0	110	0	225	0
7	58	0	68	0	77	0	85	0	67	0	72	0	62	0	68	0	113	0
8	35	0	23	0	17	0	33	0	33	0	38	0	40	0	33	0	48	7
9	2	0	8	0	3	0	10	0	3	0	3	0	2	0	8	0	5	13
10	0	0	3	0	0	3	0	2	0	0	2	0	0	0	2	0	2	20
11	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	5	2	43
12	0	0	0	0	0	3	0	10	0	0	0	3	0	0	0	10	0	38
13	0	0	0	0	0	5	0	18	0	0	0	2	0	0	0	5	2	33
14	0	0	0	3	0	1	0	12	0	0	0	3	0	3	0	8	0	32
15	0	0	0	5	0	10	0	13	0	0	0	0	0	3	0	5	0	33
16	0	0	0	5	0	7	0	12	0	5	0	12	0	5	0	13	0	28
17	0	0	0	3	0	15	0	23	0	0	0	10	0	5	0	13	0	13
18	0	0	0	3	0	18	0	27	0	2	0	13	0	8	0	28	0	15
19	0	2	0	8	0	10	0	22	0	2	0	13	0	5	0	22	0	7
20	0	2	0	15	0	18	0	27	0	7	0	10	0	18	0	20	0	8
21	0	5	0	12	0	15	0	12	0	13	0	18	0	22	0	12	0	5
22	0	3	0	12	0	10	0	13	0	8	0	17	0	5	0	10	0	7
23	0	3	0	17	0	10	0	8	0	15	0	13	0	12	0	7	0	2
24	0	12	0	5	0	7	0	2	0	10	0	0	0	7	0	5	0	0
25	0	7	0	7	0	2	0	0	0	0	0	3	0	0	0	3	0	0
26	0	10	0	2	0	0	0	0	0	10	0	2	0	0	0	0	0	2
27	0	3	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0
28	0	0	0	2	0	0	0	0	0	3	0	0	0	0	0	0	0	0
29	0	5	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0
Total	353	52	343	98	365	145	328	202	343	87	333	122	338	105	337	167	1,718	307

Table 6—Basal area per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

Treatment	Plot	Basal area: Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Square feet per acre																	
Fixed:																			
1	3	49.6	88.4	55.9	102.1	60.3	86.0	64.7	77.7	65.5	88.8	68.6	88.3	88.3	113.4	113.4	135.4	135.4	156.4
	8	50.2	84.2	54.8	98.1	60.3	84.2	64.5	76.7	66.3	89.4	68.3	89.5	89.5	115.8	115.8	141.5	141.5	163.7
	20	48.3	84.0	54.8	98.1	60.6	85.2	63.9	76.6	66.5	90.1	70.2	89.6	89.6	112.8	112.8	132.3	132.3	151.7
	Avg.	49.4	85.5	55.1	99.4	60.4	85.1	64.4	77.0	66.1	89.4	69.0	89.1	89.1	114.0	114.0	136.4	136.4	157.2
3	7	48.6	83.0	65.2	113.1	81.8	112.5	92.3	109.0	97.5	127.3	107.8	135.5	135.5	168.6	168.6	198.4	198.4	220.4
	11	49.3	87.2	65.1	114.5	81.6	111.5	92.7	109.7	97.8	127.9	106.9	132.9	132.9	164.9	164.9	196.1	196.1	223.5
	21	49.1	84.7	62.5	106.8	81.4	109.5	91.8	107.8	97.3	123.4	107.9	130.3	130.3	155.4	155.4	177.2	177.2	198.4
	Avg.	49.0	85.0	64.2	111.5	81.6	111.2	92.3	108.8	97.5	126.2	107.5	132.9	132.9	163.0	163.0	190.6	190.6	214.1
5	9	48.2	83.5	75.0	126.5	103.0	136.9	121.3	139.2	130.5	163.6	147.4	174.1	174.1	204.5	204.5	232.7	232.7	258.2
	24	50.7	89.9	74.9	124.1	103.4	137.1	121.1	140.7	130.1	160.8	148.4	174.5	174.5	202.4	202.4	223.1	223.1	217.5
	27	48.7	84.5	74.8	128.9	104.5	138.8	120.8	140.6	130.5	168.6	147.8	177.7	177.7	215.4	215.4	244.9	244.9	274.7
	Avg.	49.2	86.0	74.9	126.5	103.6	137.6	121.1	140.1	130.4	164.3	147.9	175.4	175.4	207.4	207.4	233.6	233.6	250.1
7	12	49.2	83.7	83.7	136.7	124.6	161.0	150.3	169.4	162.3	196.5	185.8	219.0	219.0	255.8	255.8	282.6	282.6	312.4
	14	51.0	88.5	85.5	141.6	124.7	162.9	149.4	169.4	162.3	198.0	186.4	222.5	222.5	254.4	254.4	289.1	289.1	318.7
	19	50.0	85.5	85.5	139.8	124.1	161.0	150.3	170.7	162.3	192.3	186.5	221.7	221.7	257.7	257.7	291.3	291.3	307.5
	Avg.	50.1	85.9	84.9	139.4	124.5	161.6	150.0	169.8	162.3	195.6	186.2	221.1	221.1	256.0	256.0	287.6	287.6	312.9
Increasing:																			
2	4	50.3	87.3	56.0	102.2	66.1	93.5	77.0	93.0	84.3	112.3	102.0	129.2	129.2	161.0	161.0	188.6	188.6	213.0
	15	50.1	88.3	57.0	102.6	66.1	93.1	77.3	92.3	85.7	111.8	102.0	127.0	127.0	155.5	155.5	180.3	180.3	204.2
	17	49.7	85.8	54.7	96.7	66.4	91.3	75.0	89.0	84.2	110.1	100.6	126.2	126.2	154.2	154.2	171.1	171.1	196.4
	Avg.	50.0	87.1	55.9	100.5	66.2	92.6	76.5	91.4	84.7	111.4	101.5	127.5	127.5	156.9	156.9	180.0	180.0	204.5
4	5	50.7	88.4	66.9	116.2	86.6	117.8	105.8	124.1	115.3	145.6	140.6	170.5	170.5	200.3	200.3	227.2	227.2	237.8
	18	49.6	85.9	65.6	113.5	87.3	118.0	105.5	122.9	115.9	145.4	140.4	168.8	168.8	197.6	197.6	209.1	209.1	231.6
	23	51.0	85.8	64.4	108.3	87.0	115.6	105.2	122.1	116.1	144.7	139.4	166.1	166.1	193.3	193.3	218.0	218.0	242.1
	Avg.	50.4	86.7	65.6	112.6	87.0	117.1	105.5	123.0	115.8	145.2	140.2	168.5	168.5	197.0	197.0	218.1	218.1	237.2
Decreasing:																			
6	1	50.2	87.2	75.2	125.9	98.1	131.0	107.8	126.1	111.8	141.6	115.4	143.7	143.7	175.0	175.0	202.0	202.0	227.6
	2	50.5	89.1	75.1	128.2	97.6	131.8	108.1	127.4	111.4	144.7	115.0	145.0	145.0	182.3	182.3	213.7	213.7	243.3
	25	48.8	87.6	75.0	128.1	97.9	131.6	108.9	127.8	111.6	143.0	114.4	140.3	140.3	169.1	169.1	178.5	178.5	202.6
	Avg.	49.9	88.0	75.1	127.4	97.8	131.5	108.3	127.1	111.6	143.1	114.9	143.0	143.0	175.4	175.4	198.1	198.1	224.5
8	6	51.2	88.8	86.7	141.5	118.8	154.2	136.7	154.9	145.7	179.9	154.7	187.7	187.7	226.0	226.0	253.9	253.9	282.2
	13	51.0	88.1	85.6	137.2	118.6	152.8	136.3	153.9	143.9	175.4	154.4	183.1	183.1	212.8	212.8	237.2	237.2	259.1
	16	49.0	86.6	85.2	139.1	118.6	155.4	137.4	157.9	144.1	180.1	153.7	188.4	188.4	228.4	228.4	262.2	262.2	292.4
	Avg.	50.4	87.8	85.8	139.3	118.7	154.1	136.8	155.6	144.6	178.5	154.3	186.4	186.4	222.4	222.4	251.1	251.1	277.9
Unthinned:																			
C	10	134.1	178.4	178.4	218.8	218.8	242.8	242.8	250.5	250.5	260.7	260.7	274.6	274.6	269.4	269.4	263.5	263.5	267.6
	22	158.1	201.7	201.7	245.9	245.9	275.1	275.1	277.2	277.2	300.2	300.2	320.2	320.2	319.6	319.6	325.3	325.3	326.2
	26	121.8	173.9	173.9	221.2	221.2	249.8	249.8	256.1	256.1	272.7	272.7	290.5	290.5	300.1	300.1	303.6	303.6	305.9
	Avg.	138.0	184.7	184.7	228.6	228.6	255.9	255.9	261.3	261.3	277.9	277.9	295.1	295.1	296.4	296.4	297.5	297.5	299.9

Table 7—Quadratic mean diameter, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

Treatment	Plot	Quadratic mean diameter																	
		Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Inches																	
Fixed:																			
1	3	5.1	6.9	7.0	9.4	9.8	11.7	11.8	12.9	13.1	15.3	15.9	18.0	18.0	20.4	20.4	22.3	22.3	23.9
	8	4.9	6.4	6.7	8.9	9.6	11.3	12.2	13.3	13.2	15.3	15.8	18.1	18.1	20.6	20.6	22.8	22.8	24.5
	20	5.1	6.8	6.9	9.3	9.6	11.4	11.7	12.9	13.2	15.4	15.3	17.3	17.3	19.4	19.4	21.0	21.0	22.5
	Avg.	5.1	6.7	6.9	9.2	9.7	11.5	11.9	13.0	13.2	15.3	15.7	17.8	17.8	20.1	20.1	22.0	22.0	23.6
3	7	4.8	6.2	6.4	8.4	8.7	10.2	10.3	11.2	11.1	12.7	13.1	14.7	14.7	16.4	16.4	18.2	18.2	19.6
	11	5.2	6.9	7.1	9.4	9.7	11.3	11.7	12.7	13.1	14.9	15.2	16.9	16.9	18.9	18.9	20.6	20.6	22.0
	21	5.5	7.3	7.2	9.4	9.5	11.0	11.2	12.1	12.2	13.7	13.7	15.1	15.1	16.5	16.5	17.6	17.6	18.6
	Avg.	5.1	6.8	6.9	9.1	9.3	10.8	11.0	12.0	12.1	13.8	14.0	15.6	15.6	17.2	17.2	18.8	18.8	20.1
5	9	5.0	6.6	6.6	8.6	8.7	10.0	10.2	10.9	11.1	12.4	12.4	13.7	13.7	15.1	15.1	16.3	16.3	17.2
	24	5.2	6.9	7.0	9.0	9.1	10.5	10.5	11.4	11.5	12.8	12.8	14.1	14.1	15.2	15.2	16.8	16.8	17.9
	27	4.8	6.3	6.4	8.3	8.4	9.8	9.9	10.8	10.8	12.3	12.6	14.1	14.1	15.7	15.7	17.0	17.0	18.3
	Avg.	5.0	6.6	6.7	8.6	8.7	10.1	10.2	11.0	11.1	12.5	12.6	14.0	14.0	15.3	15.3	16.7	16.7	17.8
7	12	5.2	6.8	6.8	8.7	8.7	9.9	10.0	10.6	10.7	11.9	11.9	13.1	13.1	14.3	14.3	15.5	15.5	16.5
	14	5.4	7.1	7.1	9.2	9.2	10.5	10.6	11.3	11.4	12.6	12.8	13.9	13.9	15.7	15.7	16.7	16.7	17.5
	19	5.3	6.9	6.9	8.8	8.9	10.1	10.2	11.0	11.1	12.4	12.3	13.4	13.4	14.7	14.7	15.6	15.6	16.6
	Avg.	5.3	6.9	6.9	8.9	8.9	10.2	10.3	11.0	11.1	12.3	12.3	13.5	13.5	14.9	14.9	15.9	15.9	16.9
Increasing:																			
2	4	5.1	6.7	6.8	9.2	9.5	11.3	11.6	12.7	12.8	14.7	14.8	16.7	16.7	18.6	18.6	20.2	20.2	21.4
	15	5.3	7.1	7.5	10.1	11.0	13.1	13.7	15.0	15.0	17.1	17.0	18.9	18.9	20.9	20.9	22.6	22.6	24.0
	17	5.1	6.8	6.8	9.1	9.3	11.1	11.2	12.2	12.1	13.9	14.3	16.0	16.0	17.7	17.7	19.2	19.2	20.6
	Avg.	5.2	6.8	7.1	9.5	9.9	11.8	12.2	13.3	13.3	15.2	15.4	17.2	17.2	19.1	19.1	20.6	20.6	22.0
4	5	4.9	6.4	6.6	8.6	8.8	10.3	10.4	11.2	11.5	12.9	12.9	14.2	14.2	15.6	15.6	16.9	16.9	18.0
	18	5.3	7.0	7.0	9.2	9.3	10.8	10.8	11.7	11.9	13.3	13.3	14.6	14.6	16.1	16.1	17.2	17.2	18.8
	23	5.7	7.5	7.7	10.0	10.3	11.9	12.0	12.9	13.1	14.6	14.9	16.3	16.3	17.9	17.9	19.1	19.1	20.1
	Avg.	5.3	7.0	7.1	9.3	9.5	11.0	11.1	11.9	12.1	13.6	13.7	15.0	15.0	16.6	16.6	17.7	17.7	19.0
Decreasing:																			
6	1	5.3	7.0	7.1	9.2	9.3	10.7	10.8	11.7	11.9	13.4	13.6	15.1	15.1	16.7	16.7	18.3	18.3	19.5
	2	5.1	6.7	6.8	8.9	8.9	10.4	10.5	11.4	11.7	13.3	13.5	15.2	15.2	17.0	17.0	18.5	18.5	19.7
	25	5.2	7.0	7.1	9.2	9.6	11.1	11.3	12.3	12.5	14.2	14.5	16.0	16.0	17.6	17.6	19.1	19.1	20.3
	Avg.	5.2	6.9	7.0	9.1	9.3	10.7	10.9	11.8	12.0	13.6	13.9	15.5	15.5	17.1	17.1	18.6	18.6	19.8
8	6	5.0	6.6	6.6	8.5	8.5	9.7	9.8	10.4	10.5	11.7	11.9	13.3	13.3	14.8	14.8	16.5	16.5	17.4
	13	5.3	7.0	7.0	8.9	9.0	10.2	10.2	11.0	11.0	12.2	12.2	13.5	13.5	14.7	14.7	16.0	16.0	17.2
	16	5.4	7.2	7.2	9.2	9.2	10.6	10.6	11.3	11.4	12.7	12.9	14.3	14.3	15.7	15.7	16.8	16.8	17.8
	Avg.	5.3	6.9	7.0	8.9	8.9	10.2	10.2	10.9	11.0	12.2	12.3	13.7	13.7	15.1	15.1	16.5	16.5	17.5
Unthinned:																			
C	10	3.6	4.2	4.2	5.3	5.3	6.1	6.1	6.5	6.5	7.3	7.3	8.3	8.3	9.6	9.6	10.9	10.9	11.9
	22	4.3	5.1	5.1	6.4	6.4	7.2	7.2	8.0	8.0	8.9	8.9	9.9	9.9	11.6	11.6	13.2	13.2	15.0
	26	3.7	4.4	4.4	5.6	5.6	6.5	6.5	7.2	7.2	8.3	8.3	9.2	9.2	10.6	10.6	12.1	12.1	13.5
	Avg.	3.8	4.6	4.6	5.8	5.8	6.6	6.6	7.2	7.2	8.2	8.2	9.1	9.1	10.6	10.6	12.1	12.1	13.5

Table 8—Total stem cubic-foot volume per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

		Volume																	
Treatment	Plot	Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Cubic feet per acre																	
Fixed:																			
1	3	749	1634	1040	2357	1399	2279	1708	2192	1859	2843	2197	3126	3126	4359	4359	5698	5698	7140
	8	770	1563	1029	2325	1462	2309	1768	2256	1941	2947	2243	3266	3266	4578	4578	5963	5963	7268
	20	737	1569	1028	2296	1433	2287	1727	2223	1923	2933	2288	3270	3270	4493	4493	5817	5817	7143
	Avg.	752	1589	1032	2326	1431	2291	1734	2224	1908	2908	2243	3221	3221	4477	4477	5826	5826	7184
3	7	742	1549	1223	2678	1941	3063	2519	3181	2847	4271	3629	5039	5039	6966	6966	8951	8951	10569
	11	757	1630	1219	2715	1939	3043	2560	3233	2895	4281	3599	4868	4868	6763	6763	8801	8801	10598
	21	752	1607	1181	2529	1912	2989	2508	3179	2866	4164	3619	4831	4831	6371	6371	8040	8040	9502
	Avg.	750	1595	1208	2641	1931	3032	2529	3198	2869	4239	3616	4913	4913	6700	6700	8597	8597	10223
5	9	725	1569	1412	3014	2461	3757	3346	4176	3926	5595	5035	6630	6630	8612	8612	10815	10815	12522
	24	755	1667	1394	2909	2440	3717	3288	4151	3842	5429	4997	6645	6645	8520	8520	10528	10528	10792
	27	707	1521	1349	2975	2413	3702	3223	4110	3801	5589	4899	6599	6599	8858	8858	11138	11138	13013
	Avg.	729	1586	1385	2966	2438	3725	3285	4146	3857	5538	4977	6625	6625	8663	8663	10827	10827	12109
7	12	742	1540	1540	3235	2936	4387	4094	4991	4785	6611	6237	8238	8238	10699	10699	13075	13075	15255
	14	774	1648	1594	3366	2951	4455	4082	5015	4802	6672	6283	8401	8401	10785	10785	13448	13448	15741
	19	747	1570	1570	3299	2922	4379	4097	5050	4804	6507	6299	8441	8441	10924	10924	13596	13596	15212
	Avg.	754	1586	1568	3300	2936	4407	4091	5019	4797	6597	6273	8360	8360	10803	10803	13373	13373	15403
Increasing:																			
2	4	727	1602	1036	2377	1542	2524	2088	2682	2427	3670	3335	4677	4677	6401	6401	8311	8311	10030
	15	743	1666	1094	2468	1631	2631	2199	2810	2606	3744	3427	4688	4688	6180	6180	7881	7881	9745
	17	721	1565	997	2248	1553	2480	2038	2588	2446	3635	3328	4684	4684	6275	6275	7607	7607	9465
	Avg.	730	1611	1043	2364	1575	2545	2108	2693	2493	3683	3363	4683	4683	6285	6285	7933	7933	9747
4	5	725	1606	1220	2673	1997	3113	2819	3568	3324	4788	4615	6281	6281	8274	8274	10294	10294	11347
	18	732	1616	1235	2708	2083	3222	2883	3662	3461	4923	4757	6377	6377	8283	8283	9595	9595	11435
	23	788	1676	1275	2669	2143	3258	2970	3735	3554	4978	4802	6359	6359	8083	8083	10064	10064	11954
	Avg.	748	1632	1243	2683	2074	3198	2891	3655	3446	4896	4725	6339	6339	8213	8213	9985	9985	11579
Decreasing:																			
6	1	757	1606	1392	2936	2291	3520	2907	3692	3260	4645	3796	5266	5266	7077	7077	9139	9139	11081
	2	741	1608	1358	2943	2238	3481	2856	3643	3198	4735	3769	5283	5283	7411	7411	9688	9688	11795
	25	725	1608	1376	2994	2304	3571	2973	3764	3298	4790	3821	5121	5121	6866	6866	7884	7884	9541
	Avg.	741	1607	1375	2958	2278	3524	2912	3699	3252	4723	3795	5223	5223	7118	7118	8904	8904	10806
8	6	777	1644	1607	3341	2814	4231	3754	4556	4299	6073	5219	7052	7052	9440	9440	11513	11513	13460
	13	786	1639	1591	3256	2814	4207	3736	4516	4219	5881	5161	6818	6818	8891	8891	10970	10970	12649
	16	766	1652	1626	3383	2884	4345	3845	4742	4326	6147	5248	7171	7171	9605	9605	12148	12148	14398
	Avg.	776	1645	1608	3327	2837	4261	3778	4605	4281	6034	5210	7014	7014	9312	9312	11544	11544	13502
Unthinned:																			
C	10	1882	3194	3194	5049	5049	6414	6414	7064	7064	8506	8506	9907	9907	10809	10809	11574	11574	12426
	22	2373	3815	3815	5960	5960	7626	7626	8295	8295	10207	10207	12058	12058	13378	13378	14923	14923	15963
	26	1733	3167	3167	5222	5222	6753	6753	7473	7473	9142	9142	10730	10730	12296	12296	13633	13633	14546
	Avg.	1996	3392	3392	5411	5411	6931	6931	7611	7611	9285	9285	10898	10898	12161	12161	13376	13376	14312

Table 9—Merchantable cubic-foot volume (6-in top diameter inside bark) per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

		Volume to 6-inch top																	
Treatment	Plot	Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Cubic feet per acre																	
Fixed:																			
1	3	60	566	392	1711	1063	1985	1493	1987	1690	2668	2073	2978	2978	4171	4171	5460	5460	6847
	8	68	485	376	1589	1090	1958	1561	2056	1764	2769	2118	3115	3115	4383	4383	5717	5717	6973
	20	53	536	372	1624	1066	1953	1502	2008	1752	2756	2149	3108	3108	4293	4293	5570	5570	6846
	Avg.	61	529	380	1641	1073	1965	1518	2017	1735	2731	2113	3067	3067	4283	4283	5582	5582	6889
3	7	67	406	370	1635	1245	2396	1994	2678	2396	3822	3291	4687	4687	6571	6571	8513	8513	10100
	11	57	632	512	1950	1451	2586	2220	2908	2637	4012	3382	4623	4623	6458	6458	8424	8424	10156
	21	96	667	492	1819	1388	2488	2104	2787	2520	3812	3316	4511	4511	6015	6015	7630	7630	9043
	Avg.	74	569	458	1802	1361	2490	2106	2791	2518	3882	3329	4607	4607	6348	6348	8189	8189	9766
5	9	27	485	454	1920	1604	2920	2643	3474	3306	4968	4470	6056	6056	8023	8023	10192	10192	11848
	24	63	648	576	2010	1705	2980	2659	3516	3277	4837	4450	6082	6082	7902	7902	9919	9919	10242
	27	41	421	390	1824	1519	2822	2490	3403	3147	4939	4384	6085	6085	8313	8313	10535	10535	12382
	Avg.	44	518	473	1918	1609	2907	2597	3465	3243	4915	4435	6074	6074	8079	8079	10215	10215	11491
7	12	75	585	585	2144	1942	3383	3188	4081	3936	5749	5433	7437	7437	9861	9861	12227	12227	14374
	14	77	666	651	2345	2071	3593	3306	4237	4084	5933	5626	7710	7710	10142	10142	12724	12724	14945
	19	74	599	599	2207	1965	3421	3233	4200	4039	5767	5572	7687	7687	10146	10146	12739	12739	14360
	Avg.	75	616	612	2232	1993	3466	3243	4173	4019	5816	5544	7611	7611	10050	10050	12564	12564	14560
Increasing:																			
2	4	35	505	348	1681	1127	2149	1810	2420	2190	3429	3121	4436	4436	6109	6109	7950	7950	9606
	15	99	725	567	1957	1370	2387	2030	2635	2444	3557	3255	4476	4476	5916	5916	7554	7554	9346
	17	54	569	357	1586	1136	2101	1731	2294	2164	3347	3093	4423	4423	5970	5970	7264	7264	9055
	Avg.	63	600	424	1741	1211	2212	1857	2450	2266	3444	3156	4445	4445	5998	5998	7589	7589	9336
4	5	47	482	399	1736	1327	2468	2263	3023	2858	4317	4158	5798	5798	7760	7760	9745	9745	10797
	18	39	627	487	1955	1513	2682	2402	3176	3036	4486	4333	5920	5920	7791	7791	9073	9073	10903
	23	155	839	683	2058	1708	2844	2601	3360	3214	4615	4480	5997	5997	7687	7687	9598	9598	11420
	Avg.	80	649	523	1916	1516	2665	2422	3186	3036	4473	4324	5905	5905	7746	7746	9472	9472	11040
Decreasing:																			
6	1	83	634	566	2076	1622	2877	2395	3183	2841	4225	3470	4918	4918	6684	6684	8702	8702	10576
	2	72	590	525	1990	1539	2790	2317	3112	2775	4313	3452	4949	4949	7026	7026	9229	9229	11264
	25	43	585	516	2114	1709	3021	2544	3348	2958	4445	3562	4839	4839	6535	6535	7530	7530	9129
	Avg.	66	603	536	2060	1623	2896	2419	3214	2858	4328	3495	4902	4902	6748	6748	8487	8487	10323
8	6	73	577	567	2134	1804	3183	2861	3663	3473	5202	4508	6344	6344	8691	8691	10826	10826	12710
	13	129	677	664	2201	1932	3321	2955	3759	3510	5157	4530	6186	6186	8230	8230	10299	10299	11987
	16	60	678	669	2390	2040	3532	3129	4050	3697	5525	4746	6655	6655	9044	9044	11513	11513	13692
	Avg.	87	644	634	2242	1925	3345	2982	3824	3560	5295	4595	6395	6395	8655	8655	10880	10880	12796
Unthinned:																			
C	10	82	331	331	1238	1238	2290	2290	2894	2894	4381	4381	6073	6073	7940	7940	9502	9502	10759
	22	238	932	932	2530	2530	4073	4073	5061	5061	7016	7016	9174	9174	11347	11347	13434	13434	14837
	26	94	557	557	1904	1904	3238	3238	4104	4104	5869	5869	7645	7645	9874	9874	11876	11876	13175
	Avg.	138	607	607	1891	1891	3200	3200	4020	4020	5755	5755	7631	7631	9720	9720	11604	11604	12924

Table 10—Scribner board-foot volume (6-in top diameter inside bark, 32-ft logs and 16-ft minimum top log) per acre, 1963-98, by treatment, plot, measurement date, and age (in parentheses)

		Volume																	
Treatment	Plot	Calibration period 1963-66 (20-23 yr)		Treatment period 1 1966-70 (23-27 yr)		Treatment period 2 1970-73 (27-30 yr)		Treatment period 3 1973-75 (30-32 yr)		Treatment period 4 1975-79 (32-36 yr)		Treatment period 5 1979-83 (36-40 yr)		Treatment period 6 1983-88 (40-45 yr)		Treatment period 7 1988-93 (45-50 yr)		Measurement period 8 1993-98 (50-55 yr)	
		Scriber board feet per acre																	
Fixed:																			
1	3	0	856	743	5854	3688	6191	4643	6081	5227	9760	7488	11463	11463	17717	17717	26052	26052	35011
	8	0	843	731	4907	3400	6080	4658	6700	5746	10273	7859	11904	11904	19503	19503	27188	27188	34907
	20	0	1043	818	5438	3504	6190	4681	6520	5693	10365	8099	12224	12224	18892	18892	26487	26487	33727
	Avg.	0	914	764	5400	3531	6154	4661	6434	5555	10133	7815	11864	11864	18704	18704	26576	26576	34549
3	7	100	649	550	5556	4300	8224	6970	9152	8085	15525	13226	19094	19094	28077	28077	39527	39527	48049
	11	0	806	699	6280	4781	7718	6616	9665	8700	15584	13045	18003	18003	29103	29103	40531	40531	50458
	21	0	1205	999	5877	4400	8153	6918	10018	8992	14422	12615	17942	17942	26500	26500	36238	36238	43754
	Avg.	33	887	749	5904	4494	8031	6835	9612	8592	15177	12962	18347	18347	27893	27893	38765	38765	47420
5	9	0	587	587	6246	5396	10073	9220	12170	11469	20108	18010	25150	25150	35202	35202	47022	47022	56441
	24	0	887	756	6322	5435	9470	8549	11775	10960	19030	17450	25386	25386	34999	34999	47344	47344	49131
	27	0	662	662	5978	5059	9435	8359	11263	10453	19544	17301	24717	24717	36652	36652	48840	48840	58286
	Avg.	0	712	668	6182	5297	9659	8709	11736	10961	19561	17587	25084	25084	35618	35618	47735	47735	54619
7	12	0	949	949	7110	6477	11576	10768	14099	13536	23108	21840	30969	30969	43838	43838	57277	57277	67340
	14	0	1087	1087	7817	6835	11791	10796	14583	13955	23809	22392	32210	32210	44767	44767	59769	59769	70106
	19	0	1030	1030	7155	6372	11589	11050	14644	13973	23276	22478	33037	33037	44295	44295	58835	58835	68151
	Avg.	0	1022	1022	7361	6561	11652	10871	14442	13821	23398	22237	32072	32072	44300	44300	58627	58627	68532
Increasing:																			
2	4	0	543	331	5548	3659	6760	5651	7623	6884	13073	11942	17014	17014	25824	25824	37517	37517	46798
	15	0	1711	1493	6052	4193	7597	6427	9350	8596	13296	12260	17635	17635	26759	26759	37069	37069	48777
	17	0	693	362	5367	3935	6652	5479	7518	7166	12718	11815	17962	17962	26049	26049	33615	33615	44730
	Avg.	0	983	729	5655	3929	7003	5853	8164	7548	13029	12006	17537	17537	26210	26210	36067	36067	46768
4	5	0	774	662	5751	4351	7850	7319	9905	9311	17187	16566	23840	23840	33860	33860	46156	46156	50591
	18	0	912	693	6788	5291	8740	7815	11065	10615	17320	16713	23856	23856	34821	34821	42991	42991	51931
	23	112	2404	2279	6345	5212	9441	8527	12087	11548	18395	17856	23924	23924	35086	35086	45722	45722	55396
	Avg.	37	1363	1212	6294	4951	8677	7887	11019	10491	17634	17045	23873	23873	34589	34589	44956	44956	52639
Decreasing:																			
6	1	0	1261	1149	6840	5240	9499	7938	10635	9557	16271	13341	19952	19952	28649	28649	40887	40887	51345
	2	0	1249	1249	6326	4992	8965	7505	10021	8965	16460	13117	19746	19746	29262	29262	43298	43298	54044
	25	0	893	781	7207	5833	9964	8229	11049	9655	17263	13801	19392	19392	27601	27601	35935	35935	44167
	Avg.	0	1135	1060	6791	5355	9476	7891	10568	9393	16665	13420	19697	19697	28504	28504	40040	40040	49852
8	6	0	980	980	6818	5772	10595	9295	12417	11841	20653	17901	27045	27045	38616	38616	50677	50677	61038
	13	0	1374	1374	7015	6350	10998	9750	12787	11832	20674	18196	25843	25843	35245	35245	47343	47343	56721
	16	0	1018	1018	8343	7137	11948	10677	14103	12868	22140	18916	27984	27984	38887	38887	52576	52576	64790
	Avg.	0	1124	1124	7392	6420	11180	9907	13102	12180	21156	18338	26957	26957	37582	37582	50199	50199	60850
Unthinned:																			
C	10	156	357	357	2962	2962	7948	7948	10853	10853	18464	18464	27445	27445	37366	37366	45768	45768	52709
	22	119	1705	1705	8592	8592	14683	14683	19065	19065	29186	29186	40256	40256	52372	52372	64095	64095	71377
	26	119	980	980	5868	5868	11930	11930	15726	15726	24963	24963	33975	33975	45695	45695	56783	56783	62935
	Avg.	131	1014	1014	5808	5808	11520	11520	15215	15215	24204	24204	33892	33892	45144	45144	55549	55549	62340

Table 11—Number, diameter, basal area, and volume of trees recorded as dead at the end of each period, by treatment, measurement date, and age (in parentheses)

	End of period									
Treatment	1966 (23 yr)	1970 (27 yr)	1973 (30 yr)	1975 (32 yr)	1979 (36 yr)	1983 (40 yr)	1988 (45 yr)	1993 (50 yr)	1998 (55 yr)	Total
					Number of trees per acre					
Fixed:										
1	2	0	0	0	0	0	0	0	0	2
3	2	0	0	0	0	0	0	2	2	6
5	2	0	2	2	0	5	3	8	7	29
7	0	0	0	2	5	2	10	5	7	31
Increasing:										
2	2	0	2	0	0	0	0	2	0	6
4	3	0	0	0	0	0	5	5	7	20
Deceasing										
6	0	0	0	0	0	0	0	5	0	5
8	2	0	0	2	2	3	3	10	3	25
Unthinned:										
C	87	368	185	148	172	113	165	112	70	1420
					Quadratic mean diameter *Inches*					
Fixed:										
1	3.18	.00	.00	.00	.00	.00	.00	.00	.00	3.18
3	3.75	.00	.00	.00	.00	.00	.00	9.32	8.49	7.59
5	4.94	.00	6.95	7.31	.00	9.97	5.76	9.31	10.38	8.90
7	.00	.00	.00	4.76	8.66	5.39	6.88	9.77	11.43	8.69
Increasing:										
2	3.83	.00	3.91	.00	.00	.00	.00	13.06	.00	8.17
4	4.31	.00	.00	.00	.00	.00	8.14	14.66	12.95	11.48
Decreasing:										
6	.00	.00	.00	.00	.00	.00	.00	15.06	.00	15.06
8	4.56	.00	.00	4.56	4.39	6.22	7.35	7.75	9.18	7.08
Unthinned:										
C	2.08	2.52	3.04	4.00	4.28	4.90	6.15	7.14	8.89	4.61
					Basal area *Square feet per acre*					
Fixed:										
1	.11	.00	.00	.00	.00	.00	.00	.00	.00	.11
3	.15	.00	.00	.00	.00	.00	.00	.95	.79	1.89
5	.27	.00	.53	.58	.00	2.71	.54	3.78	4.11	12.52
7	.00	.00	.00	.25	2.04	.32	2.58	2.60	4.99	12.78
Increasing:										
2	.16	.00	.17	.00	.00	.00	.00	1.86	.00	2.19
4	.30	.00	.00	.00	.00	.00	1.81	5.86	6.40	14.38
Decreasing:										
6	.00	.00	.00	.00	.00	.00	.00	6.18	.00	6.18
8	.23	.00	.00	.23	.21	.63	.88	3.28	1.38	6.84
Unthinned:										
C	2.04	12.73	9.31	12.92	17.16	14.81	34.01	31.10	30.15	164.24
					Volume *Cubic feet per acre*					
Fixed:										
1	1.57	.00	.00	.00	.00	.00	.00	.00	.00	1.57
3	2.38	.00	.00	.00	.00	.00	.00	37.82	30.03	70.23
5	4.44	.00	13.36	16.11	.00	97.90	14.31	147.75	186.60	480.48
7	.00	.00	.00	5.69	65.85	9.04	83.63	104.78	231.21	500.21
Increasing:										
2	2.48	.00	2.64	.00	.00	.00	.00	81.09	.00	86.20
4	4.25	.00	.00	.00	.00	.00	60.92	264.09	299.36	628.61

Table 11—Number, diameter, basal area, and volume of trees recorded as dead at the end of each period, by treatment, measurement date, and age (in parentheses) (continued)

Treatment	End of period									Total
	1966 (23 yr)	1970 (27 yr)	1973 (30 yr)	1975 (32 yr)	1979 (36 yr)	1983 (40 yr)	1988 (45 yr)	1993 (50 yr)	1998 (55 yr)	
Decreasing:										
6	.00	.00	.00	.00	.00	.00	.00	275.85	.00	275.85
8	3.84	.00	.00	4.91	5.29	19.53	32.15	127.15	61.40	254.27
Unthinned:										
C	27.16	222.18	188.84	306.22	478.69	460.32	1208.68	1210.25	1296.59	5398.93
	Volume *Cubic feet to 6-inch top per acre*									
Fixed:										
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	30.18	21.56	51.73
5	.00	.00	6.02	8.56	.00	77.92	.68	104.26	150.47	347.92
7	.00	.00	.00	.00	46.37	.00	27.59	79.82	197.53	351.32
Increasing:										
2	.00	.00	.00	.00	.00	.00	.00	75.67	.00	75.67
4	.00	.00	.00	.00	.00	.00	34.12	242.35	261.46	537.93
Decreasing:										
6	.00	.00	.00	.00	.00	.00	.00	253.05	.00	253.05
8	.00	.00	.00	.00	.00	.35	15.66	61.49	39.83	117.32
Unthinned:										
C	.00	.00	.00	18.63	26.26	27.89	253.80	471.58	867.12	1665.28
	Volume *Scribner board feet per acre*									
Fixed:										
1	.00	.00	.00	.00	.00	.00	.00	.00	.00	.00
3	.00	.00	.00	.00	.00	.00	.00	143.88	83.73	227.61
5	.00	.00	.00	43.71	.00	336.67	.00	498.21	793.30	1671.89
7	.00	.00	.00	.00	200.46	.00	137.39	419.14	991.78	1748.78
Increasing:										
2	.00	.00	.00	.00	.00	.00	.00	320.80	.00	320.80
4	.00	.00	.00	.00	.00	.00	207.02	1165.84	1266.96	2639.82
Decreasing:										
6	.00	.00	.00	.00	.00	.00	.00	1188.08	.00	1188.08
8	.00	.00	.00	.00	.00	.00	83.73	386.04	238.02	707.79
Unthinned:										
C	.00	.00	.00	83.73	83.73	99.92	945.10	2406.29	4606.12	8224.90
Decreasing:										
6	.00	.00	.00	.00	.00	.00	.00	275.85	.00	275.85
8	3.84	.00	.00	4.91	5.29	19.53	32.15	127.15	61.40	254.27
Unthinned:										
C	27.16	222.18	188.84	306.22	478.69	460.32	1208.68	1210.25	1296.59	5398.93

Table 12—Number, diameter, basal area, and volume of trees cut, by treatment, period, measurement date and age (in parentheses)

Treatment numbers	Start of period 1966 (23)	1970 (27)	1973 (30)	1975 (32)	1979 (36)	1983 (40)	1988 (45)	1993 (50)	Total
					Number of trees per acre				
Fixed:									
1	137	97	35	13	18	0	0	0	300
3	90	77	35	17	22	0	0	0	241
5	52	62	35	18	23	0	0	0	190
7	5	37	25	17	13	0	0	0	97
Increasing:									
2	135	82	27	7	10	0	0	0	261
4	87	63	20	15	7	0	0	0	192
Decreasing:									
6	55	73	42	27	32	0	0	0	229
8	8	52	33	18	33	0	0	0	144
Unthinned:									
C	0	0	0	0	0	0	0	0	0
					Quadratic mean diameter *Inches*				
Fixed:									
1	6.4	8.6	10.4	12.4	14.4	0.0	0.0	0.0	8.6
3	6.5	8.4	10.0	11.0	12.5	.0	.0	.0	8.7
5	6.2	8.2	9.3	10.0	11.5	.0	.0	.0	8.6
7	6.1	8.6	9.2	9.0	11.5	.0	.0	.0	9.2
Increasing:									
2	6.5	8.8	10.5	13.3	13.4	.0	.0	.0	8.3
4	6.7	8.6	10.3	9.4	11.5	.0	.0	.0	8.2
Decreasing:									
6	6.6	8.6	10.1	10.3	12.7	.0	.0	.0	9.4
8	6.8	8.5	9.8	10.6	11.6	.0	.0	.0	9.8
Unthinned:									
C	.0	.0	.0	.0	.0	.0	.0	.0	.0
					Basal area *Square feet per acre*				
Fixed:									
1	30.4	39.1	20.8	10.9	20.4	0.0	0.0	0.0	121.5
3	20.7	29.9	18.9	11.3	18.7	.0	.0	.0	99.5
5	11.1	22.9	16.5	9.8	16.4	.0	.0	.0	76.7
7	1.0	14.9	11.6	7.5	9.4	.0	.0	.0	44.5
Increasing:									
2	31.2	34.3	16.2	6.7	9.9	.0	.0	.0	98.3
4	21.0	25.7	11.6	7.2	5.1	.0	.0	.0	70.6
Decreasing:									
6	12.9	29.6	23.2	15.5	28.1	.0	.0	.0	109.3
8	2.0	20.6	17.3	11.0	24.2	.0	.0	.0	75.1
Unthinned:									
C	.0	.0	.0	.0	.0	.0	.0	.0	.0
					Volume *Cubic feet per acre*				
Fixed:									
1	557	895	557	316	665	0	0	0	2990
3	388	710	503	328	623	0	0	0	2552
5	201	528	440	289	561	0	0	0	2018
7	18	363	316	221	324	0	0	0	1242
Increasing:									
2	569	789	437	200	319	0	0	0	2314
4	389	609	307	209	172	0	0	0	1685

Table 12—Number, diameter, basal area, and volume of trees cut, by treatment, period, measurement date and age (in parentheses) (continued)

Treatment numbers	Start of period 1966 (23)	1970 (27)	1973 (30)	1975 (32)	1979 (36)	1983 (40)	1988 (45)	1993 (50)	Total
Decreasing:									
6	232	680	612	447	928	0	0	0	2899
8	37	489	483	323	824	0	0	0	2156
Unthinned:									
C	0	0	0	0	0	0	0	0	0
					Volume *Cubic feet to 6-inch top per acre*				
Fixed:									
1	149	568	447	282	618	0	0	0	2064
3	111	440	384	273	553	0	0	0	1761
5	45	309	310	222	480	0	0	0	1364
7	5	239	223	153	273	0	0	0	893
Increasing:									
2	176	530	356	184	288	0	0	0	1534
4	126	401	243	150	149	0	0	0	1069
Decreasing:									
6	67	436	477	356	833	0	0	0	2170
8	10	316	364	264	700	0	0	0	1654
Unthinned:									
C	0	0	0	0	0	0	0	0	0
					Volume *Scribner board feet per acre*				
Fixed:									
1	150	1869	1493	878	2317	0	0	0	6707
3	137	1410	1197	1019	2215	0	0	0	5979
5	44	885	950	775	1974	0	0	0	4629
7	0	800	781	620	1161	0	0	0	3362
Increasing:									
2	254	1726	1151	615	1023	0	0	0	4769
4	152	1343	790	528	589	0	0	0	3402
Decreasing:									
6	75	1436	1586	1176	3245	0	0	0	7517
8	0	972	1273	922	2818	0	0	0	5986
Unthinned:									
C	0	0	0	0	0	0	0	0	0

Table 13—Total stem cubic-foot volume (CVTS) per acre in trees with diameters larger than the indicated value in 1998 and cumulative (standing plus thinnings) 1963-98

	Diameter at breast height (inches)				
Treatment	1.6	7.6	11.6	15.6	19.6
	Standing CVTS per acre				
Fixed:					
1	7183.7	7183.7	7183.7	7183.7	7027.9
3	10223.2	10223.2	10223.2	9848.3	8353.1
5	12108.7	12108.7	12039.5	10715.4	7038.8
7	15402.9	15402.9	15324.5	13135.7	6789.1
Increasing:					
2	9,746.8	9746.8	9746.8	9746.8	9194.4
4	11,578.8	11578.8	11578.8	11269.6	7715.6
Decreasing:					
6	10805.6	10805.6	10805.6	10491.9	8786.4
8	13502.3	13502.3	13372.2	12220.2	6420.2
Unthinned:					
C	14311.8	14311.8	12570.1	7010.2	2678.5
	Cumulative CVTS per acre				
Fixed:					
1	10173.7	9884.0	8732.8	7624.2	7027.9
3	12775.0	12538.8	11445.2	10096.9	8353.1
5	14127.2	13970.1	12889.6	10715.4	7038.8
7	16645.0	16600.7	15882.9	13205.3	6789.1
Increasing:					
2	12060.9	11755.3	10771.1	9990.5	9299.8
4	13264.2	13111.4	12149.3	11269.6	7715.6
Decreasing:					
6	13704.5	13549.3	12341.5	10870.3	8786.4
8	15658.3	15596.9	14616.0	12520.9	6420.2
Unthinned:					
C	14311.8	14311.8	12570.1	7010.2	2678.5

Table 14—Percentage of merchantable cubic volume (CV6) of live trees in 1998 (stand age 55) in logs with scaling diameters larger than the indicated value

D.i.b. class	Trt. 1	Trt. 3	Trt. 5	Trt. 7	Trt. 2	Trt. 4	Trt. 6	Trt. 8	Control
Inches					*Percent*				
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	6.3	8.8	12.3	13.9	8.	10.0	9.6	12.9	27.6
8	7.9	8.6	11.8	14.0	6.2	9.1	9.1	10.9	26.6
10	4.5	11.5	16.5	18.9	7.0	15.8	10.5	20.8	23.1
12	8.7	19.6	24.7	28.6	16.6	25.5	19.3	26.1	11.9
14	20.8	22.0	21.1	19.2	21.8	23.2	29.7	19.2	7.5
16	27.8	25.0	11.3	5.4	24.1	12.7	18.0	7.9	2.3
18	16.3	2.8	2.3	.0	10.6	3.7	3.9	2.1	1.0
20	7.6	1.7	.0	.0	6.6	.0	.0	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	.0	.0	.0	.0	.0	.0
28	.0	.0	.0	.0	.0	.0	.0	.0	.0
30	.0	.0	.0	.0	.0	.0	.0	.0	.0

Table 15—Percentage of merchantable cubic volume (CV6) of thinning removals in logs with scaling diameters larger than the indicated value

	Cumulative thinning								
D.i.b. class	Trt. 1	Trt. 3	Trt. 5	Trt. 7	Trt. 2	Trt. 4	Trt. 6	Trt. 8	Control
Inches					*Percent*				
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	68.3	55.5	43.0	66.9	67.0	58.8	58.8	53.9	.0
8	21.3	20.1	30.9	12.1	9.6	15.2	26.1	17.3	.0
10	10.4	12.0	17.1	14.2	7.5	14.1	13.0	15.1	.0
12	.0	2.7	7.7	4.3	10.0	8.4	2.1	7.3	.0
14	.0	7.8	1.2	2.5	6.0	3.5	.0	4.6	.0
16	.0	.0	.0	.0	.0	.0	.0	1.7	.0
18	.0	1.9	.0	.0	.0	.0	.0	.0	.0
20	.0	.0	.0	.0	.0	.0	.0	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	.0	.0	.0	.0	.0	.0
28	.0	.0	.0	.0	.0	.0	.0	.0	.0
30	.0	.0	.0	.0	.0	.0	.0	.0	.0

Table 16—Percentage of Scribner board-foot volume (SV6) of live trees in 1998 (stand age 55) in logs with scaling diameters larger than the indicated value

D.i.b. class	Trt. 1	Trt. 3	Trt. 5	Trt. 7	Trt. 2	Trt. 4	Trt. 6	Trt. 8	Control
Inches					*Percent*				
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	4.0	6.7	10.3	12.6	5.5	8.2	7.4	11.1	28.0
8	5.5	7.1	10.8	13.3	4.9	8.1	7.8	10.3	25.7
10	4.5	12.5	17.9	21.2	6.7	17.3	11.4	23.0	23.5
12	9.0	20.6	25.1	28.0	17.5	25.8	19.8	25.5	11.8
14	23.1	22.4	21.5	19.4	22.9	23.6	30.9	19.6	7.6
16	28.6	25.7	11.8	5.5	25.3	13.0	18.4	8.3	2.4
18	16.9	3.0	2.5	.0	11.0	4.1	4.3	2.3	1.1
20	8.3	2.0	.0	.0	6.2	.0	.0	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	.0	.0	.0	.0	.0	.0
28	.0	.0	.0	.0	.0	.0	.0	.0	.0
30	.0	.0	.0	.0	.0	.0	.0	.0	.0

Table 17—Percentage of Scribner board-foot volume (SV6) of thinning removals in logs with scaling diameters larger than the indicated value

	Cumulative thinning								
D.i.b. class	Trt. 1	Trt. 3	Trt. 5	Trt. 7	Trt. 2	Trt. 4	Trt. 6	Trt. 8	Control
Inches					*Percent*				
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	.0	.0	.0	.0	.0	.0	.0	.0	.0
6	69.7	46.0	31.3	56.4	57.1	43.6	55.9	42.7	.0
8	19.5	17.5	25.6	12.4	7.8	14.3	24.0	14.4	.0
10	10.8	12.6	24.8	15.1	8.1	19.2	14.7	16.5	.0
12	.0	2.1	15.5	9.3	9.9	14.5	5.4	8.2	.0
14	.0	16.1	2.8	6.8	17.1	8.3	.0	12.9	.0
16	.0	.0	.0	.0	.0	.0	.0	5.2	.0
18	.0	5.7	.0	.0	.0	.0	.0	.0	.0
20	.0	.0	.0	.0	.0	.0	.0	.0	.0
22	.0	.0	.0	.0	.0	.0	.0	.0	.0
24	.0	.0	.0	.0	.0	.0	.0	.0	.0
26	.0	.0	.0	.0	.0	.0	.0	.0	.0
28	.0	.0	.0	.0	.0	.0	.0	.0	.0
30	.0	.0	.0	.0	.0	.0	.0	.0	.0

Table 18a—Stand development table for treatment 1, per-acre basis (plots 3, 8, and 20)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	*Ft³*		*No.*	*In*	*Ft²*	*Ft³*					*No.*	*In*	*Ft²*	*Ft³*	
1963	20	40	7.0	353	5.1	49.4	752	61	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	49	9.1	215	6.9	55.1	1032	380	137	6.4	30.4	557	149	4.1	2.0	.96	2	3.5	.1	2	0
1970	27	62	11.7	118	9.7	60.4	1431	1073	97	8.6	39.1	895	568	9.2	6.1	.93	0	.0	.0	0	0
1973	30	72	13.4	83	11.9	64.4	1734	1518	35	10.4	20.8	557	447	15.9	12.8	.91	0	.0	.0	0	0
1975	32	76	14.4	70	13.2	66.1	1908	1735	13	12.3	10.9	316	282	24.3	21.7	.94	0	.0	.0	0	0
1979	36	87	16.6	52	15.7	69.0	2243	2113	18	14.3	20.4	665	618	36.9	34.3	.93	0	.0	.0	0	0
1983	40	98	18.5	52	17.8	89.1	3221	3067	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1988	45	110	20.8	52	20.1	114.0	4477	4283	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1993	50	122	22.8	52	22.0	136.4	5826	5582	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1998	55	132	24.4	52	23.6	157.2	7184	6889	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		Ft³				*In*		*Ft²*		*Ft³*							
1963	20	752	752	61	61	0.00	0.00	0.0	00	0	38	0	3	0	38	0	3
1966	23	1589	1591	529	529	.54	.54	12.1	12.1	279	69	156	23	279	69	156	23
1970	27	2883	2884	1790	1790	.59	.59	11.1	11.1	323	107	315	66	323	107	315	66
1973	30	3743	3744	2683	2683	.60	.60	8.2	8.2	287	125	298	89	287	125	298	89
1975	32	4232	4234	3181	3181	.56	.56	6.3	6.3	245	132	249	99	245	132	249	99
1979	36	5233	5234	4177	4177	.54	.54	5.8	5.8	250	145	249	116	250	145	249	116
1983	40	6211	6213	5131	5131	.53	.53	5.0	5.0	245	155	238	128	245	155	238	128
1988	45	7467	7468	6347	6347	.47	.47	5.0	5.0	251	166	243	141	251	166	243	141
1993	50	8816	8817	7646	7646	.38	.38	4.5	4.5	270	176	260	153	270	176	260	153
1998	55	10174	10175	8953	8953	.32	.32	4.2	4.2	272	185	261	163	272	185	261	163

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a calibration cut. Volume (CVTS) removed in thinnings = 2,990 cubic feet (57 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 2 cubic feet (0 percent of the total gross yield).

Table 18b—Stand development table for treatment 1, per-hectare basis (plots 3, 8, and 20)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - *m³* - - -		*No.*	*Cm*	*m²*	- - - *m³* - - -					*No.*	*Cm*	*m²*	- - *m³* - -	
1963	20	12.7	17.8	873	12.9	11.4	53.2	4.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.6	23.1	531	17.4	12.7	72.8	27.1	338	16.2	7.0	39.5	10.9	.1	.1	.96	4	8.8	.0	.6	.5
1970	27	19.6	29.8	292	24.6	13.9	100.7	75.6	239	21.9	9.0	63.1	40.3	.3	.2	.93	0	.0	.0	.0	.0
1973	30	22.4	34.0	206	30.3	14.8	121.9	106.8	86	26.5	4.8	39.5	31.8	.5	.4	.91	0	.0	.0	.0	.0
1975	32	23.7	36.7	173	33.5	15.2	134.0	121.0	33	31.2	2.5	22.6	20.2	.7	.6	.94	0	.0	.0	.0	.0
1979	36	27.1	42.1	128	39.8	15.9	157.5	148.4	45	36.3	4.7	47.1	43.8	1.0	1.0	.93	0	.0	.0	.0	.0
1983	40	30.5	46.9	128	45.3	20.5	226.0	215.2	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1988	45	34.03	52.9	128	51.2	26.2	313.9	300.3	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1993	50	37.6	57.8	128	56.0	31.4	408.3	391.3	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1998	55	40.7	62.1	128	60.1	36.2	503.4	482.7	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - *m³* - - -				- - *Cm* - -		- - *m²* - -		- - - *m³* - - -							
1963	20	53.2	53.2	4.7	4.7	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.7	0.0	3.1	0.0	0.7
1966	23	111.7	111.8	37.5	37.5	1.37	1.37	2.8	2.8	20.0	5.3	11.4	2.1	20.1	5.3	11.4	2.1
1970	27	202.3	202.4	125.8	125.8	1.50	1.50	2.5	2.5	23.1	7.0	22.6	5.1	23.1	7.0	22.6	5.1
1973	30	262.5	262.6	188.3	188.3	1.54	1.54	1.9	1.9	20.6	9.2	21.3	6.8	20.6	9.2	21.3	6.8
1975	32	296.8	296.9	223.2	223.2	1.42	1.42	1.5	1.5	17.6	9.8	17.9	7.5	17.6	9.8	17.9	7.5
1979	36	366.8	366.9	292.9	292.9	1.37	1.37	1.3	1.3	18.0	10.7	17.9	8.6	18.0	10.7	17.9	8.6
1983	40	435.3	435.4	359.7	359.7	1.36	1.36	1.2	1.2	17.6	11.4	17.2	9.5	17.6	11.4	17.2	9.5
1988	45	523.2	523.3	444.8	444.8	1.19	1.19	1.1	1.1	18.1	12.1	17.5	10.4	18.1	12.1	17.5	10.4
1993	50	617.6	617.7	535.7	535.7	.96	.96	1.0	1.0	19.4	12.8	18.7	11.2	19.4	12.8	18.7	11.2
1998	55	712.7	712.8	627.2	627.2	.82	.82	1.0	1.0	19.5	13.4	18.8	11.9	19.5	13.5	18.8	11.9

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 209.3 cubic meters (57 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 0.1 cubic meter (0 percent of the total gross yield).

Table 19a—Stand development table for treatment 2, per-acre basis (plots 4, 15, and 17)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - - -		*No.*	*In*	*Ft²*	- - - - - - - - *Ft³* - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	38	7.0	343	5.2	50.0	730	63	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	48	9.1	207	7.1	55.9	1043	424	135	6.5	31.2	569	176	4.2	2.3	.95	2	4.2	.2	2	0
1970	27	62	11.8	125	9.9	66.2	1575	1211	82	8.8	34.3	789	530	9.6	7.4	.93	0	.0	.0	0	0
1973	30	73	13.6	97	12.2	76.5	2108	1857	27	10.5	16.2	437	356	16.2	13.2	.90	2	4.3	.2	3	0
1975	32	79	14.8	90	13.3	84.7	2493	2266	7	13.6	6.7	200	184	28.6	26.3	1.03	0	.0	.0	0	0
1979	36	89	16.8	80	15.4	101.5	3363	3156	10	13.4	9.9	319	288	31.9	28.8	.89	0	.0	.0	0	0
1983	40	100	18.7	80	17.2	127.5	4683	4445	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1988	45	111	20.8	80	19.1	156.9	6285	5998	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1993	50	123	22.4	78	20.6	180.0	7933	7589	0	.0	.0	0	0	.0	.0	.00	2	14.3	1.9	81	76
1998	55	135	23.9	78	22.0	204.5	9747	9336	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - *Ft³* - - - - - - - - - - -				- - - - - *In* - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - -							
1963	20	730	730	63	63	0.00	0.00	0.0	0.0	0	37	0	3	0	37	0	3
1966	23	1611	1614	600	600	.56	.56	12.4	12.4	294	70	179	26	294	70	179	26
1970	27	2933	2935	1917	1917	.60	.60	11.2	11.2	330	109	329	71	330	109	329	71
1973	30	3903	3908	2918	2918	.63	.61	8.8	8.9	323	130	334	97	324	130	334	97
1975	32	4488	4493	3512	3512	.57	.57	7.5	7.5	293	140	297	110	293	140	297	110
1979	36	5678	5683	4690	4690	.49	.49	6.7	6.7	297	158	295	130	297	158	295	130
1983	40	6997	7002	5979	5979	.46	.46	6.5	6.5	330	175	322	149	330	175	322	149
1988	45	8599	8604	7532	7532	.38	.38	5.9	5.9	320	191	311	167	320	191	311	167
1993	50	10247	10334	9124	9199	.31	.30	4.6	5.0	330	205	318	182	346	207	333	184
1998	55	12061	12147	10870	10946	.27	.27	4.9	4.9	363	219	349	198	363	221	349	199

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a calibration cut. Volume (CVTS) removed in thinnings = 2314 cubic feet (41 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 86 cubic feet (1 percent of the total gross yield).

Table 19b—Stand development table for treatment 2, per-hectare basis (plots 4, 15, and 17)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - - *m³* - - - -		*No.*	*Cm*	*m²*	- - - - - - - - *m³* - - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.1	17.7	848	13.2	11.5	51.6	4.9	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.3	23.1	510	18.0	12.9	73.5	30.2	333	16.6	7.2	40.3	12.8	.1	.1	.95	4	10.7	.0	0.7	0.5
1970	27	19.5	29.9	309	25.3	15.2	110.8	85.3	202	22.3	7.9	55.7	37.6	.3	.2	.93	0	.0	.0	.0	.0
1973	30	22.7	34.5	239	31.0	17.6	148.1	130.5	66	26.8	3.7	31.1	25.4	.5	.4	.90	4	10.9	.0	0.7	0.5
1975	32	24.5	37.6	222	33.8	19.5	175.0	159.1	16	34.5	1.5	14.5	13.4	.9	.8	1.03	0	.0	.0	.0	.0
1979	36	27.8	42.8	198	39.1	23.4	235.9	221.4	25	34.2	2.3	22.9	20.7	.9	.8	.89	0	.0	.0	.0	.0
1983	40	31.1	47.5	198	43.8	29.3	328.3	311.6	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1988	45	34.4	52.8	198	48.6	36.1	440.5	420.4	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1993	50	38.0	56.9	193	52.5	41.4	555.8	531.7	0	.0	.0	.0	.0	.0	.0	.00	4	36.4	.4	6.2	5.8
1998	55	41.7	60.7	193	56.0	47.0	682.8	654.0	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - *m³* - - - - - - - - - -				- - - - *Cm* - - -		- - - - *m²* - - - -		- - - - - - - - - - - - - - - - - *m³* - - - - - - - - - - - - - - - - - - -							
1963	20	51.6	51.6	4.9	4.9	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.7	0.0	3.1	0.0	0.7
1966	23	113.3	113.5	42.5	42.5	1.42	1.41	2.8	2.9	21.1	5.4	13.0	2.3	21.1	5.4	13.0	2.3
1970	27	205.8	206.0	134.7	134.7	1.53	1.53	2.6	2.6	23.6	8.1	23.6	5.5	23.6	8.1	23.6	5.5
1973	30	273.7	274.1	204.8	204.8	1.60	1.56	2.0	2.0	23.1	9.6	23.9	7.3	23.2	9.6	23.9	7.3
1975	32	314.7	315.0	246.3	246.3	1.45	1.45	1.7	1.7	21.0	10.3	21.3	8.2	21.0	10.3	21.3	8.2
1979	36	397.9	398.3	328.8	328	1.24	1.24	1.5	1.5	21.3	11.5	21.1	9.6	21.3	11.5	21.1	9.6
1983	40	490.3	490.9	419.0	419.0	1.17	1.17	1.5	1.5	23.6	12.7	23.1	11.0	23.6	12.8	23.1	11.0
1988	45	602.4	602.8	527.8	527.8	.96	.96	1.4	1.4	22.9	13.9	22.2	12.2	22.9	13.9	22.2	12.2
1993	50	717.8	723.8	639.2	644.2	.79	.75	1.1	1.1	23.6	14.8	22.8	13.3	24.7	15.0	23.8	13.4
1998	55	844.8	850.8	761.4	766.4	.69	.69	1.1	1.1	25.9	15.9	24.9	14.3	25.9	16.0	24.9	14.4

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 162.0 cubic meters (41 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 6.0 cubic meters (1 percent of the total gross yield).

Table 20a—Stand development table for treatment 3, per-acre basis (plots 7, 11, and 21)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - - -		*No.*	*In*	*Ft²*	- - - - - - - *Ft³* - - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	38	7.2	343	5.1	49.0	750	74	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	49	9.3	252	6.9	64.2	1208	458	90	6.5	20.7	388	111	4.3	2.3	.96	2	4.1	.2	2	0
1970	27	61	11.9	175	9.3	81.6	1931	1361	77	8.5	29.9	710	440	9.2	6.6	.94	0	.0	.0	0	0
1973	30	71	13.5	140	11.0	92.3	2529	2106	35	10.0	18.9	503	384	14.4	12.0	.92	0	.0	.0	0	0
1975	32	77	14.3	123	12.1	97.5	2869	2518	17	11.1	11.3	328	273	19.3	16.1	.93	0	.0	.0	0	0
1979	36	89	15.9	102	14.0	107.5	3616	3329	22	12.6	18.7	623	553	28.3	25.1	.92	0	.0	.0	0	0
1983	40	98	17.5	102	15.6	132.9	4913	4607	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1988	45	111	19.4	102	17.2	163.0	6700	6348	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1993	50	124	21.1	100	18.8	190.6	8597	8189	0	.0	.0	0	0	.0	.0	.00	2	10.2	.9	38	30
1998	55	133	22.5	98	20.1	214.1	10223	9766	0	.0	.0	0	0	.0	.0	.00	2	9.3	.8	30	22

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - *Ft³* - - - - - - - - - - -				- - - - -*In* - - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - - -							
1963	20	750	750	74	74	.00	.00	.0	.0	0	38	0	4	0	38	0	4
1966	23	1595	1598	569	569	.55	.55	12.0	12.0	282	69	165	25	283	69	165	25
1970	27	3028	3031	1912	1912	.55	.55	11.8	11.8	358	112	336	71	358	112	336	71
1973	30	4129	4132	3041	3041	.52	.52	9.9	9.9	367	138	376	101	367	138	376	101
1975	32	4798	4801	3726	3726	.47	.47	8.3	8.3	334	150	342	116	334	150	342	116
1979	36	6167	6170	5090	5090	.42	.42	7.2	7.2	342	171	341	141	342	171	341	141
1983	40	7464	7467	6368	6368	.39	.39	6.3	6.3	324	187	319	159	324	187	319	159
1988	45	9252	9254	8109	8109	.33	.33	6.0	6.0	357	206	348	180	357	206	348	180
1993	50	11149	11189	9950	9980	.31	.29	5.5	5.7	379	223	368	199	387	224	374	200
1998	55	12775	12845	11527	11579	.26	.24	4.7	4.9	325	232	315	210	331	234	320	211

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 2552 cubic feet (41 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 70 cubic feet (1 percent of the total gross yield).

Table 20b—Stand development table for treatment 3, per-hectare basis (plots 7, 11, and 21)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - *m³* - - -		*No.*	*Cm*	*m²*	- - - - - - - - *m³* - - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.1	18.3	848	13.1	11.3	53.0	5.7	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.3	23.6	622	17.5	14.8	85.0	32.5	222	16.5	4.8	27.6	8.2	.1	.1	.96	4	10.4	.0	0.7	0.5
1970	27	19.2	30.1	432	23.6	18.8	135.7	95.8	189	21.5	6.9	50.2	31.3	.3	.2	.94	0	.0	.0	.0	.0
1973	30	22.3	34.2	346	28.1	21.2	177.5	147.9	86	25.3	4.3	35.7	27.4	.4	.3	.92	0	.0	.0	.0	.0
1975	32	24.1	36.3	305	30.8	22.4	201.3	176.7	41	28.3	2.6	23.5	19.6	.6	.5	.93	0	.0	.0	.0	.0
1979	36	27.7	40.4	251	35.6	24.7	253.6	233.6	54	32.0	4.3	44.1	39.2	.8	.7	.92	0	.0	.0	.0	.0
1983	40	30.5	44.5	251	39.6	30.6	344.4	323.0	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1988	45	34.4	49.4	251	43.8	37.5	469.5	444.9	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1993	50	38.2	53.7	247	47.8	43.8	602.3	573.7	0	.0	.0	.0	.0	.0	.0	.00	4	26.0	.2	3.1	2.6
1998	55	41.0	57.1	243	51.0	49.2	716.1	684.1	0	.0	.0	.0	.0	.0	.0	.00	4	23.7	.2	2.6	2.0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - - *m³* - - - - - - - - - -				- - - - -*Cm* - - -		- - - - *m²* - - - -		- - - - - - - - - - - - - - - - - *m³* -							
1963	20	53.0	53.0	5.7	5.7	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.8	0.0	3.1	0.0	0.8
1966	23	112.2	112.3	40.3	40.3	1.40	1.39	2.8	2.8	20.2	5.4	12.0	2.2	20.3	5.4	12.0	2.2
1970	27	212.5	212.7	134.4	134.4	1.39	1.39	2.7	2.7	25.6	8.4	24.0	5.5	25.6	8.4	24.0	5.5
1973	30	289.6	289.7	213.4	213.4	1.31	1.31	2.3	2.3	26.2	10.1	26.8	7.6	26.2	10.1	26.8	7.6
1975	32	336.4	336.5	261.3	261.3	1.21	1.21	1.9	1.9	23.9	11.0	24.5	8.6	23.9	11.0	24.5	8.6
1979	36	432.2	432.4	356.8	356.8	1.06	1.06	1.6	1.6	24.5	12.5	24.4	10.4	24.5	12.5	24.4	10.4
1983	40	523.0	523.2	446.2	446.2	1.00	1.00	1.5	1.5	23.2	13.6	22.9	11.6	23.2	13.6	22.9	11.6
1988	45	648.1	648.3	568.1	568.1	.85	.85	1.4	1.4	25.5	14.9	24.9	13.1	25.5	14.9	24.9	13.1
1993	50	780.9	783.8	697.0	699.1	.78	.74	1.3	1.3	27.1	16.1	26.3	14.4	27.6	16.2	26.7	14.5
1998	55	894.7	899.7	807.4	811.0	.65	.60	1.1	1.1	23.3	16.8	22.6	15.2	23.7	16.8	22.0	15.2

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 178.6 cubic meters (41 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 4.9 cubic meters (1 percent of the total gross yield).

Table 21a—Stand development table for treatment 4, per-acre basis (plots 5, 18, and 23)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - -		*No.*	*In*	*Ft²*	- - - - - - - - *Ft³* - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	40	7.1	333	5.3	50.4	748	80	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	51	9.1	243	7.1	65.6	1243	523	87	6.7	21.0	389	126	4.5	2.2	.96	3	4.1	.3	4	0
1970	27	64	11.7	180	9.5	87.0	2074	1516	63	8.6	25.7	609	401	9.7	7.0	.94	0	.0	.0	0	0
1973	30	73	13.3	160	11.1	105.5	2891	2422	20	10.3	11.6	307	243	15.4	12.1	.95	0	.0	.0	0	0
1975	32	79	14.2	145	12.1	115.8	3446	3036	15	9.4	7.2	209	150	13.9	10.0	.79	0	.0	.0	0	0
1979	36	90	16.0	138	13.7	140.2	4725	4324	7	11.8	5.1	172	149	24.6	21.3	.87	0	.0	.0	0	0
1983	40	101	17.6	138	15.0	168.5	6339	5905	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1988	45	113	19.3	133	16.6	197.0	8213	7746	0	.0	.0	0	0	.0	.0	.00	5	8.1	1.8	61	34
1993	50	125	20.6	128	17.7	218.1	9985	9472	0	.0	.0	0	0	.0	.0	.00	5	14.7	5.9	264	242
1998	55	135	21.8	122	19.0	237.2	11579	11040	0	.0	.0	0	0	.0	.0	.00	7	13.3	6.4	299	261

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - *Ft³* - - - - - - - - -				- - - - *In* - - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - - -							
1963	20	748	748	80	80	0.00	0.00	0.0	0.0	0	37	0	4	0	37	0	4
1966	23	1632	1637	649	649	.56	.56	12.1	12.2	295	71	190	28	296	71	190	28
1970	27	3072	3076	2043	2043	.55	.55	11.8	11.8	360	114	348	76	360	114	348	76
1973	30	4196	4200	3191	3191	.51	.51	10.0	10.0	375	140	383	106	375	140	383	106
1975	32	4960	4964	3956	3956	.44	.44	8.8	8.8	382	155	382	124	382	155	382	124
1979	36	6410	6414	5393	5393	.36	.36	7.4	7.4	363	178	359	150	363	178	359	150
1983	40	8024	8028	6974	6974	.33	.33	7.1	7.1	404	201	395	174	404	201	395	174
1988	45	9899	9964	8815	8849	.31	.27	5.7	6.1	375	220	368	196	387	221	375	197
1993	50	11670	11999	10541	10817	.23	.23	4.2	5.4	354	233	345	211	407	240	394	216
1998	55	13264	13893	12109	12647	.25	.21	3.8	5.1	319	241	314	220	379	253	366	230

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 1685 cubic feet (26 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 629 cubic feet (5 percent of the total gross yield).

Table 21b—Stand development table for treatment 4, per-hectare basis (plots 5, 18, and 23)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - - *m³* - - - -		*No.*	*Cm*	*m²*	- - - - - - - *m³* - - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.6	18.0	823	13.5	11.6	52.9	6.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	16.0	23.1	601	18.0	15.1	87.5	37.1	214	17.0	4.8	27.7	9.3	.1	.1	.96	8	10.4	.1	0.8	0.5
1970	27	19.9	29.6	445	24.1	20.0	145.7	106.6	156	21.9	5.9	43.1	28.5	.3	.2	.94	0	.0	.0	.0	.0
1973	30	22.8	33.8	395	28.1	24.3	202.8	170.0	49	26.3	2.7	22.0	17.5	.4	.3	.94	0	.0	.0	.0	.0
1975	32	24.6	36.1	358	30.9	26.6	241.7	213.0	37	23.9	1.7	15.1	11.0	.4	.3	.79	0	.0	.0	.0	.0
1979	36	28.0	40.7	342	34.9	32.2	331.2	303.3	16	30.0	1.2	12.5	11.0	.8	.6	.87	0	.0	.0	.0	.0
1983	40	31.3	44.8	342	38.2	38.8	444.2	413.8	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1988	45	34.9	48.9	329	42.1	45.3	575.4	542.7	0	.0	.0	.0	.0	.0	.0	.00	12	20.7	.4	4.8	2.9
1993	50	38.8	52.4	317	45.1	50.2	699.4	663.5	0	.0	.0	.0	.0	.0	.0	.00	12	37.3	1.3	19.0	17.5
1998	55	41.7	55.3	301	48.2	54.6	811.0	773.3	0	.0	.0	.0	.0	.0	.0	.00	16	33.7	1.5	21.5	18.8

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - *m³* - - - - - - - - - - -				- - - - -*Cm* - -		- - - - *m²* - - - -		- - - - - - - - - - - - - - - - - *m³* -							
1963	20	52.9	52.9	6.1	6.1	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.8	0.0	3.1	0.0	0.8
1966	23	114.8	115.1	45.9	45.9	1.43	1.42	2.8	2.8	21.1	5.5	13.8	2.5	21.2	5.5	13.8	2.5
1970	27	215.5	215.8	143.5	143.5	1.39	1.39	2.7	2.7	25.7	8.5	24.9	5.8	25.7	8.5	24.9	5.8
1973	30	294.2	294.5	223.9	223.9	1.29	1.29	2.3	2.3	26.7	10.3	27.3	7.9	26.7	10.3	27.3	7.9
1975	32	347.7	348.0	277.4	277.4	1.12	1.12	2.0	2.0	27.2	11.3	27.2	9.2	27.2	11.4	27.2	9.2
1979	36	449.2	449.5	378.0	378.0	.92	.92	1.7	1.7	25.9	13.0	25.6	11.0	25.9	13.0	25.6	11.0
1983	40	562.2	562.5	488.7	488.7	.84	.84	1.6	1.6	28.7	14.5	28.2	12.7	28.7	14.5	28.2	12.7
1988	45	693	697	617.6	619.9	.78	.67	1.3	1.4	26.7	15.9	26.3	14.2	27.6	16.0	26.8	14.3
1993	50	817.4	840.4	738.4	757.7	.59	.57	1.0	1.2	25.3	16.8	24.7	15.3	29.0	17.3	28.1	15.6
1998	55	929.0	973.0	848.2	885.8	.63	.53	.9	1.2	22.8	17.4	22.5	15.9	27.0	18.2	26.1	16.6

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 118.0 cubic meters (26 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 44.0 cubic meters (5 percent of the total gross yield).

Table 22a—Stand development table for treatment 5, per-acre basis (plots 9, 24, and 27)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - -		*No.*	*In*	*Ft²*	- - - - - - - - *Ft³* - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	39	6.8	365	5.0	49.2	729	44	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	50	8.9	312	6.7	74.9	1385	473	52	6.3	11.1	201	45	3.9	1.5	.95	2	5.4	.3	4	0
1970	27	62	11.4	250	8.7	103.6	2438	1609	62	8.2	22.9	528	309	8.5	5.4	.96	0	.0	.0	0	0
1973	30	71	13.0	213	10.2	121.1	3285	2597	35	9.3	16.5	440	310	12.6	9.4	.92	2	7.6	.5	13	6
1975	32	78	13.8	193	11.1	130.4	3857	3243	18	9.9	9.8	289	222	16.1	13.1	.90	2	8.0	.6	16	9
1979	36	89	15.6	170	12.6	147.9	4977	4435	23	11.4	16.4	561	480	24.4	20.9	.91	0	.0	.0	0	0
1983	40	101	17.3	165	14.0	175.4	6625	6074	0	.0	.0	0	0	.0	.0	.00	5	10.0	2.7	98	78
1988	45	113	19.0	162	15.3	207.4	8663	8079	0	.0	.0	0	0	.0	.0	.00	3	5.5	.5	14	1
1993	50	127	20.4	153	16.7	233.6	10827	10215	0	.0	.0	0	0	.0	.0	.00	8	9.1	3.8	148	104
1998	55	133	21.4	145	17.8	250.1	12109	11491	0	.0	.0	0	0	.0	.0	.00	7	10.6	4.1	187	150

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - *Ft³* - - - - - - - - - -				- - - - -*In* - - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - - -							
1963	20	729	729	44	44	0.00	0.00	0.0	0.0	0	36	0	2	0	36	0	2
1966	23	1586	1590	518	518	.54	.54	12.3	12.3	286	69	158	23	287	69	158	23
1970	27	3167	3171	1963	1963	.50	.50	12.9	12.9	395	117	361	73	395	117	361	73
1973	30	4454	4472	3260	3266	.45	.45	11.3	11.5	429	148	433	109	434	149	435	109
1975	32	5314	5348	4128	4142	.41	.40	9.5	9.8	430	166	434	129	438	167	438	129
1979	36	6995	7029	5799	5814	.34	.34	8.5	8.5	420	194	418	161	420	195	418	161
1983	40	8643	8775	7439	7531	.33	.32	6.9	7.6	412	216	410	186	436	219	429	188
1988	45	10682	10828	9443	9537	.27	.25	6.4	6.5	408	237	401	210	411	241	401	212
1993	50	12846	13139	11580	11777	.28	.22	5.2	6.0	433	257	427	232	462	263	448	236
1998	55	14127	14608	12855	13203	.22	.17	3.3	4.1	256	257	255	234	294	266	285	240

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 2018 cubic feet (29 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 480 cubic feet (3 percent of the total gross yield).

Table 22b—Stand development table for treatment 5, per-hectare basis (plots 9, 24, and 27)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - *m³* - - -		*No.*	*Cm*	*m²*	- - - *m³* - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.5	17.2	902	12.7	11.3	51.5	3.5	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.6	22.6	770	16.9	17.2	97.4	33.6	128	15.9	2.5	14.5	3.6	.1	.0	.95	4	13.8	.1	0.8	0.5
1970	27	19.4	28.9	618	22.2	23.8	171.1	113.2	152	21.0	5.3	37.5	22.1	.2	.2	.96	0	.0	.0	.0	.0
1973	30	22.2	33.0	527	26.0	27.8	230.5	182.3	86	23.7	3.8	31.3	22.2	.4	.3	.92	4	19.4	.1	1.4	0.9
1975	32	24.3	35.1	478	28.3	30.0	270.5	227.5	45	25.1	2.2	20.7	16.0	.4	.4	.90	4	20.4	.1	1.6	1.1
1979	36	27.6	39.7	420	32.1	34.0	348.9	310.9	58	28.9	3.8	39.7	34.1	.7	.6	.91	0	.0	.0	.0	.0
1983	40	31.3	43.8	408	35.5	40.3	464.2	425.7	0	.0	.0	.0	.0	.0	.0	.00	12	25.3	.6	7.4	6.0
1988	45	35.0	48.1	399	39.0	47.7	606.9	566.0	0	.0	.0	.0	.0	.0	.0	.00	8	13.9	.1	1.5	0.5
1993	50	39.2	51.8	379	42.5	53.7	758.4	715.6	0	.0	.0	.0	.0	.0	.0	.00	21	23.2	.9	10.8	7.8
1998	55	41.1	54.5	358	45.3	57.5	848.1	804.9	0	.0	.0	.0	.0	.0	.0	.00	16	27.0	.9	13.6	11.0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - *m³* - - - - - - - -				- - - *Cm* - - -		- - - *m²* - - -		- - - - - - - - *m³* - - - - - - - -							
1963	20	51.5	51.5	3.5	3.5	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.7	0.0	3.1	0.0	0.7
1966	23	111.5	111.8	36.7	36.7	1.37	1.37	2.8	2.8	20.5	5.3	11.6	2.1	20.6	5.3	11.6	2.1
1970	27	222.2	222.5	137.9	137.9	1.27	1.27	3.0	3.0	28.2	8.7	25.8	5.6	28.2	8.7	25.8	5.6
1973	30	312.3	313.5	228.7	229.2	1.15	1.15	2.6	2.6	30.5	10.9	30.8	8.1	30.9	10.9	30.9	8.1
1975	32	372.5	374.9	289.4	290.5	1.04	1.02	2.2	2.3	30.6	12.1	30.9	9.5	31.2	12.2	31.2	9.6
1979	36	490.2	492.5	406.4	407.5	.87	.87	2.0	2.0	29.9	14.1	29.7	11.8	29.9	14.2	29.7	11.8
1983	40	605.5	614.7	521.2	527.7	.85	.80	1.6	1.7	29.3	15.6	29.2	13.5	31.0	15.9	30.6	13.7
1988	45	748.2	758.4	661.5	668.1	.70	.64	1.5	1.5	29.0	17.1	28.6	15.2	29.2	17.3	28.6	15.3
1993	50	899.7	920.3	811.1	824.9	.70	.56	1.2	1.4	30.8	18.5	30.4	16.7	32.9	18.9	31.9	17.0
1998	55	989.4	1023.0	900.4	924.7	.55	.42	.8	1.0	18.4	18.5	18.4	16.6	21.1	19.1	20.5	17.3

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 141.3 cubic meters (29 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 33.6 cubic meters (3 percent of the total gross yield).

Table 23a—Stand development table for treatment 6, per-acre basis (plots 1, 2, and 25)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	Ft	In	No.	In	Ft^2	- - - Ft^3 - - -		No.	In	Ft^2	- - - - - - - - Ft^3 - - - - - - - - -					No.	In	Ft^2	- - - Ft^3 - - -	
1963	20	40	7.0	338	5.2	49.9	741	66	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	49	9.1	283	7.0	75.1	1375	536	55	6.6	12.9	232	67	4.2	1.9	.95	0	.0	.0	0	0
1970	27	62	11.6	210	9.3	97.8	2278	1623	73	8.6	29.6	680	436	9.3	6.4	.95	0	.0	.0	0	0
1973	30	71	13.3	168	10.9	108.3	2912	2419	42	10.1	23.2	612	477	14.6	11.9	.94	0	.0	.0	0	0
1975	32	77	14.2	142	12.0	111.6	3252	2858	27	10.3	15.5	447	356	16.6	13.2	.88	0	.0	.0	0	0
1979	36	88	16.0	110	13.9	114.9	3795	3495	32	12.8	28.1	928	833	29.0	27.8	.94	0	.0	.0	0	0
1983	40	98	17.6	110	15.5	143.0	5223	4902	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1988	45	110	19.4	110	17.1	175.4	7118	6748	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0
1993	50	123	21.0	105	18.6	198.1	8904	8487	0	.0	.0	0	0	.0	.0	.00	5	15.1	6.2	276	253
1998	55	133	22.5	105	19.8	224.5	10806	10323	0	.0	.0	0	0	.0	.0	.00	0	.0	.0	0	0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - Ft^3 - - - - - - - - -				- - - - -In - - - -		- - - - Ft^2 - - - -		- - - - - - - - - - - - - - - - - Ft^3 - - - - - - - - - - - - - - - - - - -							
1963	20	741	741	66	66	0.00	0.00	0.0	0.0	0	37	0	3	0	37	0	3
1966	23	1607	1607	603	603	.57	.57	12.7	12.7	289	70	179	26	289	70	179	26
1970	27	3190	3190	2127	2127	.53	.53	13.1	13.1	396	118	381	79	396	118	381	79
1973	30	4436	4436	3400	3400	.49	.49	11.2	11.2	415	148	424	113	415	148	424	113
1975	32	5223	5223	4195	4195	.45	.45	9.4	9.4	394	163	398	131	394	163	398	131
1979	36	6694	6694	5665	5665	.40	.40	7.9	7.9	368	186	367	157	368	186	367	157
1983	40	8122	8122	7072	7072	.40	.40	7.0	7.0	357	203	352	177	357	203	352	177
1988	45	10017	10017	8918	8918	.33	.33	6.5	6.5	379	223	369	198	379	223	369	198
1993	50	11803	12079	10657	10910	.30	.28	4.5	5.8	357	236	348	213	412	242	398	218
1998	55	13705	13981	12493	12746	.24	.24	5.3	5.3	380	249	367	227	380	254	367	232

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 2899 cubic feet (43 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 276 cubic feet (2 percent of the total gross yield).

Table 23b—Stand development table for treatment 6, per-hectare basis (plots 1, 2, and 25)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - - *m³* - - - -		*No.*	*Cm*	*m²*	- - - - - - - *m³* - - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.6	17.8	836	13.2	11.5	52.4	5.1	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.4	23.1	700	17.7	17.3	96.8	38.0	136	16.7	3.0	16.7	5.2	.1	.1	.95	0	.0	.0	.0	.0
1970	27	19.3	29.5	519	23.5	22.5	159.9	114.1	181	21.9	6.8	48.1	31.1	.3	.2	.95	0	.0	.0	.0	.0
1973	30	22.2	33.8	416	27.7	24.9	204.3	169.8	103	25.7	5.3	43.3	33.9	.4	.3	.94	0	.0	.0	.0	.0
1975	32	23.9	36.0	350	30.6	25.7	228.1	200.6	66	26.3	3.6	31.8	25.4	.5	.4	.88	0	.0	.0	.0	.0
1979	36	27.3	40.6	272	35.3	26.4	266.2	245.1	78	32.5	6.5	65.4	58.8	.8	.8	.94	0	.0	.0	.0	.0
1983	40	30.4	44.6	272	39.3	32.9	366.1	343.7	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1988	45	34.0	49.4	272	43.5	40.4	498.8	472.9	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0
1993	50	38.0	53.4	259	47.4	45.6	623.8	594.6	0	.0	.0	.0	.0	.0	.0	.00	12	38.3	1.4	19.8	18.2
1998	55	41.2	57.1	259	50.4	51.6	756.9	723.1	0	.0	.0	.0	.0	.0	.0	.00	0	.0	.0	.0	.0

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - *m³* - - - - - - - - - - - -				- - - - -*Cm* - - -		- - - - *m²* - - - -		- - - - - - - - - - - - - - - - - *m³* - - - - - - - - - - - - - - - - - - -							
1963	20	52.4	52.4	5.1	5.1	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.7	0.0	3.1	0.0	0.7
1966	23	113.0	113.0	42.7	42.7	1.45	1.45	2.9	2.9	20.7	5.4	13.0	2.3	20.7	5.4	13.0	2.3
1970	27	223.8	223.8	149.4	149.4	1.34	1.34	3.0	3.0	28.2	8.8	27.2	6.0	28.2	8.8	27.2	6.0
1973	30	311.0	311.0	238.5	238.5	1.25	1.25	2.6	2.6	29.6	10.9	30.2	8.4	29.6	10.9	30.2	8.4
1975	32	366.1	366.1	294.2	294.2	1.16	1.16	2.2	2.2	28.1	11.9	28.3	9.7	28.1	11.9	28.3	9.7
1979	36	469.1	469.1	397.0	397.0	1.01	1.01	1.8	1.8	26.2	13.5	26.2	11.5	26.2	13.5	26.2	11.5
1983	40	569.1	569.1	495.6	495.6	1.01	1.01	1.6	1.6	25.5	14.7	25.1	12.9	25.5	14.7	25.1	12.9
1988	45	701.7	701.7	624.8	624.8	.84	.84	1.5	1.5	27.0	16.1	26.3	14.4	27.0	16.1	26.3	14.4
1993	50	826.7	846.0	746.5	764.2	.77	.72	1.0	1.3	25.5	17.0	24.8	15.4	29.4	17.4	28.4	15.8
1998	55	959.8	979.1	875.0	892.7	.61	.61	1.2	1.2	27.1	17.9	26.2	16.4	27.1	18.3	26.3	16.7

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 202.9 cubic meters (43 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 19.3 cubic meters (2 percent of the total gross yield).

Table 24a—Stand development table for treatment 7, per-acre basis (plots 12, 14, and 19)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - -		*No.*	*In*	*Ft²*	- - - - - - - - *Ft³* - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	39	7.2	328	5.3	50.1	754	75	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	49	9.3	323	6.9	84.9	1568	612	5	6.1	1.0	18	5	3.6	1.7	.88	0	.0	.0	0	0
1970	27	62	11.6	287	8.9	124.5	2936	1993	37	8.6	14.9	363	239	9.8	7.5	.97	0	.0	.0	0	0
1973	30	71	13.0	262	10.3	150.0	4091	3243	25	9.2	11.6	316	223	12.6	9.7	.91	0	.0	.0	0	0
1975	32	77	13.8	243	11.1	162.3	4797	4019	17	9.1	7.5	221	153	13.0	9.0	.83	2	5.2	.2	6	0
1979	36	88	15.3	225	12.3	186.2	6273	5544	13	11.4	9.4	324	273	24.9	21.0	.93	5	8.7	2.0	66	46
1983	40	100	16.8	223	13.5	221.1	8360	7611	0	.0	.0	0	0	.0	.0	.00	2	5.9	.3	9	0
1988	45	112	18.2	213	14.9	256.0	10803	10050	0	.0	.0	0	0	.0	.0	.00	10	6.9	2.6	84	28
1993	50	125	19.6	208	15.9	287.6	13373	12564	0	.0	.0	0	0	.0	.0	.00	5	9.8	2.6	105	80
1998	55	134	20.8	202	16.9	312.9	15403	14560	0	.0	.0	0	0	.0	.0	.00	7	11.7	5.0	231	198

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - *Ft³* - - - - - - - - - -				- - - - -*In* - - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - - -							
1963	20	754	754	75	75	0.00	0.00	0.0	0.0	0	38	0	4	0	38	0	4
1966	23	1586	1586	616	616	.55	.55	11.9	11.9	277	69	180	27	277	69	180	27
1970	27	3318	3318	2237	2237	.49	.49	13.6	13.6	433	123	405	83	433	123	405	83
1973	30	4788	4788	3709	3709	.42	.42	12.4	12.4	490	160	491	124	490	160	491	124
1975	32	5716	5721	4639	4639	.35	.33	9.9	10.0	464	179	465	145	467	179	465	145
1979	36	7515	7587	6436	6483	.30	.29	8.3	8.8	450	209	449	179	466	211	461	180
1983	40	9602	9683	8504	8551	.29	.28	8.7	8.8	522	240	517	213	524	242	517	214
1988	45	12045	12209	10942	11016	.28	.23	7.0	7.5	488	268	488	243	505	271	493	245
1993	50	14615	14884	13456	13610	.21	.20	6.3	6.9	514	292	503	269	535	298	519	272
1998	55	16645	17145	15453	15804	.19	.17	5.0	6.0	406	303	399	281	452	312	439	287

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 1242 cubic feet (16 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 500 cubic feet (3 percent of the total gross yield).

Table 24b—Stand development table for treatment 7, per-hectare basis (plots 12, 14, and 19)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - - *m³* - - - - -		*No.*	*Cm*	*m²*	- - - - - - - - *m³* - - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.3	18.3	811	13.4	11.5	53.3	5.8	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.3	23.5	799	17.6	19.5	110.3	43.3	12	15.5	.2	1.8	0.8	.1	.0	.88	0	.0	.0	.0	.0
1970	27	19.5	29.6	708	22.7	28.6	206.0	140.0	91	22.0	3.4	25.9	17.2	.3	.2	.97	0	.0	.0	.0	.0
1973	30	22.3	33.1	646	26.1	34.5	286.9	227.5	62	23.5	2.7	22.6	16.1	.4	.3	.91	0	.0	.0	.0	.0
1975	32	24.0	35.2	601	28.1	37.3	336.3	281.9	41	23.2	1.7	16.0	11.2	.4	.3	.83	4	13.2	.1	0.9	0.5
1979	36	27.5	38.9	556	31.4	42.8	439.6	388.6	33	28.9	2.2	23.2	19.6	.7	.6	.93	12	22.0	.5	5.1	3.7
1983	40	31.1	42.5	552	34.3	50.8	585.7	533.3	0	.0	.0	.0	.0	.0	.0	.00	4	15.0	.1	1.1	0.5
1988	45	34.8	46.3	527	37.8	58.9	756.7	704.0	0	.0	.0	.0	.0	.0	.0	.00	25	17.5	.6	6.4	2.4
1993	50	38.5	49.8	515	40.5	66.2	936.6	879.9	0	.0	.0	.0	.0	.0	.0	.00	12	24.8	.6	7.8	6.1
1998	55	41.5	52.8	498	42.9	72.0	1078.7	1019.7	0	.0	.0	.0	.0	.0	.0	.00	16	29.8	1.1	16.7	14.3

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - *m³* - - - - - - - - - - -				- - - - -*Cm* - - -		- - - - *m²* - - - -		- - - - - - - - - - - - - - - - *m³* -							
1963	20	53.3	53.3	5.8	5.8	0.00	0.00	0.0	0.0	0.0	3.1	0.0	0.8	0.0	3.1	0.0	0.8
1966	23	111.5	111.5	43.7	43.7	1.39	1.39	2.7	2.7	19.9	5.3	13.1	2.4	19.9	5.3	13.1	2.4
1970	27	232.7	232.7	157.1	157.1	1.24	1.24	3.1	3.1	30.8	9.9	28.9	6.3	30.8	9.1	28.9	6.3
1973	30	335.7	335.7	260.1	260.1	1.06	1.06	2.8	2.8	34.8	11.7	34.9	9.2	34.8	11.7	34.9	9.2
1975	32	400.6	401.0	325.3	325.3	.88	.85	2.3	2.3	33.0	13.0	33.1	10.6	33.2	13.0	33.1	10.6
1979	36	526.6	531.6	451.0	454.3	.77	.74	1.9	2.0	32.0	15.1	31.9	13.0	33.1	15.3	32.8	13.1
1983	40	672.7	678.3	595.8	599.0	.73	.71	2.0	2.0	37.0	17.3	36.7	15.4	37.2	17.4	36.7	15.5
1988	45	843.6	855.1	766.5	771.6	.70	.58	1.6	1.7	34.7	19.2	34.6	17.5	35.9	19.5	35.0	17.6
1993	50	1023.6	1042.4	942.4	953.2	.54	.50	1.5	1.6	36.5	21.0	35.7	19.3	38.0	21.3	36.8	19.6
1998	55	1165.7	1200.7	1082.2	1106.8	.48	.42	1.2	1.4	28.9	21.7	28.4	20.2	32.2	22.3	31.2	20.6

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 87.0 cubic meters (16 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 35.0 cubic meters (3 percent of the total gross yield).

Table 25a-Stand development table for treatment 8, per-acre basis (plots 6, 13, and 16)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - -		*No.*	*In*	*Ft²*	- - - - - - - - *Ft³* - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	40	7.3	337	5.3	50.4	776	87	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	49	9.4	327	7.0	85.8	1608	634	8	6.6	2.0	37	10	4.6	1.4	.96	2	5.0	.2	4	0
1970	27	63	11.8	275	8.9	118.7	2837	1925	52	8.6	20.6	489	316	9.4	7.0	.97	0	.0	.0	0	0
1973	30	72	13.2	242	10.2	136.8	3778	2982	33	9.8	17.3	483	364	14.6	11.4	.96	0	.0	.0	0	0
1975	32	78	14.0	222	11.0	144.6	4281	3560	18	10.5	11.0	323	264	17.9	15.5	.96	2	5.0	.2	5	0
1979	36	89	15.5	187	12.3	154.3	5210	4595	33	11.5	24.2	824	700	25.0	21.2	.95	2	4.8	.2	5	0
1983	40	99	16.8	183	13.7	186.4	7014	6395	0	.0	.0	0	0	.0	.0	.00	3	5.9	.6	20	0
1988	45	112	18.5	180	15.1	222.4	9312	8655	0	.0	.0	0	0	.0	.0	.00	3	7.0	.9	32	16
1993	50	123	20.0	170	16.5	251.1	11544	10880	0	.0	.0	0	0	.0	.0	.00	10	7.8	3.3	127	61
1998	55	132	21.3	167	17.5	277.9	13502	12796	0	.0	.0	0	0	.0	.0	.00	3	8.7	1.4	61	40

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - - - *Ft³* - - - - - - - - - -				- - - - *In* - - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - - -							
1963	20	776	776	87	87	0.00	0.00	0.0	0.0	0	39	0	4	0	39	0	4
1966	23	1645	1649	644	644	.57	.57	12.5	12.6	290	72	186	28	291	72	186	28
1970	27	3363	3367	2252	2252	.48	.48	13.4	13.4	430	125	402	83	430	125	402	83
1973	30	4787	4791	3672	3672	.41	.41	11.8	11.8	475	160	473	122	475	160	473	122
1975	32	5613	5622	4514	4514	.36	.34	9.4	9.5	413	175	421	141	416	176	421	141
1979	36	7366	7380	6249	6249	.32	.31	8.5	8.5	438	205	434	174	439	205	434	174
1983	40	9170	9203	8049	8050	.34	.32	8.0	8.2	451	229	450	201	456	230	450	201
1988	45	11468	11534	10309	10325	.28	.26	7.2	7.4	460	255	452	229	466	256	455	229
1993	50	13700	13892	12534	12611	.28	.22	5.7	6.4	446	274	445	251	472	278	457	252
1998	55	15658	15913	14450	14568	.21	.18	5.4	5.6	392	285	383	263	404	289	391	265

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 2156 cubic feet (29 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 254 cubic feet (2 percent of the total gross yield).

Table 25b—Stand development table for treatment 8, per-hectare basis (plots 6, 13, and 16)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - *m³* - - -		*No.*	*Cm*	*m²*	- - - - - - - - *m³* - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	12.7	18.6	832	13.4	11.6	54.8	6.6	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	15.5	23.9	807	17.7	19.7	113.1	44.8	21	16.8	.5	3.1	1.2	.1	.1	.96	4	12.7	.1	0.8	0.5
1970	27	19.7	29.9	679	22.7	27.3	199.1	135.3	128	21.7	4.7	34.7	22.6	.3	.2	.97	0	.0	.0	.0	.0
1973	30	22.5	33.4	597	25.9	31.5	265.0	209.2	82	24.8	4.0	34.3	26.0	.4	.3	.96	0	.0	.0	.0	.0
1975	32	24.2	35.5	548	27.8	33.2	300.2	249.7	45	26.7	2.5	23.1	18.0	.5	.4	.96	4	12.7	.1	0.8	0.5
1979	36	27.6	39.3	461	31.4	35.5	365.2	322.1	82	29.3	5.6	58.2	49.5	.7	.6	.95	4	12.2	.0	0.9	0.5
1983	40	30.8	42.8	453	34.8	42.9	491.5	448.2	0	.0	.0	.0	.0	.0	.0	.00	8	15.0	.1	1.9	0.5
1988	45	34.5	47.0	445	38.3	51.1	652.3	606.4	0	.0	.0	.0	.0	.0	.0	.00	8	17.7	.2	2.8	1.6
1993	50	38.1	50.7	420	41.8	57.8	808.6	762.1	0	.0	.0	.0	.0	.0	.0	.00	25	19.7	.8	9.4	4.8
1998	55	40.9	54.0	412	44.4	63.9	945.7	896.2	0	.0	.0	.0	.0	.0	.0	.00	8	22.2	.3	4.8	3.3

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - *m³* - - - - - - - -				- - - - *Cm* - - -		- - - - *m²* - - - -		- - - - - - - - - - - - *m³* - - - - - - - - - - - -							
1963	20	54.8	54.8	6.6	6.6	0.00	0.00	0.0	0.0	0.0	3.2	0.0	0.8	0.0	3.2	0.0	0.8
1966	23	115.6	115.9	45.6	45.6	1.44	1.44	2.9	2.9	20.8	5.5	13.5	2.5	20.9	5.5	13.5	2.5
1970	27	235.8	236.2	158.2	158.2	1.21	1.21	3.1	3.1	30.6	9.2	28.6	6.3	30.6	9.2	28.6	6.3
1973	30	335.9	335.9	257.5	257.5	1.05	1.05	2.7	2.7	33.7	11.7	33.6	9.1	33.7	11.7	33.6	9.1
1975	32	393.4	394.0	316.5	316.5	.91	.87	2.2	2.2	29.4	12.8	30.0	10.4	29.6	12.8	30.0	10.4
1979	36	516.1	517.1	437.9	437.9	.80	.78	1.9	2.0	31.2	14.8	30.9	12.7	31.3	14.8	30.9	12.7
1983	40	642.4	644.7	564.0	564.0	.85	.80	1.8	1.9	32.1	16.5	32.0	14.6	32.4	16.6	32.0	14.6
1988	45	803.3	807.9	722.1	723.3	.71	.66	1.7	1.7	32.7	18.3	32.1	16.5	33.1	18.4	32.4	16.6
1993	50	959.5	973.0	877.9	883.3	.71	.55	1.3	1.5	31.7	19.7	31.6	18.0	33.5	19.9	32.5	18.2
1998	55	1096.6	1114.4	1012.0	1020.2	.52	.46	1.2	1.3	27.9	20.4	27.3	18.9	28.8	20.8	27.9	19.0

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) removed in thinnings = 150.9 cubic meters (29 percent of the total gross yield at the time of the last thinning). Volume (CVTS) in mortality = 17.8 cubic meters (2 percent of the total gross yield).

Table 26a—Stand development table for control, per-acre basis (plots 10, 22, and 26)

		After thinning							Removed in thinning								Mortality				
		40 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*Ft*	*In*	*No.*	*In*	*Ft²*	- - - *Ft³* - - -		*No.*	*In*	*Ft²*	- - - - - - - *Ft³* - - - - - - - - -					*No.*	*In*	*Ft²*	- - - *Ft³* - - -	
1963	20	42	7.6	1718	3.8	138.0	1996	138	0	0.0	0.0	0	0	0.0	0.0	0.00	0	0.0	0.0	0	0
1966	23	51	9.1	1637	4.6	184.7	3392	607	0	.0	.0	0	0	.0	.0	.00	87	2.1	2.0	27	0
1970	27	65	10.9	1272	5.8	228.6	5411	1891	0	.0	.0	0	0	.0	.0	.00	368	2.5	12.7	222	0
1973	30	74	12.0	1087	6.6	255.9	6931	3200	0	.0	.0	0	0	.0	.0	.00	185	3.0	9.3	189	0
1975	32	80	12.7	938	7.2	261.3	7611	4020	0	.0	.0	0	0	.0	.0	.00	148	4.0	12.9	306	19
1979	36	90	13.8	767	8.2	277.9	9285	5755	0	.0	.0	0	0	.0	.0	.00	172	4.3	17.2	479	26
1983	40	99	15.0	653	9.1	295.1	10898	7631	0	.0	.0	0	0	.0	.0	.00	113	4.9	14.8	460	28
1988	45	111	16.3	488	10.6	296.4	12161	9720	0	.0	.0	0	0	.0	.0	.00	165	6.1	34.0	1209	254
1993	50	122	17.6	377	12.1	297.5	13376	11604	0	.0	.0	0	0	.0	.0	.00	112	7.1	31.1	1210	472
1998	55	130	19.0	307	13.5	299.9	14312	12924	0	.0	.0	0	0	.0	.0	.00	70	8.9	30.1	1297	867

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - *Ft³* - - - - - - - - - - -				- - - - -*In* - - - -		- - - - *Ft²* - - - -		- - - - - - - - - - - - - - - - - *Ft³* - - - - - - - - - - - - - - - - - - -							
1963	20	1996	1996	138	138	0.00	0.00	0.0	0.0	0	100	0	7	0	100	0	7
1966	23	3392	3419	607	607	.24	.21	15.6	16.2	465	147	156	26	474	149	156	26
1970	27	5411	5660	1891	1891	.30	.19	11.0	14.2	505	200	321	70	560	210	321	70
1973	30	6931	7369	3200	3200	.28	.16	9.1	12.2	507	231	436	107	570	246	436	107
1975	32	7611	8355	4020	4038	.30	.13	2.7	9.2	340	238	410	126	493	261	419	126
1979	36	9285	10508	5755	5800	.25	.13	4.1	8.4	419	258	434	160	538	292	440	161
1983	40	10898	12582	7631	7703	.23	.13	4.3	8.0	403	272	469	191	518	315	476	193
1988	45	12161	15053	9720	10047	.29	.13	.2	7.0	253	270	418	216	494	335	469	223
1993	50	13376	17479	11604	12402	.30	.13	.2	6.4	243	268	377	232	485	350	471	248
1998	55	14312	19711	12924	14589	.28	.15	.5	6.5	187	260	264	235	446	358	437	265

[a] 40 largest: Average height and d.b.h. of the 40 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 6-in top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) in mortality = 5399 cubic feet (27 percent of the total gross yield).

Table 26b—Stand development table for control, per-hectare basis (plots 10, 22, and 26)

		After thinning							Removed in thinning								Mortality				
		100 largest[a]					Volume[c]					Volume		Avg. volume						Volume	
Year	Stand age	HT	D.b.h.	Trees	QMD[b]	Basal area	CVTS	CV6	Trees	QMD	Basal area	CVTS	CV6	CVTS	CV6	d/D[d]	Trees	QMD	Basal area	CVTS	CV6
	Yr	*m*	*Cm*	*No.*	*Cm*	*m²*	- - - *m³* - - -		*No.*	*Cm*	*m²*	- - - - - - - - - *m³* - - - - - - - - -					*No.*	*Cm*	*m²*	- - - *m³* - - -	
1963	20	13.4	19.2	4244	9.8	31.7	140.2	10.2	0	0.0	0.0	0.0	0.0	0.0	0.0	0.00	0	0.0	0.0	0.0	0.0
1966	23	16.1	23.0	4043	11.6	42.5	237.9	43.0	0	.0	.0	.0	.0	.0	.0	.00	214	5.3	.5	2.4	0.
1970	27	20.3	27.6	3141	14.7	52.6	379.2	132.9	0	.0	.0	.0	.0	.0	.0	.00	910	6.4	2.9	16.1	0.5
1973	30	23.2	30.5	2684	16.8	58.9	485.7	224.5	0	.0	.0	.0	.0	.0	.0	.00	457	7.7	2.1	13.7	0.5
1975	32	25.0	32.2	2318	18.3	60.1	533.3	281.9	0	.0	.0	.0	.0	.0	.0	.00	366	10.2	3.0	21.9	1.8
1979	36	27.8	35.1	1894	20.8	63.9	650.5	403.4	0	.0	.0	.0	.0	.0	.0	.00	424	10.9	3.9	34.0	2.3
1983	40	30.7	38.1	1614	23.2	67.9	763.4	534.6	0	.0	.0	.0	.0	.0	.0	.00	280	12.4	3.4	32.7	2.5
1988	45	34.2	41.5	1206	26.9	68.2	851.8	680.9	0	.0	.0	.0	.0	.0	.0	.00	408	15.6	7.8	85.1	18.3
1993	50	37.8	44.7	930	30.7	68.4	936.9	812.8	0	.0	.0	.0	.0	.0	.0	.00	276	18.2	7.2	85.2	33.5
1998	55	40.2	48.3	757	34.2	69.0	1002.2	905.1	0	.0	.0	.0	.0	.0	.0	.00	173	22.6	6.9	91.3	61.2

		Cumulative yield[e]				QMD growth		BA growth		Net volume growth				Gross volume growth			
		Net CVTS	Gross CVTS	Net CV6	Gross CV6	Net	Surv.	Net	Gross	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI	CVTS PAI	CVTS MAI	CV6 PAI	CV6 MAI
		- - - - - - - - *m³* - - - - - - - - -				- - - - -*Cm* - - -		- - - - *m²* - - - -		- - - - - - - - - - - - - - - - *m³* - - - - - - - - - - - - - - - - - - -							
1963	20	140.2	140.2	10.2	10.2	0.00	0.00	0.0	0.0	0.0	7.5	0.0	1.0	0.0	7.5	0.0	1.0
1966	23	237.9	239.8	43.0	43.0	.62	.54	3.6	3.7	33.1	10.8	11.4	2.3	33.7	10.9	11.4	2.3
1970	27	379.2	396.7	132.9	132.9	.76	.48	2.5	3.3	35.8	14.5	23.0	5.4	39.7	15.2	23.0	5.4
1973	30	485.7	516.4	224.5	224.5	.70	.42	2.1	2.8	36.0	16.7	31.1	8.0	40.4	17.7	31.1	8.0
1975	32	533.3	585.4	281.9	283.2	.77	.33	.6	2.1	24.3	17.1	29.2	9.3	35.0	18.9	29.8	9.3
1979	36	650.5	736.1	403.4	406.5	.63	.33	1.0	1.9	29.8	18.6	30.9	11.7	38.2	20.9	31.3	11.8
1983	40	763.4	881.2	534.6	539.7	.60	.32	1.0	1.8	28.7	19.6	33.3	13.9	36.8	22.5	33.8	14.0
1988	45	851.8	1054.2	680.9	703.8	.74	.33	.1	1.6	18.2	19.4	29.8	15.6	35.1	23.9	33.3	16.1
1993	50	936.9	1224.0	812.8	868.7	.75	.34	.1	1.5	17.5	19.2	26.9	16.7	34.5	25.0	33.5	17.9
1998	55	1002.3	1380.2	905.1	1021.7	.71	.38	.1	1.5	13.6	18.7	19.0	16.9	31.7	25.6	31.1	19.1

[a] 100 largest: Average height and d.b.h. of the 100 largest trees per acre (estimated from d.b.h. and HT-d.b.h. curves).
[b] QMD: Quadratic mean diameter at breast height.
[c] Volume: All volumes are total stem cubic (CVTS) or merchantable cubic to a 15.25-cm top diameter (CV6), inside bark.
[d] d/D: Average d.b.h. cut ÷ average d.b.h. before thinning.
[e] Cumulative yield: net = standing + thinning; gross = standing + thinning + mortality; yield does not include any volume removed in a Calibration cut. Volume (CVTS) in mortality = 377.9 cubic meters (27 percent of the total gross yield).

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