Research Paper PNW-323

LEVELS-OF-GROWING-STOCK COOPERATIVE STUDY IN DOUGLAS-FIR

REPORT NO. 7

PRELIMINARY RESULTS, STAMPEDE CREEK, AND SOME COMPARISONS WITH IRON CREEK AND HOSKINS

PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION
U.S. Department of Agriculture
Forest Service
Portland, Oregon

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

Thinning	Treatment							
	1	2	3	4	5	6	7	8
	Percent							
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

Abstract for Report No. 1

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 which is 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 Vancouver Island, Canada. Site quality of these areas varies from I through IV.

Climatic and soil characteristics for each area and data for the stand after the conditioning thinning are described briefly.

KEYWORDS: Thinnings, stand growth, Douglas-fir, *Pseudotsuga menziesii.*

LEVELS-OF-GROWING-STOCK COOPERATIVE STUDY IN DOUGLAS-FIR

Report No. 7—Preliminary Results, Stampede Creek, and Some Comparisons With Iron Creek and Hoskins

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USDA Forest Service Research Paper PNW-323
Pacific Northwest Forest and Range Experiment Station
Forest Service Portland, Oregon
U.S. Department of Agriculture 1984

Other LOGS (levels-of-growing stock) reports:

WILLIAMSON, RICHARD L.; STAEBLER, GEORGE R. 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; **1965.** 12 p.
Describes purpose and scope of a cooperative study which is investigating the relative merits of eight different thinning regimes. Main features of six study areas installed since 1961 in young stands are also summarized.

WILLIAMSON, RICHARD L.; STAEBLER, GEORGE R. 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; **1971.** 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. Levels-of-growing-stock cooperative study on Douglas-fir: Report No. 2—The Hoskins study, 1963-1970. Res. Pap. PNW-130. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1972.** 19 p.
A calibration thinning and the first treatment thinning in a 20-year-old Douglas-fir stand at Hoskins, Oregon, are described. Data tabulated for the first 7 years of management show that growth changes in the thinned stands were greater than anticipated.

DIGGLE, P. K. 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; **1972.** 46 p.

WILLIAMSON, RICHARD L. Level-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; **1976.** 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. Levels-of-growing-stock cooperative study on Douglas-fir; Report No. 5—The Hoskins Study, 1963-1975. Res. Pap. PNW-257. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1979.** 29 p.
The study dramatically demonstrates the capability of young Douglas-fir stands to transfer the growth from many trees to few trees. It also indicates that at least some of the treatments have the potential to equal or surpass the gross cubic-foot volume of the controls during the next treatment periods.

ARNOTT, J. T.; BEDDOWS, D. 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; **1981.** 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 are also included.

Reference Abstract

WILLIAMSON, RICHARD L.; CURTIS, ROBERT O. 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; **1984.** 42 p.

Results of the Stampede Creek LOGS study in southwest Oregon are summarized, and results are compared with two more-advanced LOGS studies and, in general, are similar. To age 43, thinning in this low site III Douglas-fir *(Pseudotsuga menziesii* (Mirb.) Franco) stand resulted in some reduction in volume growth and moderate gains in diameter growth. Growth was strongly related to level of growing stock. Desirable density levels are recommended for young Douglas-fir stands.

KEYWORDS: Growing stock (-increment/yield, increment -)growing stock management, stand density, thinnings, Douglas-fir, *Pseudotsuga menziesii*, southwest Oregon, Oregon (southwest), series—Douglas-fir LOGS.

Research Summary

Results of the Stampede Creek LOGS study in southwest Oregon are summarized through the first treatment period. Results are compared with those from two more-advanced LOGS studies and, in general, are similar. To age 43, thinning in this low site III Douglas-fir *(Pseudotsuga menziesii)* (Mirb.) Franco) stand resulted in some reduction in volume growth and moderate gains in diameter growth. Gains from thinning would be minor if this stand were harvested now, but the comparisons indicate a much more favorable evaluation of thinning when rotations are longer or stands are on higher sites. Growth was strongly related to growing stock level, and there is little indication of any plateau of constant growth over a range of stocking in young stands. Recommendations are made for desirable density levels in young Douglas-fir stands.

Contents

Introduction

The Stampede Creek levels-of-growing-stock (LOGS) study is one of nine thinning studies established in young, even-aged Douglas-fir *(Pseudotsuga menziesii* (Mirb.) Franco) stands according to a common work plan (Williamson and Staebler 1971) (see appendix 1 in this report). These studies are a regional cooperative effort involving Weyerhaeuser Company, Oregon State University, Washington Department of Natural Resources, Canadian Forestry Service, and the USDA Forest Service. The objective is to compare tree and stand development under eight thinning regimes, begun before the onset of severe competition between trees. When the study was established, trees in all areas generally had live branches down to breast height, but other stand characteristics varied considerably among areas.

The Stampede Creek stand is located on the Tiller Ranger District, Umpqua National Forest, near Tiller in southwest Oregon (fig. 1). It is of natural origin after wildfire. When the study was established in 1968, the stand was older (33 years) and taller than other LOGS stands were at the time of study establishment. The ages of dominant and codominant trees varied from 29 to 36 years. Elevation is 2,700 feet. Soils are heavy loam over heavy clay loam and clay derived from well-weathered volcanic tuffs and breccias. Average (1972-78) growing season (May-September) temperature and precipitation are 54.9 °F and 7.71 inches. Based on the 1978 measurement, estimated average site index (based on crop tree heights) is about 100 in King's (1966) system (50 years at breast height), and 120 according to McArdle and others (1961) at 100 years total age.

The Stampede Creek study, like the other LOGS studies, is a completely randomized experiment comparing eight thinning regimes, with three replications each, plus control. An initial "calibration" thinning at age 33 reduced all treated plots to a common basal area level (table 1). Subsequent thinnings retain varying percentages of gross periodic increment observed on the untreated control plots (inside front cover) and are expected to produce the basal area trends shown schematically in figure 2. The thinning interval is the time required for crop trees to grow 10 feet in height (averaged over all treatments). The principal features of the general LOGS plan are reproduced in appendix 1, and they are more fully described by Williamson and Staebler (1971).

The Stampede Creek study has completed only the calibration (ages 33-38) and first treatment (ages 38-43) growth periods. This report presents some interim results of the Stampede Creek study as of the end of the first treatment period and updates a previous report (Williamson 1976). Early results from this and similar studies can provide some information on desirable levels of growing stock for intensively managed young stands. Early results from the Stampede Creek study are of particular interest in connection with the FIR program,[1] because this is the only LOGS study located in southwest Oregon.

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[1]Funding for preparation of LOGS Report 7 was provided by the FIR (Forestry Intensified Research) program for southwestern Oregon, administered by Oregon State University and the Pacific Northwest Forest and Range Experiment Station.

Figure 1.—Triangles indicate locations of the nine levels-of-growing-stock studies in coastal Douglas-fir.

Table 1—Stand values after the calibration thinning for the Stampede Creek, Iron Creek, and Hoskins LOGS studies

Study area and year established	Estimated site index at index age (years): 50, 1/ breast height	100, 2/ total	Age: Breast height	Total	Average height of crop trees	Quadratic mean d.b.h.: Control	Thinned	Number of trees, all species: Control	Thinned	Basal area: Control	Thinned
	- - - Feet - - -		Years		Feet	- - -Inches - -		- Per acre -		Square feet per acre	
Stampede Creek, 1968	100	120	25	33	56	4.7	6.6	995	290	118.5	68.1
Iron Creek, 1966	127	150	12	19	36	3.7	5.0	1,125	335	82.0	47.4
Hoskins, 1963	130	160	13	20	36	3.8	5.2	1,727	345	113.8	49.8

1/King (1966).
2/McArdle and others (1961).

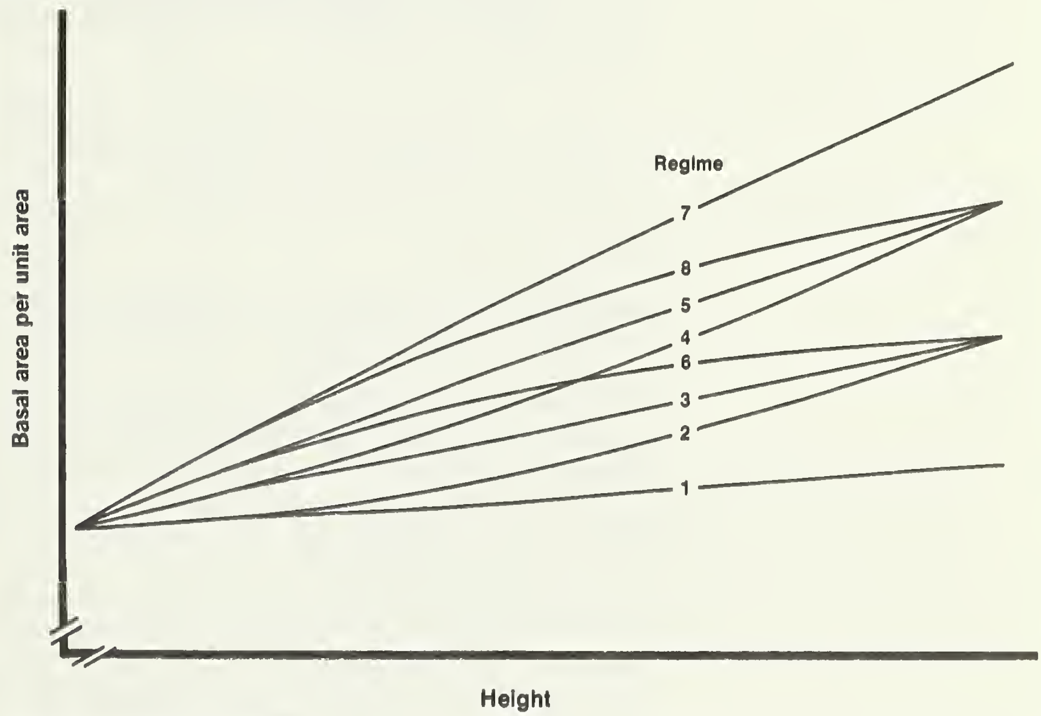


Figure 2.—Levels-of-growing-stock study in Douglas-fir: idealized trends of basal area for the eight thinning regimes.

This report also makes some comparisons with results from two other LOGS studies, Iron Creek (Williamson 1976) and Hoskins (Berg and Bell 1979). The Iron Creek and Hoskins studies are on higher sites and differ in some other respects (table 1). Because Iron Creek and Hoskins are now further advanced in the planned treatment sequence, comparisons may provide some indications of consistency of results at different locations and of the probable applicability of results from other LOGS studies to stands of the Pacific Douglas-fir type (Williamson 1980) in southwest Oregon.

Objectives

The objectives of this report are to:

1. Present revised data summaries showing development of the Stampede Creek LOGS stands through age 43 (end of the first treatment period). These tables incorporate the most recent measurement and replace the tables published by Williamson in 1976.

2. Compare results from the Stampede Creek LOGS study with the Iron Creek and Hoskins studies for: (a) relationship of growth to growing stock, (b) growth of crop trees versus growth of all trees, (c) growth by treatment groups, and (d) effects of treatments on tree size and merchantable volumes.

3. Compare consistency of results at Stampede Creek, Iron Creek, and Hoskins LOGS studies for (a) initial stand densities, (b) growth of thinned stands relative to growth of controls, (c) relationship of growth to growing stock for all available periods and for the period at each area when initial heights of crop trees averaged about 65 feet, and (d) gross yields relative to stand age and to average height of crop trees.

4. Examine the possibility that results at Iron Creek and Hoskins are indicative of probable future development of the Stampede Creek study.

Data Summarization

Volume and increment statistics discussed in this report were obtained by the following procedures:

1. Diameters (to the nearest 0.1 inch) at breast height were measured on all trees 1.6 inches in d.b.h. (diameter at breast height) and larger on each plot.

2. Total height (to the nearest foot) was measured on a sample of at least 15 randomly chosen trees per plot, distributed throughout the diameter range, with two-thirds of the sample trees larger than the stand quadratic mean diameter.

3. Total volume, inside bark, was calculated for each sample tree by the Bruce and DeMars (1974) volume equation.

4. Total cubic volume of every tree on each plot was calculated, using a regression logarithm of volume on logarithm of diameter at breast height fit to the sample tree measurements for that plot and measurement date. Plot volume was then calculated as the summation of tree volumes.

5. Periodic gross growth in total cubic volume was calculated as the difference between live volumes at start and end of the growth period, plus mortality and ingrowth.

Data compilations for all three study areas were done with a common set of computer programs. Complete summaries are given for all available periods for Stampede Creek (tables 5 to 10 in appendix 2 and 16 to 33 in appendix 3). Data for the Hoskins study are from Berg and Bell (1979), plus unpublished data for the 1975-79 period provided by John Bell of Oregon State University. Pertinent values for Iron Creek are given in tables 11 to 15 (appendix 2), including previously unpublished data for the 1973-77 and 1977-80 periods.

Results—Stampede Creek

Calibration Period

All trees.—Prethinning numbers of trees and basal areas were about 83 percent of normal for the stand diameter (table 25 in McArdle and others 1961). This suggests relatively low competition and incomplete site utilization at younger ages and is consistent with the observation that live crowns extended nearly to breast height at the time of study establishment.

Gross volume growth of thinned plots was 80 percent of that of control plots (table 2) even though the mean volume in cubic feet was only 66 percent of the volume of the controls. Average growth percent (based on mean growing stock for the period) of thinned plots was 10.0, compared with 8.3 for controls.[2] Growth per unit of growing stock volume on the thinned plots was about 20 percent (10.0/8.3) higher than on the control plots.

Table 2—Stampede Creek: periodic annual gross volume growth, growing stock, growth percent, and initial volume per tree for crop trees, noncrop trees, and all trees, ages 33-38, calibration period

Component and treatment	Gross growth per year	Mean growing stock	Growth percent 1/	Initial volume per tree	Ratio, thinned:control — Gross growth	Ratio, thinned:control — Growing stock	Ratio, thinned:control — Growth percent
	Cubic feet per acre	Cubic feet per acre	Percent	Cubic feet			
Crop trees:					1.12	.99	1.13
Thinned	104	1,011	10.28	9.40			
Control	93	1,022	9.10	9.88			
Noncrop trees:					.60	.48	1.24
Thinned	92	937	9.77	3.45			
Control	153	1,934	7.91	1.71			
All trees:					.80	.66	1.21
Thinned	196	1,948	10.04	5.08			
Control	246	2,956	8.32	2.36			

1/Calculated as percentage of mean growing stock for the period.

Crop trees.—Crop trees had been chosen on the basis of spacing, dominance, and vigor, as trees expected to be retained in subsequent thinnings. Crop trees in thinned plots grew 12 percent more than those in control plots, though later discussion suggests that some of this improvement was due to a slight edge in beginning volume for control trees (table 2). Average growth percent of crop trees for thinned plots was 10.3 compared with 9.1 for controls (table 2). This suggests a 13-percent (10.3/9.1) improvement in growth per unit of growing stock volume because of thinning.

First Treatment Period

All trees.—Average gross growth on the thinned plots during this period was 80 percent of gross growth on the control plots, whereas growth per unit of growing stock volume was about 28 percent higher on the thinned plots than on the controls (table 3).

[2]Growth percents used in this report were calculated as:

$$\frac{100(\text{periodic annual increment in } X)}{(X_1 + X_2)/2},$$

where: X_1 and X_2 are values of the variable at start and end of the growth period. This expresses current rate of change in X in relation to mean value of X for the period, rather than the initial value of X used in previous LOGS reports. The change in method of computation was made to facilitate comparisons among different installations.

Table 3—Stampede Creek: periodic annual gross volume growth, growing stock, growth percent, and initial volume per tree for crop trees, noncrop trees, and all trees, ages 33-38, by treatment group, 1st treatment period

Component and treatment	Gross growth per year	Mean growing stock	Growth percent 1/	Initial volume per tree	Ratio, thinned:control	
					Gross growth	Growth percent
	Cubic feet per acre		Percent	Cubic feet		
Crop trees:					1.14	1.09
1 and 2	140	1,612	8.7	15.8		
3 and 4	132	1,534	8.6	15.0		
5 and 6	136	1,612	8.4	15.9		
7 and 8	135	1,687	8.0	16.9		
Control	119	1,551	7.7	15.7		
Noncrop trees:					.56	1.42
1 and 2	68	755	9.0	5.3		
3 and 4	94	1,044	9.0	6.7		
5 and 6	103	1,117	9.2	4.9		
7 and 8	106	1,331	8.0	6.4		
Control	166	2,680	6.2	2.5		
All trees:					.80	1.28
1 and 2	208	2,367	8.8	9.7		
3 and 4	226	2,578	8.8	10.0		
5 and 6	238	2,729	8.7	8.4		
7 and 8	241	3,018	8.0	9.8		
Control	285	4,231	6.7	3.5		

1/Calculated as percentage of mean growing stock for the period.

The treatments combined in table 3 were identical for the first treatment period (see treatment schedule on inside front cover); during this period, there are effectively four thinning treatments, plus control. Differences in gross growth among these four treatment groups for the first treatment period were (barely) significant at the 0.10 level; treatment means of gross growth increased from treatments 1 and 2 through 7 and 8.

Gross growth of control plots during this period (table 3) was roughly equivalent to normal yield table estimates for midsite III (Curtis 1967, Curtis and others 1982, Staebler 1955).

When gross volume growth per year is plotted over periodic average growing stock (fig. 3), a positive slope is evident. If only the thinned plots are considered, the relationship approximates a straight line through the origin.

In figure 4 we have chosen to fit the data, including the controls, with the equation $Y = bX - cX^2$ because:

1. This meets the logical requirements that zero stocking should produce zero growth and that growth cannot increase indefinitely as stocking increases.

2. This is the equation of best fit (minimum standard error of estimate) when the control plots are included, and the curves with and without the control plots are almost the same.

3. This is the curve form found best in concurrent work with the Iron Creek and Hoskins data.

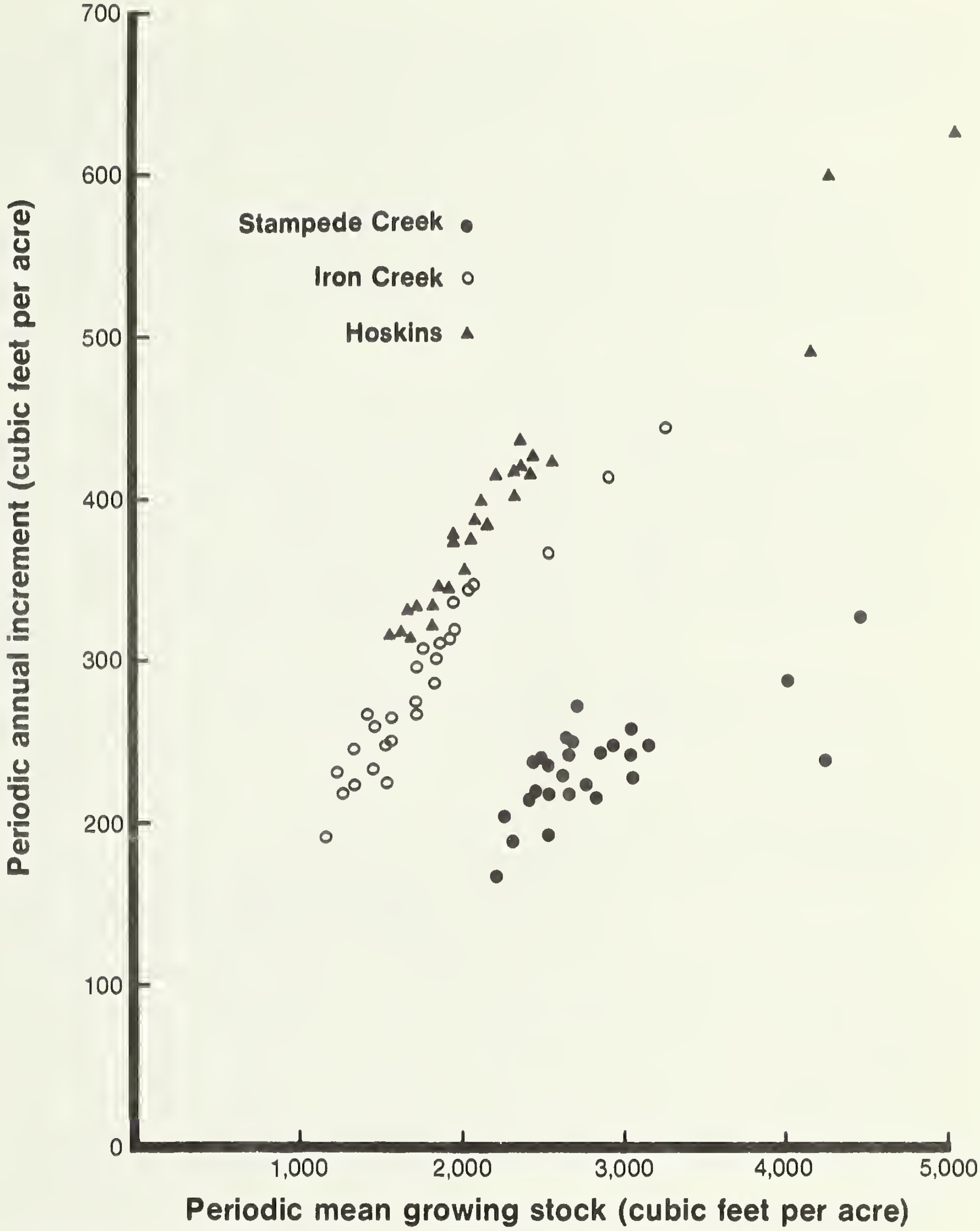


Figure 3.—Stampede Creek, Iron Creek, and Hoskins: periodic annual gross volume increment (trees 1.6 inches in d.b.h. and larger) in relation to volume of growing stock, first treatment period.

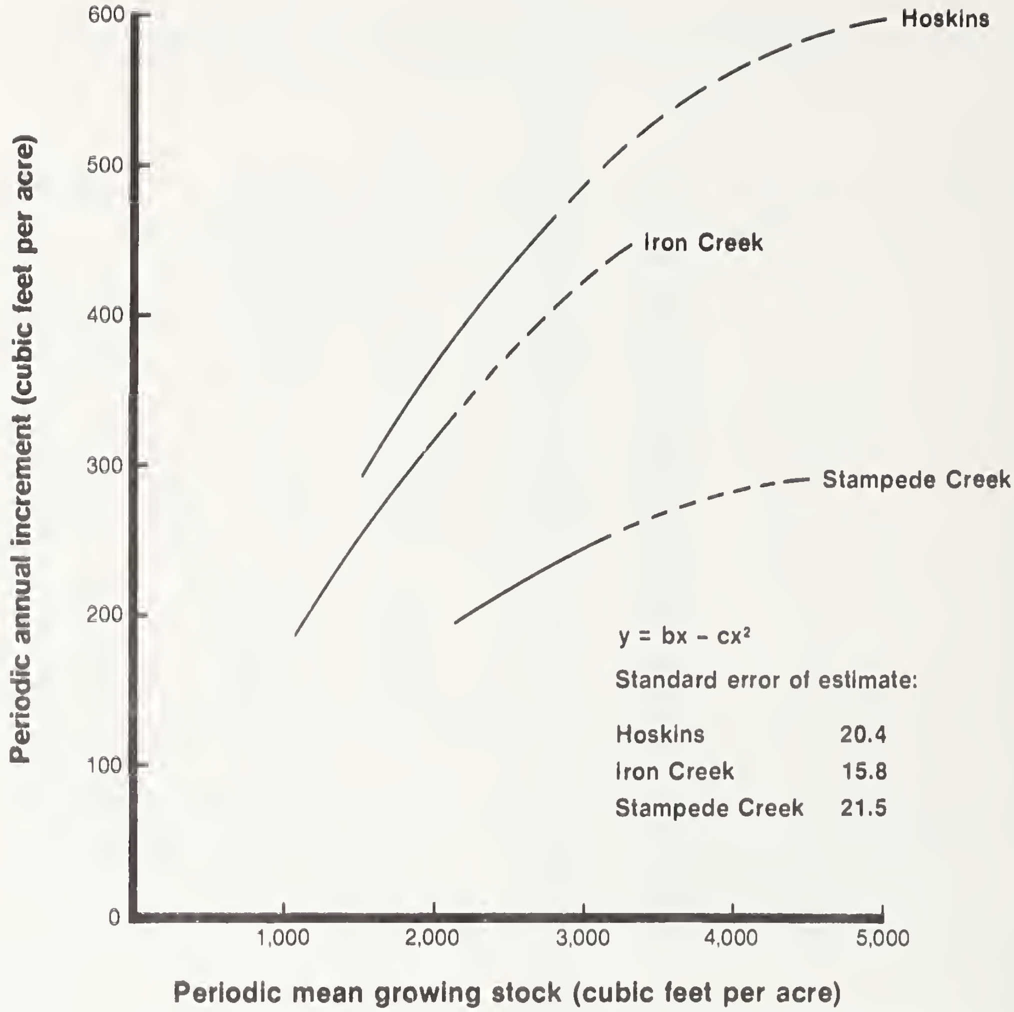


Figure 4.—Stampede Creek, Iron Creek, and Hoskins: regressions expressing periodic annual gross volume increment (trees 1.6 inches in d.b.h. and larger) as a function of volume of growing stock, first treatment period. Solid portions of curves represent range of thinned plot data; dashed portions include range of control plots.

Variability about the regression was greater and the curve was less clearly defined than for the comparable period at Iron Creek and Hoskins (fig. 3). This could be related to the initially greater height and less homogeneous stand conditions at Stampede Creek than at the other two areas.

Crop trees.—Gross volume growth percent for crop trees in treatments 1 and 2 was 8.7 percent compared with 7.7 percent for controls. Inspection of growth percents by treatment groups suggests a trend of decreasing growth percents with increase in growing stock, although differences were not statistically significant (table 3).

Growth percents for crop trees in all thinning treatments (except 7 and 8) were slightly less than those for noncrop trees, probably reflecting the greater average size of crop trees. Since tree size affects growth percent, a more meaningful comparison is that of crop trees and all trees at the times their average dimensions were similar. Average heights and diameters were comparable for crop trees at the start of the calibration period and for all trees at the start of the first treatment period. For comparable tree size, growth percents of crop trees exceeded those of all trees. This suggests that the smaller trees (in these thinned stands, codominants) grew less efficiently than the larger trees.

A similar result has been obtained in an older stand (Williamson 1982). Both growth efficiency and stand security considerations indicate that larger trees should be favored.

Cubic volume yields to age 42.—Tables 16 to 33 in appendix 3 illustrate the yields obtained at Stampede Creek by tree diameter at breast height, both separately and cumulatively, from largest diameter to smallest for each of the eight thinning treatments and the unthinned control.

Figure 5 shows cumulative cubic volume production in trees larger than 7.6, 9.6, and 11.6 inches for eight thinning treatments and the control. At age 43, after 10 years of thinning, average cumulative yield of the thinned plots in trees 7.6 inches and larger is 86 percent of that of the control plots. Cumulative yield of thinned plots in trees 9.6 inches and larger is about the same as that of the controls, whereas yield in trees 11.6 inches and larger is 140 percent of that of the controls. At age 43, average diameters range from 6.1 inches for the controls to 10.4 inches for treatment 1.

This stand was of natural origin, somewhat uneven aged, with considerable crown differentiation. To age 43, thinning has produced no gains in usable fiber production, if all trees 7.6 inches and larger are assumed to be merchantable. All thinning treatments exceed the controls in volumes of trees over 11.6 inches, however, and the effects of thinning in increasing tree size and value should become more evident with advancing age.

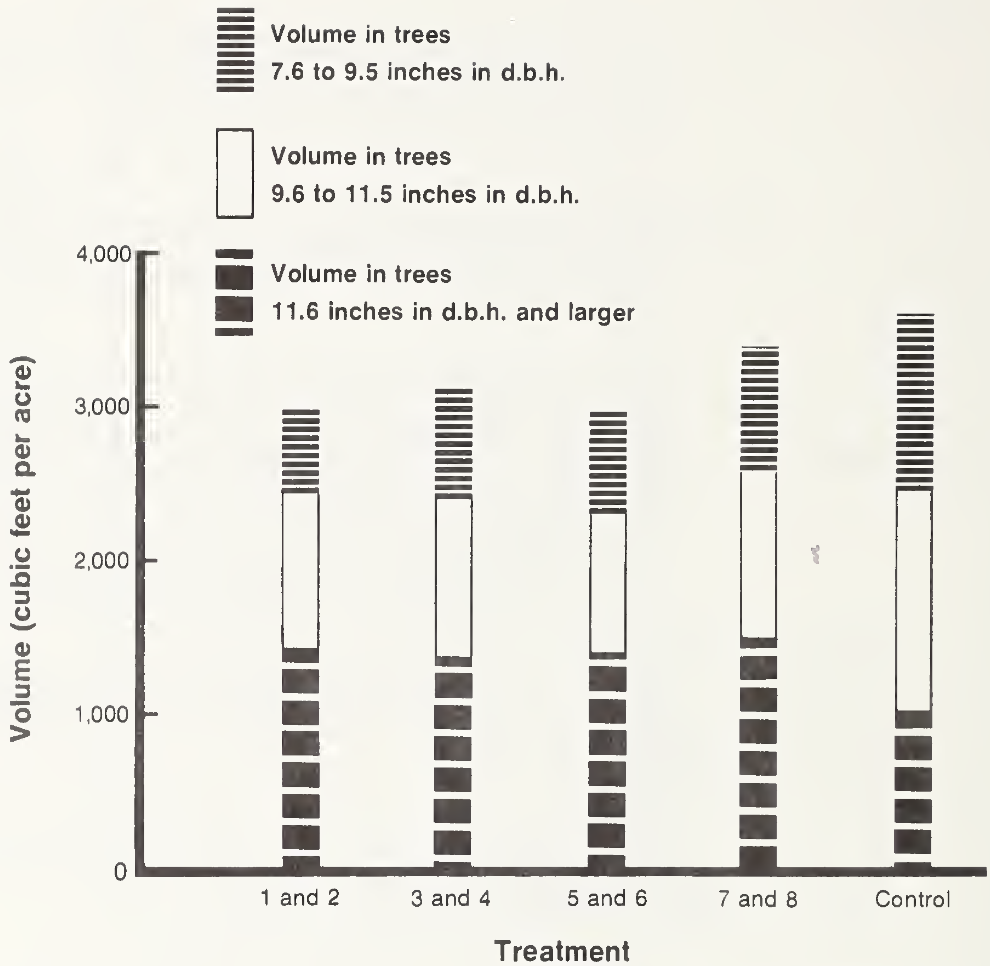


Figure 5.—Stampede Creek: cumulative volume production for trees 11.6 inches in d.b.h. and larger and for trees 9.6 to 11.5 and 7.6 to 9.5 inches in d.b.h. at end of first treatment period (age 43). Volumes are for live stand at age 43, plus trees cut in thinning (calibration cut excluded).

Results—Comparisons With Iron Creek and Hoskins

Initial Stand Conditions

The Iron Creek and Hoskins study areas were initially similar in stand characteristics, except for a much greater number of trees at Hoskins. Although Iron Creek and Hoskins controls started with the same average crop tree height and a considerable difference in number of trees, initial average diameters were almost identical; evidently, initial competition was low. The Stampede Creek stand was older and considerably taller at the time of establishment than were the Iron Creek and Hoskins stands (table 1). Iron Creek was a plantation with considerable natural fill-in. Hoskins was an unusually uniform natural stand. Stampede Creek was a natural stand with considerably more variation in tree ages and sizes.

A relative density scale useful in comparisons is provided by a measure (Curtis 1982) defined as:

$$RD = (\text{basal area})/(Dg)^{1/2};$$

where: Dg is quadratic mean diameter, and the units are square feet per acre for basal area and inches for diameter. This measure is similar to Reineke's (1933) Stand Density Index but more convenient to use. Dividing RD values by 65 gives a close approximation to normality ratio according to table 25 in McArdle and others (1961).

Values of RD for the control plots at the time of the calibration thinning were:

Stampede Creek	55
Iron Creek	43
Hoskins	71

The common study plan for the regional cooperative LOGS studies assumed that the spacing equation used to guide the calibration thinning would provide equal levels of competition among installations that differ in initial average diameter and would thereby facilitate comparisons between areas. Average RD values for the thinned plots at the end of the calibration period were 34, 32, and 33 at ages 38, 23. and 23 for Stampede Creek, Iron Creek, and Hoskins. This goal was accomplished.

Subsequent to the calibration period, the Hoskins control plots have developed and maintained extremely high densities. At the end of the first treatment period, RD values for these plots were 74, 74, and 95 for Stampede Creek, Iron Creek, and Hoskins. Increases since the calibration thinning were consistent with site, age, and initial stocking. The Hoskins control had 37 percent more basal area and 54 percent more volume than the Iron Creek control. Since then, Hoskins has stabilized at RD's just below 100. The Iron Creek control was at RD 92 at age 33 and appears to be approaching the RD of the Hoskins control as initial differences in density are reduced through greater natural mortality at Hoskins.

Growth Relative to Control Plot Growth

Calibration period.—For the calibration period, the ratios of gross volume growth of thinned plots to growth of control plots follow a logical order for the three studies (table 4). Stampede Creek has the largest ratio (0.80), perhaps because of greater average height and slightly higher relative density. Hoskins is lowest (0.61), probably because the much greater initial density resulted in greater growth of the control and in a heavier calibration thinning.

First treatment period.—A similar comparison (fig. 6) for the first treatment period shows that differences among thinning treatments in gross volume increment as percents of control plot growth were much more pronounced for Iron Creek and Hoskins (which behaved similarly) than for Stampede Creek. The reason for this difference in response is not clear; it may be associated with the later start of thinning (both in years and in attained stand height) at Stampede Creek.

Table 4—Periodic annual net growth in quadratic mean diameter, and gross growth in basal area and total cubic volume during the calibration period—Stampede Creek, Iron Creek, and Hoskins studies

Study and treatment	Total age	Net growth in quadratic mean diameter	Gross growth in basal area	Gross growth in total volume	Ratio, thinned:control	
					Gross volume growth	Net diameter growth
	Years	Inch	Square feet per acre	Cubic feet per acre		
Stampede Creek:	33-38				0.80	2.89
Control		0.09	7.0	246		
Thinned		.26	5.8	196		
Iron Creek:	19-23				.72	2.16
Control		.19	12.1	306		
Thinned		.41	9.0	219		
Hoskins:	20-23				.61	2.62
Control		.21	16.2	469		
Thinned		.55	12.3	285		

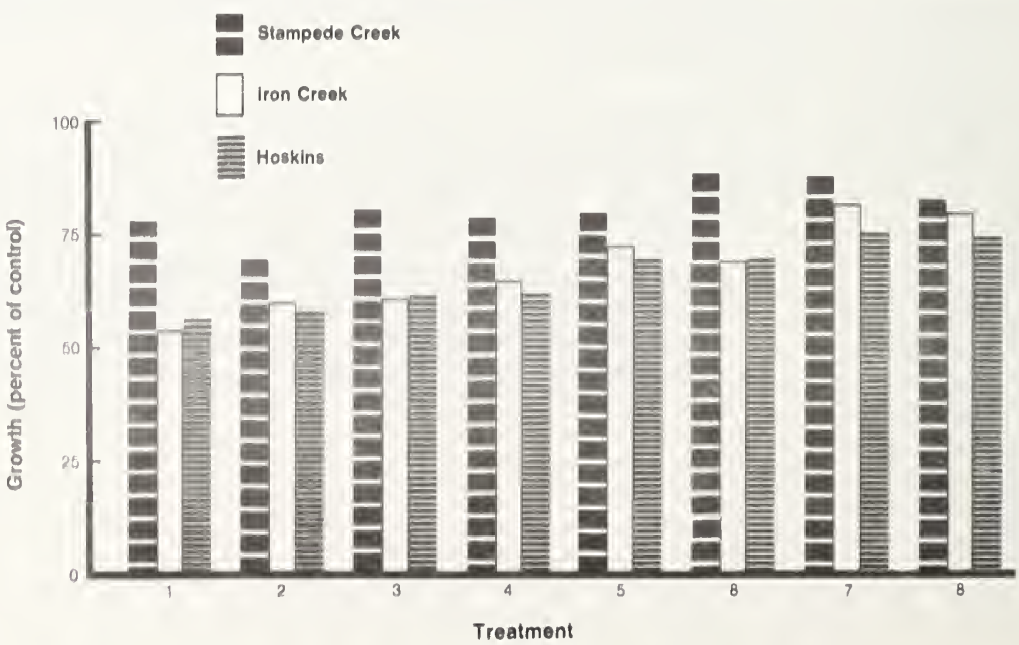


Figure 6—Stampede Creek, Iron Creek, and Hoskins: gross cubic volume growth (trees 1.6 inches in d.b.h. and larger) by treatments, expressed as percentages of growth of control, first treatment period.

Growth:Growing Stock Relationships

Curves of periodic annual increment in gross volume over mean volume by periods (fig. 4) indicate much lower gross growth rates for given levels of growing stock at Stampede Creek than at the other two areas. Conversely, results for Iron Creek and Hoskins are much closer (figs. 4, 7, and 8). The lesser growth:growing stock ratios at Stampede Creek reflect its greater age and lower site index.

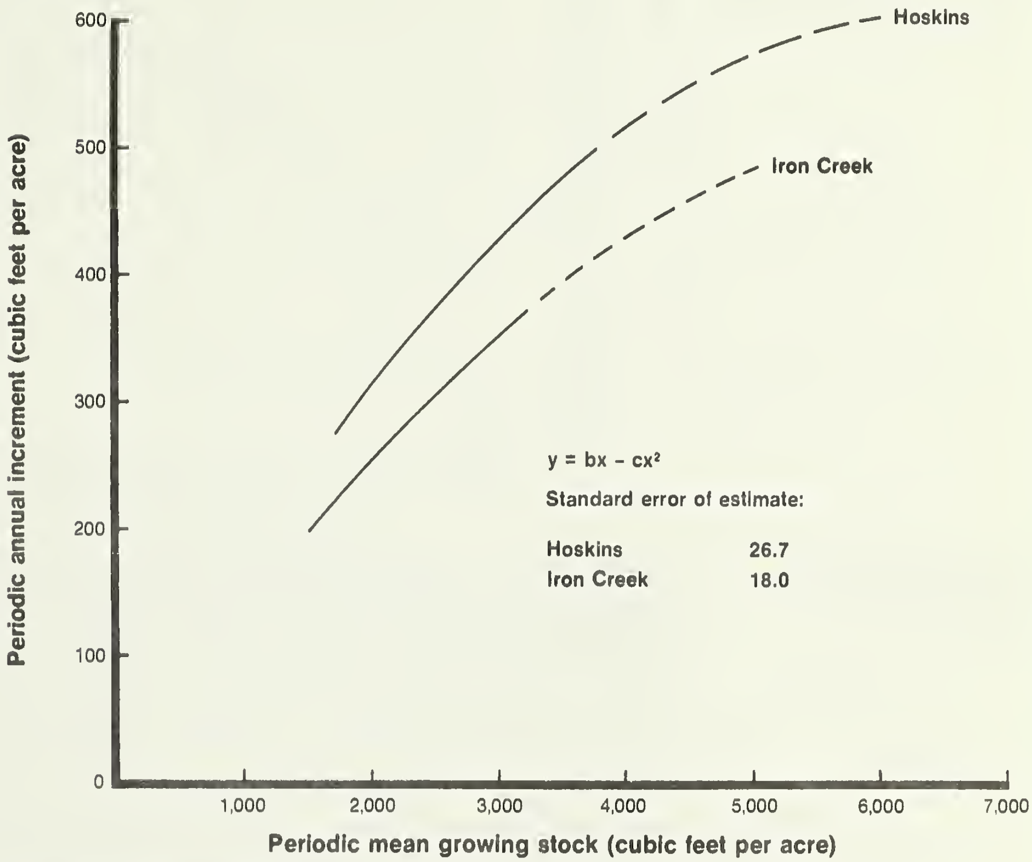
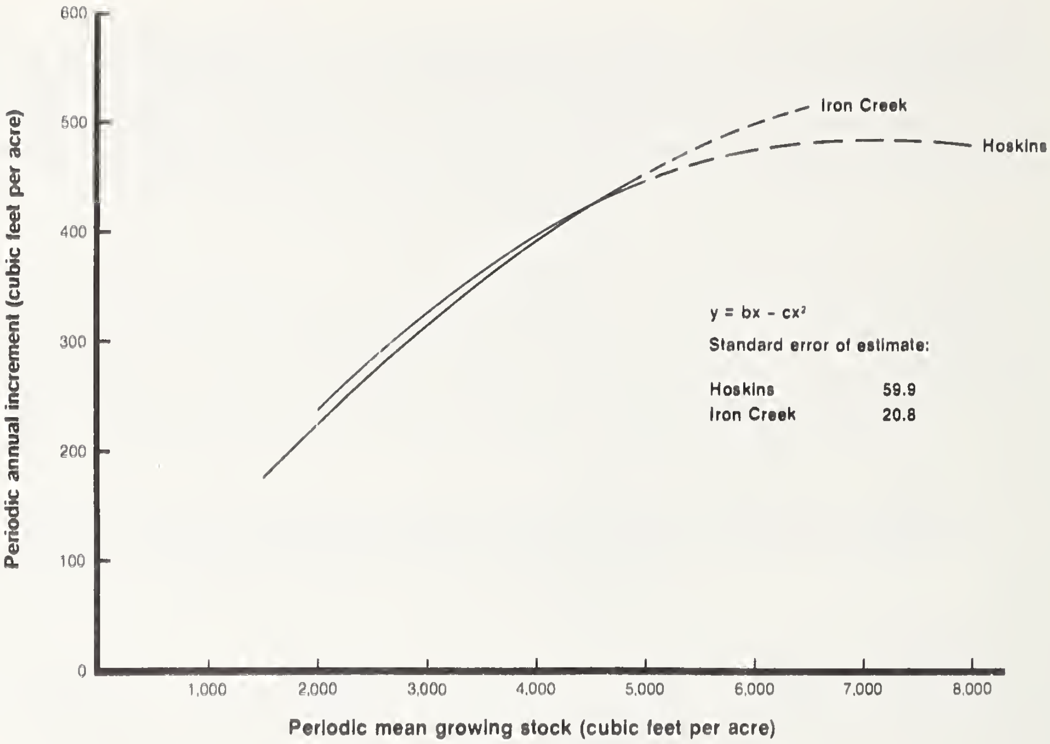


Figure 7.—Iron Creek and Hoskins: regressions expressing periodic annual gross volume increment (trees 1.6 inches in d.b.h. and larger) as a function of volume of growing stock, second treatment period. Solid portions of curves represent range of thinned plot data; dashed portions include range of control plots.

Figure 8.—Iron Creek and Hoskins: regressions expressing periodic annual gross volume increment (trees 1.6 inches in d.b.h. and larger) as a function of volume of growing stock, third treatment period. Solid portions of curves represent range of thinned plot data; dashed portions include range of control plots.



Gross Yields Relative to Stand Age

Relationships of gross yields to stand age (fig. 9) correspond to those expected according to age, site index, and initial stocking. Iron Creek is not illustrated because trends there were similar to those at Hoskins. Stampede Creek has substantially lower site index than the other two areas; thus, slopes of the yield curves are less. Though initial volume at Stampede Creek was about the same as that at Hoskins, Stampede Creek was 13 years older when the study was established.

Though well into the planned thinning regimes, with 40 to 50 feet of height growth since the calibration thinning, both Iron Creek and Hoskins are still in a period of growth acceleration for the control and most treatments, as shown by the upward curvature of these yield curves (fig. 9).

Gross Yields Relative to Stand Height

Cumulative yields by treatments in gross cubic feet per acre for Hoskins and Stampede Creek are shown plotted over average height of crop trees in figure 10. (Curves for Iron Creek were similar to those for Hoskins and are not shown.) Mortality has been negligible at these two areas, except on the Hoskins control plots where about 12 percent of gross production was lost to mortality. The wide spread in cumulative yields among the Hoskins thinning treatments corresponds to the relationship of growth to growing stock shown in figures 6 to 8.

Figure 9.—Hoskins and Stampede Creek: cumulative gross yield (trees 1.6 inches in d.b.h. and larger, calibration cut excluded) in relation to stand age, for controls and for thinning treatments 1, 3, 5, and 7. Net yield is shown for Hoskins control only.

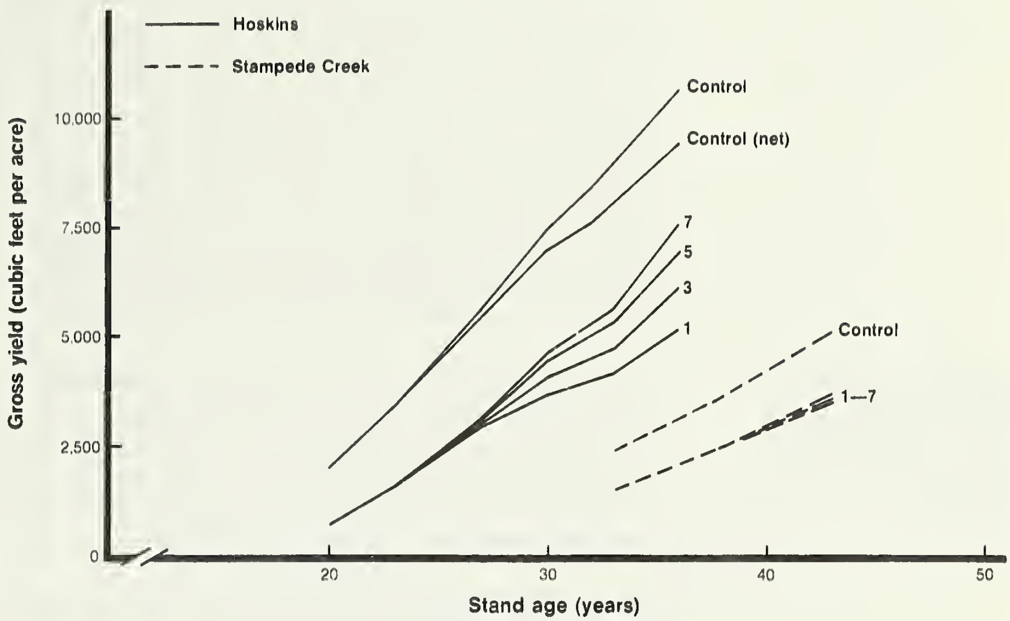
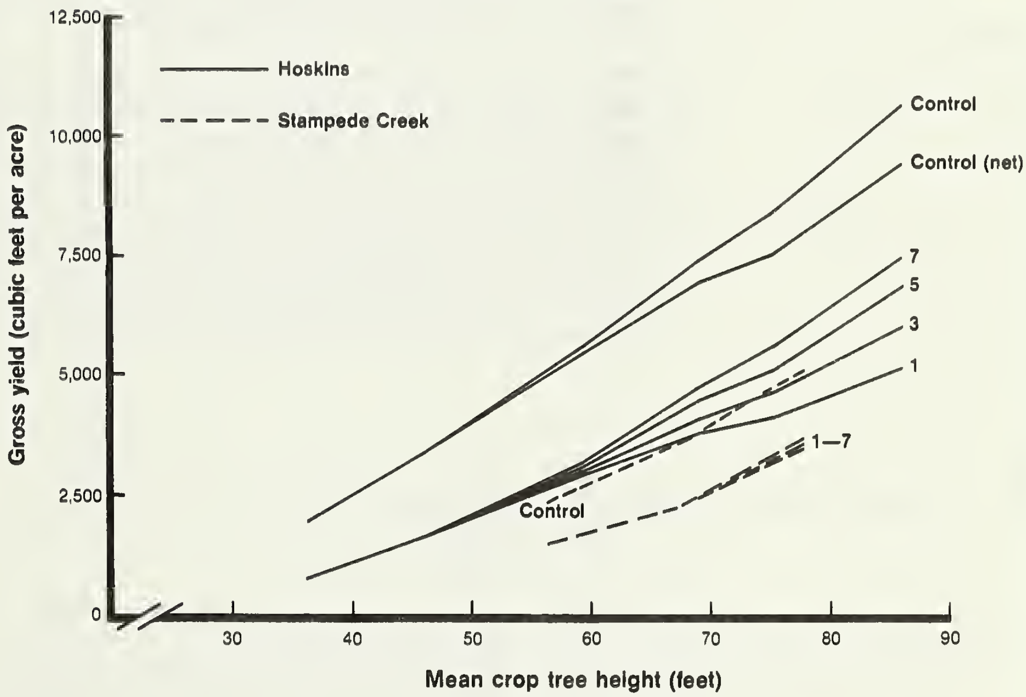


Figure 10.—Hoskins and Stampede Creek: cumulative gross yield (trees 1.6 inches in d.b.h. and larger, calibration cut excluded) in relation to mean height of crop trees, for controls and for thinning treatments 1, 3, 5, and 7. Net yield is shown for Hoskins control only.



If the curve for the Stampede Creek control were extrapolated back to a height of 36 feet, it would be close to the curve at that height for the Hoskins thinning treatments and would suggest initial low density. This initial similarity in volume of the Stampede Creek control and the Hoskins thinned plots is associated with differences in the diameter distributions at the two locations. The diameter distribution for the stand at Stampede Creek at the start of the first treatment period was somewhat J-shaped, with a large number of trees in the smallest size classes. Though ranges in diameter were similar, Stampede Creek had many more trees in the smallest size classes (fig. 11). This suggests a somewhat greater range in tree ages at Stampede Creek, with greater initial crown differentiation. Such stands are common in the South Umpqua drainage.

Comparison of Volume Growth Per Unit of Height Growth Relative to Average Growing Stock for Stands 65 Feet in Height

It seems reasonable to compare growth at Stampede Creek during its first treatment period with growth at Hoskins and Iron Creek when the latter stands were of similar height (third treatment period). Volume growth should be closely related to initial height and to periodic height increment (Evert 1964), and comparisons of growth per unit of height growth are one way of removing effects of age and site differences.

Since periodic height increments were not identical nor exactly 10 feet, volume growth was expressed as gross cubic volume growth per foot of height increment for the period, when stands were about 65 feet tall at the start of the period.

Graphical comparisons of the results indicate, as expected, general similarity among installations (fig. 12). Stampede Creek appeared to have slightly more volume growth per foot of height growth, for a given initial volume. It also had slightly higher values of relative density, presumably reflecting its different structure and earlier stage in the thinning regime. These data suggest no density type III (fig. 13) as postulated by Langsaeter (Braathe 1957), and the Hoskins controls are very dense. Such a density type has been suggested for older stands (Williamson and Price 1971, Williamson 1982), and it may be that the hypothesis is more appropriately applied to older stands past the period of rapid height growth.

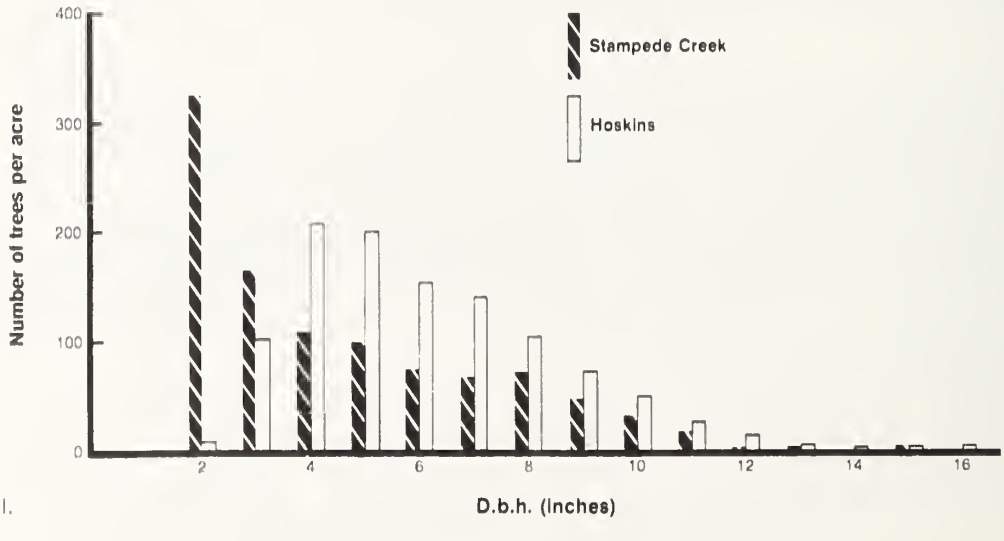


Figure 11.—Diameter distributions of control for Stampede Creek at start of first treatment period and for Hoskins at start of third treatment period, when both stands were about 65 feet tall.

Figure 12.—Stampede Creek, Iron Creek, and Hoskins: volume growth per foot of crop tree height growth in relation to volume of growing stock, when stands were about 65 feet tall.

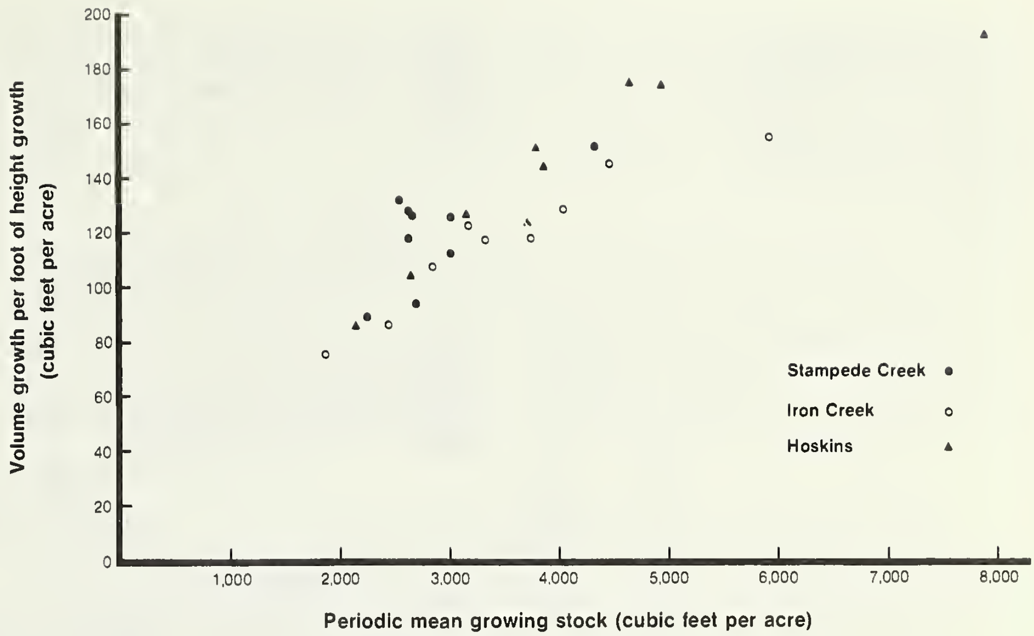
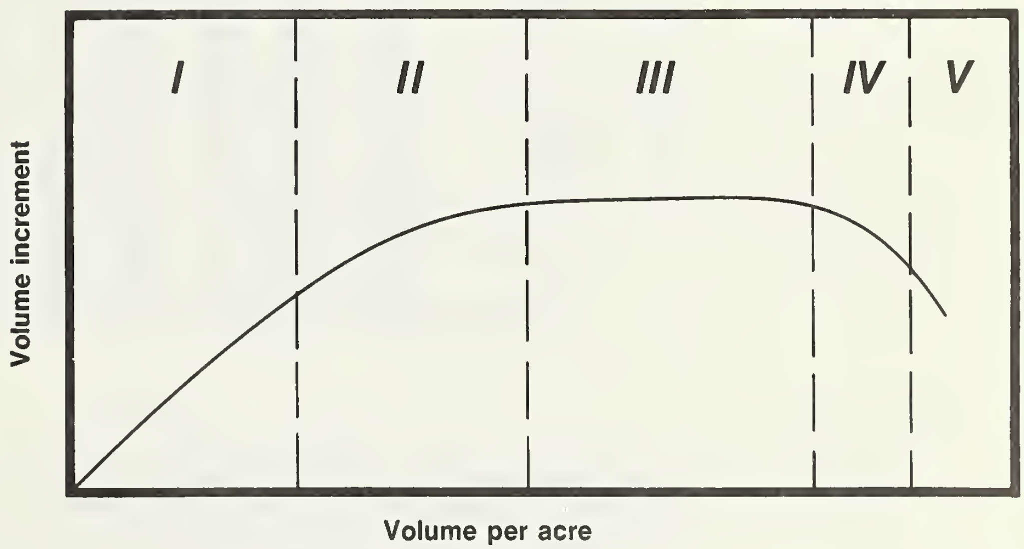


Figure 13.—Relation between standing volume and volume increment, as hypothesized by Langsaeter (prepared from Braathe 1957). Roman numerals denote Langsaeter's "density types."

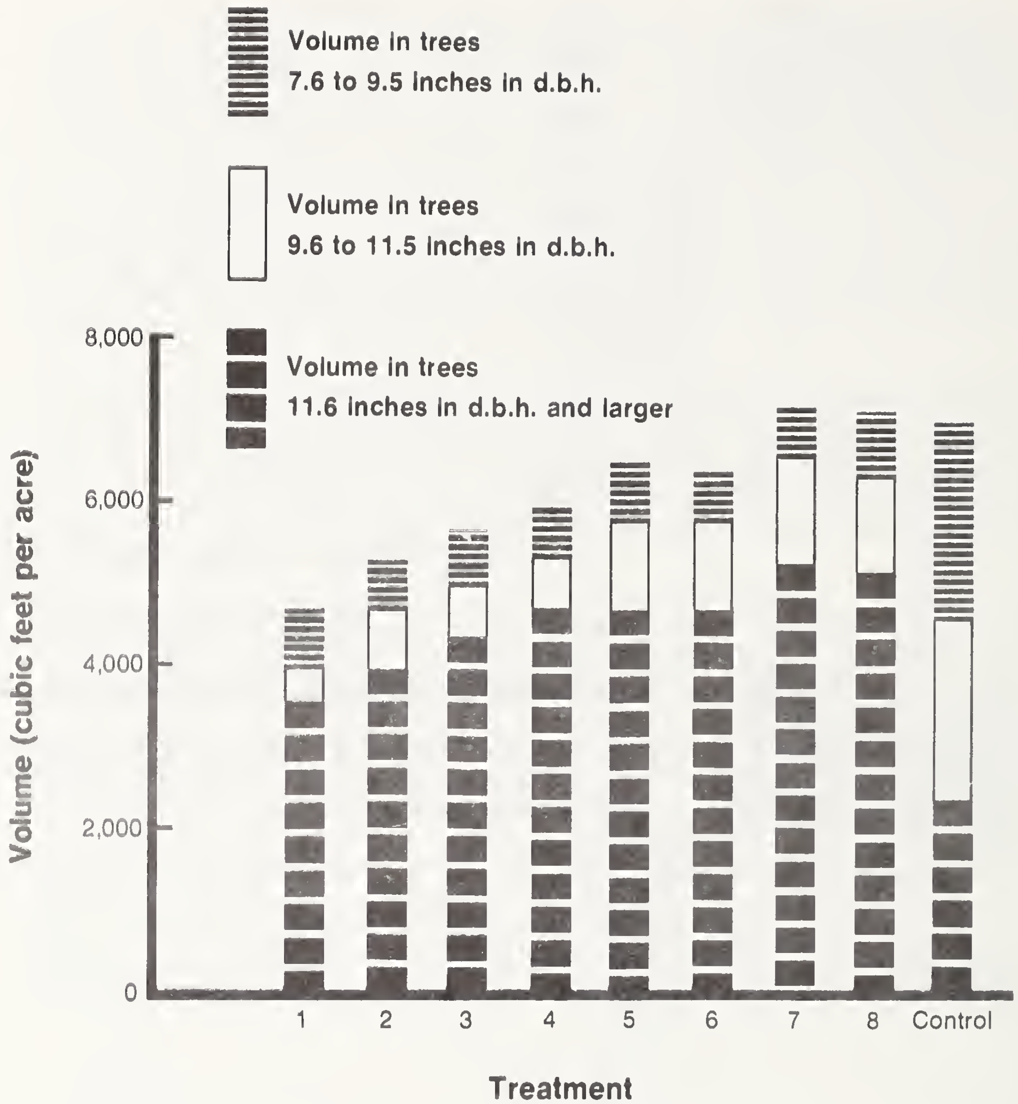


Cumulative Net Production by Size Classes

Figure 14 shows cumulative yields in total volume of trees, 7.6 inches and larger, 9.6 inches and larger, and 11.6 inches and larger, at the end of the fourth treatment period in the Hoskins study. At that time, average crop tree height was 86 feet, with 50 feet of elapsed height growth since the calibration thinning.

Total production in trees 7.6 inches and larger was less on the thinned treatments than on the control, in trees 9.6 inches and larger it was about the same, and in trees 11.6 inches and larger it was roughly twice as much on the thinned treatments as on the control. Any economic evaluation depends on the premium for large size trees and on the choice of harvest age. Differences can be expected to continue to increase as stand age increases.

Figure 14.—Hoskins: cumulative volume production for trees 11.6 inches in d.b.h. and larger and for trees 9.6 to 11.5 and 7.6 to 9.5 inches in d.b.h. at end of fourth treatment period (age 37), plus trees removed in thinnings (calibration cut excluded).



The 16 years of record on the Hoskins plots are probably a good indication of what can be expected in the future from the other studies, although the lesser initial density and less uniform nature of the Stampede Creek control may reduce the differences between thinned treatments and the control at Stampede Creek.

Discussion

Early results show that Stampede Creek differs somewhat from Iron Creek and Hoskins in the relationship of growth to growing stock and of growth of thinned stand to growth of control. Possible causes include: (1) differences in initial stand structure and stand homogeneity, (2) the later start of thinning at Stampede Creek, and (3) the evident differences in site quality and site characteristics.

Because of the later start of thinning at Stampede Creek, the thinning treatments lag behind those at the other studies, in relation to height development. This introduces some differences, but the general pattern of future development will probably be similar. In particular, relationships of growth to growing stock will be similar to those observed at Iron Creek and Hoskins, but at lower levels because of lower site quality.

To age 43, the Stampede Creek thinnings have resulted in some reduction in total production accompanied by moderate gains in diameters. In this stand and similar stands having moderate initial numbers of stems and considerable early crown differentiation, thinning probably is not economically justifiable if the objective is fiber production on very short rotations (for example, 50 years or less for this low site III stand). The large increases in tree diameters attained at Hoskins by the end of the fourth treatment period, however, indicate a different picture for longer rotations or higher sites.

The particular thinning regimes used in the LOGS studies were designed to determine growth to growing stock relationships, rather than operationally optimum regimes. Most managers would make only one precommercial thinning and would probably adopt somewhat longer intervals between commercial thinnings. The principles of growth to growing stock relationships, however, would remain much the same.

At the time the LOGS studies were established, thinking was strongly influenced by the so-called Langsaeter hypothesis (fig. 13). As stated by Braathe (1957, p. 49):

> The roman numerals [in figure 13] denote what Langsaeter called "density types". In density type I the stand is so open that the individual tree exerts no influence on its neighbours, and the annual yield is therefore proportional to the number of trees or the volume of the stand.
>
> Density type II shows a flattening curve for the annual yield; i.e., the trees are beginning to crowd each other increasingly.
>
> The broad band of type III shows an almost horizontal line for the yield curve denoting a rather wide band in which the yield is independent of stand density. Density type IV indicates a rather abrupt change to declining yield, as stand density becomes excessive and leads to declining tree vigor.
>
> This decreasing yield is even more pronounced in density type V, the condition of density where the trees have been so crowded that their resistance to disease and injury has been greatly lowered, and where pronounced stagnation results.

As shown by the growth:growing stock curves, the calibration and first treatment periods in the LOGS studies clearly fall in Langsaeter's zone I, with later thinning periods in zone II. The control plots in the later periods at Iron Creek and Hoskins are close to the maximum possible density, and there is little indication of any broad "plateau" of constant gross volume growth over a wide range of stocking. Thinnings that do much more than anticipate mortality will reduce total growth, with an offsetting gain in tree size and value.

Curves of gross volume periodic annual increment over RD resemble the growth:growing stock curves presented, except that RD provides a scale comparable across all ages. Such curves suggest that Langsaeter's zone II corresponds to RD values of about 30 to 60, and that stands maintained in the range of RD40 to RD55 represent a reasonable compromise between some loss of total volume increment and substantial gains in tree size and stand stability. Once stands reach a stage where thinnings can pay their way, this seems a reasonable stocking goal.

If an RD of 55 is attained when stand average diameter reaches 20 inches, the related basal area would be 246 square feet per acre, corresponding to about 89 percent of normal according to table 25 in McArdle and others (1961). Such a stocking goal seems reasonable for southwest Oregon, or for anywhere else within the Pacific Douglas-fir forest type (Williamson 1980).

Metric Equivalents

1 centimeter = 0.3937 inch
1 meter = 3.2808 feet
1 square meter = 10.7643 square feet
1 cubic meter = 35.3107 cubic feet
1 square meter per hectare = 4.3560 square feet per acre
1 cubic meter per hectare = 14.2918 cubic feet per acre
°C = 0.5556 (°F minus 32)

Literature Cited

Berg, Alan B.; Bell, John F. Levels-of-growing-stock cooperative study on Douglas-fir, report No. 5—the Hoskins study, 1963-1975. Res. Pap. PNW-257. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1979.** 29 p.

Braathe, Peder. Thinnings in even-aged stands. A summary of European literature. Fredericton, NB: University of New Brunswick, Faculty of Forestry; **1957.** 92 p.

Bruce, David; DeMars, Donald J. Volume equations for second-growth Douglas-fir. Res. Note PNW-239. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1974.** 5 p.

Curtis, Robert O. A method of estimation of gross yield of Douglas-fir. For. Sci. Monogr. 13; **1967.** 24 p.

Curtis, Robert O. A simple index of stand density for Douglas-fir. For. Sci. 28: 92-94; **1982.**

Curtis, Robert O.; Clendenen, Gary W.; Reukema, Donald L.; DeMars, Donald J. Yield tables for managed stands of coast Douglas-fir. Gen. Tech. Rep. PNW-135. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1982.** 182 p.

Evert, F. Components of stand volume and its increment. J. For. 62: 810-813; **1964.**

King, James E. Site index curves for Douglas-fir in the Pacific Northwest. Weyerhaeuser For. Pap. 8. Centralia, WA: Forestry Research Center; **1966.** 49 p.

McArdle, Richard E.; Meyer, Walter H.; Bruce, Donald. The yield of Douglas-fir in the Pacific Northwest. Tech. Bull. 201. Washington, DC: U.S. Department of Agriculture; **1961.** 74 p.

Staebler, George R. Gross yield and mortality tables for fully stocked stands of Douglas-fir. Res. Pap. 14. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1955.** 20 p.

Reineke, L. H. Perfecting a stand density index for even-aged forests. J. Agric. Res. 46: 627-638; **1933.**

Williamson, Richard L. 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; **1976.** 39 p.

Williamson, Richard L. Pacific Douglas-fir (229). In: Eyre, F. H., ed. Forest cover types of the United States and Canada. Washington, DC: Society of American Foresters; **1980:** 106-107.

Williamson, Richard L. Response to commercial thinning in a 110-year-old Douglas-fir stand. Res. Pap. PNW-296. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1982.** 16 p.

Williamson, Richard L.; Price, Frank E. Initial thinning effects in 70- to 150-year-old Douglas-fir—western Oregon and Washington. Res. Pap. PNW-117. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station; **1971.** 15 p.

Williamson, Richard L.; Staebler, George R. 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; **1971.** 12 p.

Appendix 1

Excerpt from Report No. 1 (Williamson and Staebler 1971):

DESCRIPTION OF EXPERIMENT

The experiment is designed to test a number of thinning regimes beginning in young stands made alike at the start through a "calibration" thinning. Thereafter, through the time required for 60 feet of height growth, growing stock is controlled by allowing a specified addition to the growing stock between successive thinnings. Any extra growth is cut and is one of the measured effects of the thinning regime.

. . . .

Experimental Design

A single experiment consists of eight thinning regimes plus unthinned plots whose growth is the basis for treatment in these regimes. There are three plots per treatment arranged in a completely randomized design for a total of twenty-seven 1/5-acre plots. ...

Interaction of site quality and treatment can be evaluated by replicating installations on each site quality class. Cooperative effort has made this replication possible.

Crop Tree Selection

Well formed, uniformly spaced, dominant trees at the rate of 80 per acre, or 16 per plot, are designated as crop trees prior to initial thinning. Each quarter of a plot must have no fewer than three suitable crop trees nor more than five—another criterion for stand uniformity.

Initial or "Calibration" Thinning

All 24 treated plots are thinned initially to the same density to minimize the effect of variations in original density on stand growth. Density of residual trees is controlled by quadratic mean diameter [diameter of tree of average basal area] of the *residual* stand according to the formula:

Average spacing in feet = 0.6167 (quadratic mean d.b.h.) + 8.

. . . .

If one concentrates on leaving a certain amount of basal area corresponding to an estimated overall quadratic mean d.b.h. ... [Dg], then the residual number of trees may vary freely and the actual ... [Dg's] may vary between plots... ±10 percent. Alternatively, if emphasis is on leaving a certain number of trees corresponding to an estimated overall... [Dg], then the basal area may vary and the actual... [Dg's] may vary... ±15 percent between plots.

. . . .

Treatments

The eight thinning regimes tested differ in the amount of basal area allowed to accumulate in the growing stock. The amount of growth retained at any thinning is a predetermined percentage of the gross increase found in the unthinned plots since the last thinning. . .[table inside front cover]. The average residual basal area for all thinned plots after the calibration thinning is the foundation upon which all future growing stock accumulation is based. As used in the study, control plots may be thought of as providing a "local gross yield table" for the study area.

. . . .

Control of Thinning Interval

Thinnings will be made [after the calibration thinning] whenever average height growth of crop trees. . .comes closest to each multiple of 10 feet [above the initial height].

Control of Type of Thinning

As far as possible, type of thinning is eliminated as a variable in the treatment thinnings through several specifications:

1. No crop tree may be cut until all noncrop trees have been cut (another tree may be substituted for a crop tree damaged by logging or killed by natural agents).
2. The quadratic mean diameter of cut trees should approximate that of trees that are available for cutting.
3. The diameters of cut trees should be distributed across the full diameter range of trees available for cutting.

Appendix 2

Tables 5 to 10—summary data for live stand, periodic annual growth, and cut trees: Stampede Creek

Tables 11 to 15—summary data for live stand and periodic annual growth: Iron Creek

Table 5—Stampede Creek: stand data for all live trees, by treatment, at beginning and end of period—1968-73 and 1973-78

	Trees per acre				Quadratic mean d.b.h.				Basal area per acre				Total stem volume per acre			
	Calibration		1st treatment		Calibration		1st treatment		Calibration		1st treatment		Calibration		1st treatment	
Treatment	1968	1973	1973	1978	1968	1973	1973	1978	1968	1973	1973	1978	1968	1973	1973	1978
	Number				Inches				Square feet				Cubic feet			
1	293	292	192	190	6.6	7.9	8.4	9.9	68.7	98.4	73.2	100.5	1,475	2,448	1,868	2,975
2	287	283	190	187	6.6	7.9	8.3	9.8	67.5	96.0	71.8	97.5	1,440	2,389	1,837	2,789
3	288	287	197	197	6.7	7.9	8.6	10.0	69.6	98.9	78.8	107.1	1,466	2,440	2,004	3,147
4	296	290	207	203	6.6	7.9	8.4	9.9	69.7	99.2	79.9	107.5	1,448	2,469	2,037	3,125
5	283	282	235	235	6.7	8.0	8.2	9.5	68.9	97.6	86.4	114.6	1,505	2,482	2,238	3,364
6	320	317	278	275	6.1	7.4	7.5	8.9	64.7	94.4	85.8	119.0	1,318	2,212	2,031	3,284
7	278	277	258	250	6.7	8.0	8.1	9.5	68.8	97.5	92.9	122.0	1,544	2,510	2,403	3,629
8	255	253	235	233	7.0	8.3	8.5	9.7	67.5	95.6	91.8	120.3	1,498	2,518	2,441	3,597
Control	997	1,010	1,010	887	4.7	5.3	5.3	6.1	119.2	152.0	152.0	181.9	2,354	3,557	3,557	4,905

Table 6—Stampede Creek: stand data for crop trees, by treatment, at beginning and end of period—1968-73 and 1973-78

	Trees per acre				Quadratic mean d.b.h.				Basal area per acre				Total stem volume per acre			
	Calibration		1st treatment		Calibration		1st treatment		Calibration		1st treatment		Calibration		1st treatment	
Treatment	1968	1973	1973	1978	1968	1973	1973	1978	1968	1973	1973	1978	1968	1973	1973	1978
	Number				Inches				Square feet				Cubic feet			
1	80	80	80	80	8.3	10.0	10.0	11.7	30.0	43.4	43.4	59.7	713	1,182	1,182	1,871
2	80	80	80	78	8.8	10.6	10.6	12.5	33.9	48.6	48.9	66.5	802	1,340	1,349	2,047
3	80	80	80	80	8.4	10.0	10.0	11.7	30.6	43.9	43.9	59.7	705	1,191	1,191	1,850
4	80	80	80	80	8.3	10.1	10.1	11.8	30.3	44.3	44.3	60.7	694	1,216	1,216	1,878
6	80	80	80	80	9.1	10.8	10.8	12.5	36.2	51.2	51.2	67.8	885	1,471	1,471	2,164
6	80	80	80	80	8.0	9.8	9.8	11.5	28.0	41.4	41.4	57.6	645	1,076	1,076	1,739
7	80	80	80	80	8.4	10.1	10.1	11.6	30.8	44.4	44.4	58.8	740	1,236	1,236	1,882
8	80	80	80	80	8.9	10.7	10.7	12.3	34.6	49.9	49.9	66.3	827	1,462	1,462	2,167
Control	80	80	80	80	8.7	10.1	10.1	11.5	33.0	44.8	44.8	57.6	790	1,254	1,254	1,849

Table 7—Stampede Creek: periodic annual growth, total growth, and cumulative volume yield for all trees, by treatment and period—1968-73 and 1973-78

Treatment	Quadratic mean d.b.h.			Basal area		
	Periodic annual net growth			Periodic annual gross growth		
	Calibration, 1968-73	1st treatment, 1973-78	Total growth, 1968-78	Calibration, 1968-73	1st treatment, 1973-78	Total growth, 1968-78
	Inches			Square feet per acre		
1	0.26	0.29	2.7	6.0	5.5	57.5
2	.26	.28	2.7	5.8	5.3	55.9
3	.26	.28	2.7	5.9	5.7	57.9
4	.26	.28	2.7	6.0	5.7	58.6
5	.25	.25	2.5	5.8	5.6	57.0
6	.26	.27	2.6	6.0	6.7	63.4
7	.26	.24	2.5	5.7	6.0	58.8
8	.27	.25	2.6	5.6	5.8	57.0
Control	.09	.11	1.0	6.9	6.9	69.3

Treatment	Total stem volume			
	Periodic annual gross growth		Cumulative yield	
	Calibration, 1968-73	1st treatment, 1973-78	Calibration, 1973	1st treatment, 1978
	Cubic feet per acre			
1	196	222	2,456	3,564
2	193	195	2,407	3,383
3	196	229	2,448	3,591
4	207	222	2,481	3,593
5	196	225	2,484	3,610
6	179	251	2,215	3,472
7	193	249	2,511	3,754
8	204	233	2,518	3,684
Control	246	285	3,584	5,009

Table 8—Stampede Creek: periodic annual growth, total growth, and cumulative volume yield for crop trees, by treatment and period—1968-73 and 1973-78

Treatment	Quadratic mean d.b.h.: Periodic annual net growth, Calibration, 1968-73	Quadratic mean d.b.h.: Periodic annual net growth, 1st treatment, 1973-78	Quadratic mean d.b.h.: Total growth, 1968-78	Basal area: Periodic annual gross growth, Calibration, 1968-73	Basal area: Periodic annual gross growth, 1st treatment, 1973-78	Basal area: Total growth, 1968-78
	- - - Inches - - -			- - - - Square feet per acre - - - -		
1	0.33	0.35	3.4	2.7	3.3	29.7
2	.35	.36	3.5	3.0	3.6	32.9
3	.33	.33	3.3	2.7	3.2	29.0
4	.35	.34	3.4	2.8	3.3	30.3
5	.35	.33	3.4	3.0	3.3	31.6
6	.35	.35	3.5	2.7	3.2	29.6
7	.34	.30	3.2	2.7	2.9	28.0
8	.36	.33	3.4	3.1	3.3	31.7
Control	.29	.27	2.8	2.4	2.6	24.6

Treatment	Total stem volume: Periodic annual gross growth, Calibration, 1968-73	Total stem volume: Periodic annual gross growth, 1st treatment, 1973-78	Total stem volume: Total growth, 1968-78	Total stem volume: Cumulative yield, Calibration, 1973	Total stem volume: Cumulative yield, 1st treatment, 1973
	- - - - - - - - - - - - - Cubic feet per acre - - - - - - - - - - - - -				
1	94	138	1,159	1,182	1,871
2	108	142	1,249	1,340	2,052
3	97	132	1,145	1,191	1,850
4	104	132	1,184	1,216	1,878
5	117	139	1,278	1,471	2,164
6	86	133	1,094	1,076	1,739
7	99	129	1,142	1,236	1,882
8	127	141	1,339	1,462	2,167
Control	93	119	1,059	1,254	1,849

Table 9—Stampede Creek: trees cut, by treatment and thinning—1973 and 1978

	Trees per acre		Quadratic mean d.b.h.		Basal area per acre		Total stem volume per acre	
Treatment	1973	1978	1973	1978	1973	1978	1973	1978
	- - Number- -		- - - -Inches - - -		- Square feet -		- -Cubic feet - -	
1	100	62	6.8	8.7	25.2	25.3	580	699
2	93	62	6.9	7.8	24.1	20.6	553	521
3	90	42	6.4	8.6	20.1	16.8	437	456
4	83	47	6.5	8.4	19.3	18.0	432	482
5	47	32	6.6	8.6	11.1	12.9	244	353
6	38	57	6.4	7.9	8.6	19.4	180	494
7	18	20	6.8	8.5	4.6	7.9	107	218
8	18	25	6.1	8.1	3.7	9.0	77	238

Table 10—Stampede Creek: mean height of crop trees by treatment and measurement year—1968, 1973, and 1978

	Trees measured			Mean height		
Treatment	1968	1973	1978	1968	1973	1978
	- - Number - -			- - - - Feet - - -		
1	11	19	31	56.2	67.3	76.2
2	13	16	33	56.5	67.0	78.0
3	12	14	31	55.2	68.0	76.9
4	11	16	32	57.6	68.5	77.3
5	14	18	35	57.1	67.5	79.7
6	13	15	28	55.0	65.3	75.9
7	10	16	31	56.0	67.9	77.8
8	10	16	31	57.9	69.4	79.8
Control	12	16	24	57.7	69.1	78.4
Thinned treatments only	94	130	252	56.4	67.6	77.7
All treatments	106	146	276	56.5	67.8	77.8
Standard deviation				1.01	1.14	1.31

Table 11—Iron Creek: stand data for all live trees, by treatment, at beginning and end of period—1966-70, 1970-73, 1973-77, 1977-80

	Trees per acre								Quadratic mean d.b.h.							
	Calibration		1st treatment		2d treatment		3d treatment		Calibration		1st treatment		2d treatment		3d treatment	
Treatment	1966	1970	1970	1973	1973	1977	1977	1980	1966	1970	1970	1973	1973	1977	1977	1980
	Number								Inches							
1	366	343	223	210	152	145	100	97	4.7	6.4	6.6	8.1	8.3	10.2	10.6	11.9
2	360	347	198	188	165	153	127	123	5.0	6.7	6.9	8.4	8.5	10.4	10.6	11.8
3	348	340	248	237	193	188	162	160	4.9	6.6	6.8	8.2	8.3	10.0	10.1	11.3
4	362	353	242	227	195	190	178	177	6.0	6.7	6.9	8.4	8.5	10.3	10.4	11.5
5	347	338	277	273	242	237	227	227	6.1	6.7	6.9	8.2	8.3	9.9	9.9	10.8
6	360	343	307	295	252	247	203	202	4.8	6.5	6.6	7.9	8.0	9.6	9.6	10.7
7	360	347	333	317	305	297	297	293	5.0	6.7	6.7	7.9	8.0	9.4	9.4	10.2
8	352	345	313	290	275	273	257	250	6.1	6.8	6.9	8.2	8.3	9.7	9.8	10.7
Control	1,128	1,193	1,193	1,192	1,192	1,183	1,183	1,095	3.7	4.5	4.5	5.1	5.1	5.1	6.7	6.2

	Basal area per acre								Total stem volume per acre							
	Calibration		1st treatment		2d treatment		3d treatment		Calibration		1st treatment		2d treatment		3d treatment	
	1966	1970	1973	1973	1973	1977	1977	1980	1966	1970	1970	1973	1973	1977	1977	1980
	Square feet								Cubic feet							
1	43.4	76.0	52.9	74.5	57.1	82.7	60.9	74.7	600	1,370	964	1,552	1,205	2,020	1,505	2,087
2	48.8	84.4	51.6	72.2	60.8	89.9	77.5	94.0	735	1,638	1,013	1,659	1,404	2,344	2,031	2,763
3	46.3	79.9	61.9	86.1	72.0	102.1	90.7	111.5	648	1,474	1,151	1,834	1,539	2,592	2,308	3,168
4	49.5	86.2	63.2	86.6	77.2	110.4	104.7	126.8	771	1,703	1,272	1,970	1,761	2,899	2,752	3,762
5	48.6	82.6	71.3	99.7	91.3	125.3	120.7	145.3	733	1,688	1,383	2,236	2,055	3,297	3,178	4,293
6	46.4	79.0	71.9	100.0	87.2	123.1	103.3	125.9	629	1,428	1,303	2,085	1,822	3,070	2,584	3,562
7	49.2	83.7	80.7	108.9	105.9	142.6	142.6	167.2	734	1,590	1,534	2,442	2,378	3,739	3,739	4,649
8	49.2	86.7	80.9	106.5	102.5	140.9	133.9	156.5	763	1,667	1,562	2,364	2,282	3,589	3,419	4,464
Control	82.4	129.9	129.9	156.6	156.6	209.4	209.4	228.2	1,116	2,328	2,328	3,510	3,510	6,170	5,170	5,404

Table 12—Iron Creek: stand data for crop trees, by treatment, at beginning and end of period—1966-70, 1970-73, 1973-77, 1977-80

	Trees per acre								Quadratic mean d.b.h.							
	Calibration		1st treatment		2d treatment		3d treatment		Calibration		1st treatment		2d treatment		3d treatment	
Treatment	1966	1970	1970	1973	1973	1977	1977	1980	1966	1970	1970	1973	1973	1977	1977	1980
	Number								Inches							
1	80	77	78	75	75	72	73	72	5.6	7.5	7.4	9.1	9.1	11.1	11.1	12.4
2	80	77	80	73	73	73	77	73	5.8	7.7	7.7	9.3	9.2	11.2	11.1	12.4
3	80	80	80	78	78	77	77	77	5.9	7.8	7.8	9.2	9.2	11.0	11.0	12.2
4	80	78	80	75	77	77	77	75	5.9	7.8	7.8	9.3	9.3	11.2	11.2	12.4
5	80	80	80	80	78	77	77	77	6.1	8.0	8.0	9.5	9.5	11.2	11.2	12.4
6	80	78	80	80	80	78	77	75	5.7	7.5	7.5	9.0	9.0	10.8	10.8	12.0
7	78	77	78	72	77	77	77	76	5.7	7.5	7.5	9.0	8.9	10.5	10.5	11.5
8	78	77	78	70	80	80	82	82	6.0	8.0	8.0	9.6	9.4	11.1	11.1	12.1
Control	78	78	78	78	78	77	78	77	5.8	7.4	7.4	8.6	8.6	9.7	9.7	10.4

	Basal area per acre								Total stem volume per acre							
	Calibration		1st treatment		2d treatment		3d treatment		Calibration		1st treatment		2d treatment		3d treatment	
	1966	1970	1970	1973	1973	1977	1977	1980	1966	1970	1970	1973	1973	1977	1977	1980
	Square feet								Cubic feet							
1	13.6	23.3	23.7	33.6	33.6	48.0	49.1	60.5	200	440	446	728	728	1,206	1,230	1,699
2	14.9	24.7	25.5	34.6	34.1	49.8	51.7	61.5	238	603	520	819	803	1,316	1,357	1,823
3	15.2	26.4	26.3	35.4	35.3	60.8	50.8	62.6	227	512	511	797	796	1,312	1,312	1,807
4	16.2	26.3	26.6	35.5	36.5	52.2	52.5	63.0	253	552	557	833	866	1,395	1,483	1,895
5	16.2	27.8	28.1	38.7	38.7	52.9	52.9	63.8	258	563	570	908	908	1,427	1,427	1,942
6	14.0	24.5	24.8	36.5	35.1	49.5	48.7	59.2	207	462	466	769	759	1,277	1,257	1,726
7	13.9	23.7	24.0	31.6	33.4	46.4	46.4	54.3	217	460	465	726	768	1,245	1,245	1,644
8	15.2	26.8	27.2	36.2	38.8	53.9	55.2	55.6	247	545	554	826	905	1,427	1,458	1,927
Control	14.4	23.4	23.4	31.2	31.2	39.5	40.3	45.7	215	459	459	717	717	1,062	1,082	1,393

Table 13—Iron Creek: periodic annual growth and cumulative volume yield for all trees, by treatment and period—1966-70, 1970-73, 1973-77, 1977-80

Treatment	Quadratic mean d.b.h., periodic annual net growth				Basal area, periodic annual gross growth			
	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80
	Inch				Square feet per acre			
1	0.40	0.46	0.45	0.44	8.5	8.3	6.8	5.3
2	.41	.48	.46	.40	9.4	7.9	7.4	6.2
3	.40	.45	.42	.38	8.6	9.0	8.0	7.1
4	.41	.45	.43	.36	9.4	9.1	8.5	7.7
5	.40	.43	.37	.32	8.8	9.9	8.9	8.2
6	.40	.43	.39	.34	8.8	10.3	9.3	7.8
7	.40	.41	.34	.27	9.0	10.8	9.8	8.7
8	.42	.43	.36	.28	9.6	11.0	9.6	8.0
Control	.19	.18	.12	.09	12.1	12.9	11.9	9.1

Treatment	Periodic annual gross growth				Cumulative yield			
	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80
	Cubic feet per acre				Cubic feet per acre			
1	197	216	213	213	1,389	2,038	2,889	3,528
2	234	240	237	266	1,673	2,391	3,338	4,136
3	210	246	275	293	1,487	2,227	3,327	4,206
4	238	262	289	345	1,721	2,506	3,663	4,698
5	218	293	320	372	1,606	2,486	3,765	4,880
6	206	277	318	331	1,454	2,286	3,559	4,553
7	221	333	355	424	1,620	2,617	4,039	5,310
8	229	320	328	360	1,678	2,639	3,953	5,034
Control	307	406	442	480	2,342	3,562	5,329	6,769

Table 14—Iron Creek: periodic annual growth and cumulative volume yield for crop trees, by treatment and period—1966-70, 1970-73, 1973-77, 1977-80

Treatment	Quadratic mean d.b.h., periodic annual net growth				Basal area periodic annual gross growth			
	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80
	Inch				Square feet per acre			
1	0.45	0.51	0.48	0.45	2.5	3.6	3.9	4.2
2	.44	.51	.48	.41	2.6	3.8	3.9	4.0
3	.47	.49	.45	.41	2.8	3.6	3.9	3.9
4	.47	.49	.46	.39	2.8	3.7	3.9	3.8
5	.47	.49	.42	.37	2.9	3.7	3.7	3.6
6	.47	.50	.44	.39	2.7	3.6	3.8	3.7
7	.45	.45	.40	.32	2.5	3.1	3.2	2.9
8	.50	.49	.42	.33	3.0	3.6	3.8	3.5
Control	.40	.39	.30	.25	2.2	2.6	2.4	2.2

Treatment	Periodic annual gross growth				Cumulative yield			
	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment, 1977-80	Calibration, 1966-70	1st treatment, 1970-73	2d treatment, 1973-77	3d treatment 1977-80
	Cubic feet per acre							
1	62	100	125	167	449	749	1,251	1,751
2	69	116	128	174	514	864	1,377	1,900
3	71	101	136	165	512	817	1,360	1,855
4	76	109	135	172	555	882	1,421	1,938
5	76	116	134	172	563	911	1,448	1,963
6	65	101	133	162	468	770	1,302	1,787
7	63	100	119	142	468	769	1,245	1,670
8	76	111	130	156	550	884	1,406	1,875
Control	61	86	95	116	459	717	1,096	1,443

Table 15—Iron Creek: mean height of crop trees, by treatment and measurement year—1966, 1970, 1973, 1977, and 1980

Treatment	Trees measured					Mean height				
	1966	1970	1973	1977	1980	1966	1970	1973	1977	1980
	Number					Feet				
1	16	22	21	28	32	34.4	45.9	53.5	63.6	71.9
2	16	22	21	30	30	36.4	48.7	56.4	66.3	75.6
3	16	24	23	31	30	34.9	47.0	53.9	64.6	72.8
4	15	22	23	28	26	38.8	50.5	58.5	68.6	77.4
5	15	22	19	30	30	37.6	48.9	57.3	67.5	77.0
6	15	21	22	27	28	35.4	45.8	53.2	64.6	72.8
7	16	24	24	30	27	36.7	46.7	55.2	67.3	76.1
8	15	21	20	30	29	38.4	49.6	57.7	66.5	75.1
Control	14	19	18	20	20	35.4	47.5	55.7	65.9	75.1
Thinned only	124	178	173	234	232	36.6	47.9	55.7	66.1	74.8
All treatments	138	197	191	254	252	36.4	47.8	55.7	66.1	74.8
Standard deviation						1.47	1.58	1.83	1.52	1.87

Appendix 3

Tables 16 to 24—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatments 1 through 9 at beginning and end of period—1968 to 1973

Tables 25 to 33—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatments 1 through 9 at end of period—1978

Table 16—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 1 at beginning and end of period—1968-73

D.b.h. class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	- - -Number- - - -				- - - - Cubic feet - - - -				- Percent -		- Cubic feet -		- -Percent - -	
13.6 - 14.5		2		2		33.9		56.6		2.3		56.6		2.3
12.6 - 13.5		3		5		27.1		90.3		3.7		146.9		6.0
11.6 - 12.5	2	3	2	8	23.1	22.7	38.4	75.6	2.61	3.1	38.4	222.5	2.6	9.1
10.6 - 11.5	2	12	3	20	18.0	18.5	30.0	216.3	2.03	8.8	68.4	438.8	4.6	17.9
9.6 - 10.5	5	35	8	55	14.7	14.9	73.3	522.3	4.97	21.3	141.7	961.0	9.6	39.2
8.6 - 9.5	23	48	32	103	10.7	11.3	249.6	545.2	16.93	22.3	391.3	1,506.2	26.5	61.5
7.6 - 8.5	42	50	73	153	8.0	8.8	332.9	440.3	22.58	18.0	724.2	1,946.6	49.1	79.5
6.6 - 7.5	65	37	138	190	5.8	6.1	379.3	224.2	25.72	9.2	1,103.5	2,170.8	74.8	88.7
5.6 - 6.5	48	42	187	232	3.9	4.0	189.7	165.9	12.87	6.8	1,293.3	2,336.7	87.7	95.4
4.6 - 5.5	48	25	235	257	2.4	2.7	114.3	66.5	7.75	2.7	1,407.5	2,403.2	95.5	98.2
3.6 - 4.5	38	22	273	278	1.4	1.6	54.8	33.7	3.72	1.4	1,462.3	2,437.0	99.2	99.5
2.6 - 3.5	18	13	292	292	.6	.8	11.5	11.3	.78	.5	1,473.8	2,448.3	99.9	100.0
1.6 - 2.5	2		293		.4		.7		.05		1,474.5		100.0	
Total	293	292					1,474.5	2,448.3	100.0	100.0				
Average					5.0	8.4								

1/Rounded to whole numbers.

Table 17—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 2 at beginning and end of period—1968-73

D.b.h. class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	- - - Number- - - - -				- - - - - Cubic feet - - -				- Percent -		- Cubic feet -		- Percent -	
15.6 - 16.5		2		2		51.2		85.3		3.6		85.3		3.6
14.6 - 15.5		2		3		44.7		74.5		3.1		159.8		6.7
13.6 - 14.5	2	5	2	8	34.6	33.8	57.7	169.0	4.0	7.1	57.7	328.8	4.0	13.8
12.6 - 13.5	2	5	3	13	26.8	26.6	44.7	133.1	3.1	5.6	102.4	462.0	7.1	19.3
11.6 - 12.5	5	12	8	25	21.4	21.1	106.8	246.7	7.4	10.3	209.2	708.6	14.5	29.7
10.6 - 11.5	5	13	13	38	16.2	18.8	80.8	250.3	5.6	10.5	290.0	958.9	20.1	40.1
9.6 - 10.5	13	28	27	67	12.9	14.0	171.8	396.0	11.9	16.6	461.9	1,354.9	32.1	56.7
8.6 - 9.5	18	20	45	87	10.5	10.5	193.3	209.5	13.4	8.8	655.1	1,564.4	45.5	65.5
7.6 - 8.5	27	33	72	120	7.7	8.5	204.7	281.9	14.2	11.8	859.8	1,846.3	59.7	77.3
6.6 - 7.5	42	30	113	150	5.4	5.9	223.4	177.3	15.5	7.4	1,083.2	2,023.6	75.2	84.7
5.6 - 6.5	43	48	157	198	3.7	4.1	161.4	197.1	11.2	8.2	1,244.6	2,220.7	86.4	93.0
4.6 - 5.5	42	43	198	242	2.3	2.7	96.7	116.0	6.7	4.8	1,341.3	2,336.7	93.1	97.8
3.6 - 4.5	52	30	250	272	1.4	1.4	74.4	42.7	5.2	1.8	1,415.8	2,379.4	98.3	99.6
2.6 - 3.5	35	12	287	283	.7	.8	24.0	9.7	1.7	.4	1,439.8	2,389.1	99.9	100.0
1.6 - 2.5	2				.3		.6		.0		1,440.4		100.0	
Total	287	283					1,440.4	2,389.1	100.0	100.0				
Average					5.0	8.4								

1/Rounded to whole numbers.

Table 18—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 3 at beginning and end of period—1968-73

D.b.h. class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	Number				Cubic feet				Percent		Cubic feet		Percent	
13.6 - 14.5		2		2		32.9		54.8		2.2		54.8		2.2
12.6 - 13.5		0		2		0		0		0		54.8		2.2
11.6 - 12.5	2	7	2	8	20.9	22.9	34.8	152.8	2.4	6.3	34.8	207.6	2.4	8.5
10.6 - 11.5	0	27	2	35	0	18.4	0	489.4	0	20.0	34.8	697.0	2.4	28.6
9.6 - 10.5	8	17	10	52	13.7	14.8	114.1	246.3	7.8	10.1	148.9	943.3	10.2	38.6
8.6 - 9.6	28	48	38	100	10.8	11.0	306.2	532.5	20.9	21.8	455.1	1,475.8	31.0	60.5
7.6 - 8.5	30	55	68	155	7.7	8.6	231.4	473.3	15.8	19.4	686.5	1,949.1	46.8	79.9
6.6 - 7.5	73	38	142	193	5.6	6.0	410.0	229.3	28.0	9.4	1,096.6	2,178.4	74.8	89.3
5.6 - 6.5	60	35	192	228	3.9	4.0	193.6	139.5	13.2	5.7	1,290.2	2,318.0	88.0	95.0
4.6 - 5.5	43	33	235	262	2.5	2.7	107.0	89.0	7.3	3.6	1,397.2	2,407.0	95.3	98.6
3.6 - 4.5	40	20	275	282	1.5	1.5	60.2	30.0	4.1	1.2	1,457.4	2,437.0	99.4	99.9
2.6 - 3.5	13	5	288	287	.7	.7	9.0	3.4	.6	.1	1,466.5	2,440.4	100.0	100.0
Total	288	287					1,466.5	2,440.4	100.0	100.0				
Average					5.1	8.5								

1/Rounded to whole numbers.

Table 19—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 4 at beginning and end of period—1968-73

D.b.h. class	Trees per acre 1/		Cumulative trees per tree		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	Number				Cubic feet				Percent		Cubic feet		Percent	
11.6 - 12.5		8		8		22.9		190.8		7.7		190.8		7.7
10.6 - 11.5		20		28		18.6		371.8		15.1		562.6		22.8
9.6 - 10.5	8	38	8	67	13.8	14.8	115.0	567.8	7.9	23.0	115.0	1,130.3	7.9	45.8
8.6 - 9.5	23	33	32	100	10.6	11.4	247.5	379.8	17.1	15.4	362.6	1,510.2	25.0	61.2
7.6 - 8.5	48	40	80	140	8.0	8.5	384.3	338.9	26.5	13.7	746.9	1,849.1	51.6	74.9
6.6 - 7.5	53	58	133	198	5.6	6.2	299.4	360.1	20.7	14.6	1,046.3	2,209.2	72.2	89.5
5.6 - 6.5	62	42	195	240	3.7	4.0	228.2	167.6	15.8	6.8	1,274.4	2,376.8	88.0	96.2
4.6 - 5.5	48	22	243	262	2.5	2.7	120.4	57.5	8.3	2.3	1,394.8	2,434.3	96.3	98.6
3.6 - 4.5	28	17	272	278	1.4	1.6	38.7	26.2	2.7	1.1	1,433.5	2,460.5	99.0	99.6
2.6 - 3.5	20	12	292	290	.7	.8	13.7	9.0	1.0	.4	1,477.2	2,469.5	99.9	100.0
1.6 - 2.5	3		295		.3		1.0		.1		1,448.2		100.0	
Total	295	290					1,448.2	2,469.5	100.0	100.0				
Average					4.9	8.5								

1/Rounded to whole numbers.

Table 20—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 5 at beginning and end of period—1968-73

D.b.h. class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	Number				Cubic feet				Percent		Cubic feet		Percent	
14.6 - 15.5		3		3		40 6		135.5		5.5		135.5		5.5
13.6 - 14.5		2		5		37.7		62.8		2.5		198.3		8.0
12.6 - 13.5	2	8	2	13	26.2	28.2	43.7	235.1	2.9	9.5	43.7	433.4	2.9	17.5
11.6 - 12.5	3	10	5	23	23.3	24.9	77.5	248.6	5.2	10.0	121.2	682.0	8.0	27.5
10.6 - 11.5	13	20	18	43	17.0	19.4	226.2	387.9	15.0	15.6	347.4	1,069.9	23.1	43.1
9.6 - 10.5	10	12	28	55	13.3	14.0	133.5	163.5	8.9	6.6	480.9	1,233.3	32.0	49.7
8.6 - 9.5	15	37	43	92	11.4	11.5	170.4	421.1	11.3	17.0	651.3	1,654.4	43.3	66.7
7.6 - 8.5	28	37	72	128	7.8	8.4	219.8	309.1	14.6	12.4	871.1	1,963.5	57.9	79.1
6.6 - 7.5	45	32	117	160	5.8	6.1	259.2	191.9	17.2	7.7	1,130.3	2,155.4	75.1	86.8
5.6 - 6.5	40	47	157	207	4.0	3.9	158.6	183.2	10.5	7.4	1,288.8	2,338.6	85.6	94.2
4.6 - 5.5	55	40	212	247	2.5	2.6	134.9	102.9	9.0	4.2	1,423.8	2,441.6	94.6	98.4
3.6 - 4.5	47	22	258	268	1.4	1.5	66.6	31.9	4.4	1.3	1,490.4	2,473.4	99.0	99.7
2.6 - 3.5	18	13	277	282	.7	.6	12.8	8.5	.8	.3	1,503.1	2,481.9	99.9	100.0
1.6 - 2.5	7		283		.3		2.2		.1		1,505.3		100.0	
Total	283	282					1,505.3	2,481.9	100.0	100.0				
Average					5.3	8.8								

1/Rounded to whole numbers.

Table 21—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 6 at beginning and end of period—1968-73

D.b.h. class	Trees per acre 1/		Cumulative trees per tree		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	Number				Cubic feet				Percent		Cubic feet		Percent	
13.6 - 14.5		3		3		30.9		102.9		4.6		102.9		4.6
12.6 - 13.5		2		5		26.3		43.9		2.0		146.8		6.6
11.6 - 12.5	3	3	3	8	21.1	23.9	70.2	79.8	5.3	3.6	70.2	226.6	5.3	10.2
10.6 - 11.5	2	12	5	20	15.4	17.2	25.7	200.8	2.0	9.1	95.8	427.3	7.3	19.3
9.6 - 10.5	5	23	10	43	14.6	14.4	73.0	335.0	5.5	15.2	168.8	762.3	12.8	34.5
8.6 - 9.5	10	43	20	87	10.2	10.7	102.4	465.3	7.8	21.0	271.2	1,227.6	20.6	55.5
7.6 - 8.5	38	40	58	127	8.1	8.0	308.9	321.5	23.4	14.5	580.1	1,549.1	44.0	70.0
6.6 - 7.5	48	47	107	173	5.6	5.7	270.3	267.2	20.5	12.1	850.4	1,816.3	64.5	82.1
5.6 - 6.5	62	52	168	225	3.7	4.1	228.8	209.3	17.4	9.5	1,079.3	2,025.6	81.9	91.6
4.6 - 5.5	52	50	220	275	2.4	2.5	124.2	126.1	9.4	5.7	1,203.5	2,151.7	91.3	97.3
3.6 - 4.5	67	35	287	310	1.4	1.5	90.9	53.8	6.9	2.4	1,294.4	2,205.5	98.2	99.7
2.6 - 3.5	33	7	320	317	.7	.9	23.6	6.2	1.8	.3	1,318.0	2,211.7	100.0	100.0
Total	320	317					1,318.0	2,211.7	100.0	100.0				
Average					4.1	7.0								

1/Rounded to whole numbers.

Table 22—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 7 at beginning and end of period—1968-73

D.b.h class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	- - - - - Number - - - -				- - - - - Cubic feet - - - -				- Percent -		- - Cubic feet - -		- Percent-	
12.6 - 13.5		8		8		27.8		231.3		9.2		231.3		9.2
11.6 - 12.5		8		17		23.5		195.6		7.8		426.9		17.0
10.6 - 11.5	8	12	8	28	17.5	18.4	146.1	215.0	9.5	8.6	146.1	641.8	9.5	25.6
9.6 - 10.5	8	18	17	47	13.5	15.1	112.9	277.6	7.3	11.1	259.0	919.4	16.8	36.6
8.6 - 9.5	18	52	35	98	10.6	11.7	193.6	602.6	12.5	24.0	452.5	1,522.0	29.3	60.6
7.6 - 8.5	38	58	73	157	7.8	8.6	297.5	504.3	19.3	20.1	750.1	2,026.3	48.6	80.7
6.6 - 7.5	63	37	137	193	6.1	6.3	387.6	232.2	25.1	9.2	1,137.7	2,258.5	73.7	90.0
6.5 - 5.6	57	33	193	227	4.2	4.3	237.5	141.9	15.4	5.6	1,375.2	2,400.4	89.1	95.6
4.6 - 5.5	45	25	238	252	2.6	2.8	116.6	70.6	7.6	2.8	1,491.8	2,471.1	99.6	98.5
3.6 - 4.5	25	18	263	270	1.6	1.8	40.7	33.2	2.6	1.3	1,532.6	2,504.3	99.3	99.8
2.6 - 3.5	12	7	275	277	.8	.8	9.6	5.3	.6	.2	1,542.1	2,509.6	99.9	100.0
1.6 - 2.5	3		278		.4		1.5		.1		1,543.6		100.0	
Total	278	277					1,543.6	2,509.6	100.0	100.0				
Average					5.5	9.1								

1/Rounded to whole numbers.

Table 23—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 8 at beginning and end of period—1968-73

D.b.h class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	- - - - - Number- - - -				- - - - - - Cubic feet - - - -				- Percent -		-Cubic feet -		- - Percent- -	
13.6 - 14.5		3		3		38.8		129.3		5.1		129.3		5.1
12.6 - 13.5		8		12		29.9		249.5		9.9		378.8		15.0
11.6 - 12.5	3	12	3	23	21.9	24.3	73.1	284.1	4.9	11.3	73.1	662.8	4.9	26.3
10.6 - 11.5	8	22	12	45	17.1	19.5	142.1	422.8	9.5	16.8	215.3	1,085.7	14.4	43.1
9.6 - 10.5	13	20	25	65	13.7	14.6	182.4	291.9	12.2	11.6	397.7	1,377.6	26.5	54.7
8.6 - 9.5	20	32	45	97	10.8	11.5	216.1	363.5	14.4	14.4	613.7	1,741.1	41.0	69.2
7.6 - 8.5	33	47	78	143	7.9	8.8	263.2	409.6	17.6	16.3	877.0	2,150.7	58.5	85.4
6.6 - 7.5	58	27	137	170	5.8	6.0	338.8	160.9	22.6	6.4	1,215.8	2.311.6	81.2	91.8
5.6 - 6.5	40	32	177	202	4.1	4.0	163.1	128.1	10.9	5.1	1,378.9	2,439.7	92.0	96.9
4.6 - 5.5	32	22	208	223	2.5	2.2	79.6	48.0	5.3	1.9	1,458.5	2,487.7	97.4	98.8
3.6 - 4.5	13	17	222	240	1.3	1.3	17.0	20.9	1.1	.8	1,475.5	2,508.6	98.5	99.6
2.6 - 3.5	28	13	250	253	.8	.7	21.4	9.0	1.4	.4	1,496.9	2,517.6	99.9	100.0
1.6 - 2.5	5		255		.3		1.3		.1		1,498.2		100.0	
Total	255	253					1,498.2	2,517.6	100.0	100.0				
Average					5.9	9.9								

1/Rounded to whole numbers.

Table 24—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 9 (control) at beginning and end of period—1968-73

D.b.h class	Trees per acre 1/		Cumulative trees per acre		Volume per tree		Volume per acre				Cumulative volume per acre			
	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973	1968	1973
Inches	Number				Cubic feet				Percent		Cubic feet		Percent	
14.6 - 15.5		2		2		42.7		71.1		2.0		71.1		2.0
13.6 - 14.5		0		2		0		0		0		71.1		2.0
12.6 - 13.5	2	3	2	5	26.6	27.9	44.3	93.1	1.9	2.6	44.3	164.2	1.9	4.6
11.6 - 12.5	2	3	3	8	21.0	22.3	35.0	74.5	1.5	2.1	79.3	238.7	3.4	6.7
10.6 - 11.5	3	17	7	25	17.2	19.1	57.3	317.7	2.4	8.9	136.6	556.4	5.8	15.6
9.6 - 10.5	12	32	18	57	13.2	15.3	154.3	485.4	6.6	13.6	291.0	1,041.9	12.4	29.3
8.6 - 9.5	30	45	48	102	10.3	11.9	308.9	535.5	13.1	15.1	599.9	1,577.4	25.5	44.4
7.6 - 8.5	45	72	93	173	7.9	8.7	357.3	620.6	15.2	17.4	957.2	2,198.0	40.7	61.8
6.6 - 7.5	78	67	172	240	5.6	6.1	437.5	405.9	18.6	11.4	1,394.7	2,603.9	59.2	73.2
5.6 - 6.5	92	73	263	313	3.8	4.3	344.4	313.1	14.6	8.8	1,739.2	2,916.9	73.9	82.0
4.6 - 5.5	95	100	358	413	2.4	2.6	230.2	263.5	9.8	7.4	1,969.3	3,180.4	83.6	89.4
3.6 - 4.5	133	107	492	520	1.4	1.5	189.4	163.2	8.0	4.6	2,158.7	3,343.7	91.7	94.0
2.6 - 3.5	163	165	655	685	.7	.7	110.9	122.7	4.7	3.4	2,269.6	3,466.3	96.4	97.5
1.6 - 2.5	342	325	997	1,010	.2	.3	84.6	90.4	3.6	2.5	2,354.2	3,556.7	100.0	100.0
Total	997	1,010					2,354.2	3,556.7	100.0	100.0				
Average					2.4	3.5								

1/Rounded to whole numbers.

Table 25—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 1 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	Number		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
16.6 - 17.5	2	2	53.7	89.5	3.0	89.5	3.0
15.6 - 16.5	0	2	0	0	0	89.5	3.0
14.6 - 15.5	2	3	44.8	74.7	2.5	164.2	5.5
13.6 - 14.5	3	7	34.8	115.9	3.9	280.2	9.4
12.6 - 13.5	7	13	29.7	198.2	6.7	478.3	16.1
11.6 - 12.5	27	40	25.5	678.7	22.8	1,157.0	38.9
10.6 - 11.5	30	70	20.1	602.0	20.2	1,759.0	59.1
9.6 - 10.5	37	107	16.2	594.4	20.0	2,353.4	79.1
8.6 - 9.5	17	123	12.7	211.2	7.1	2,564.7	86.2
7.6 - 8.5	22	143	9.1	198.1	6.7	2,726.8	92.9
6.6 - 7.5	20	165	6.6	131.3	4.4	2,894.1	97.3
5.6 - 6.5	10	175	4.3	43.3	1.5	2,937.4	98.7
4.6 - 5.5	8	183	3.2	26.4	.9	2,963.8	99.6
3.6 - 4.5	5	188	1.8	9.2	.3	2,973.1	99.9
2.6 - 3.5	2	190	1.2	2.0	.1	2,975.0	100.0
Total	190			2,975.0	100.0		
Average			15.7				

1/Rounded to whole numbers.

Table 26—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 2 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number - - -		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
18.6 - 19.5	2	2	73.2	122.1	4.4	122.1	4.4
17.6 - 18.5	2	3	62.4	104.0	3.7	226.0	8.1
16.6 - 17.5	2	5	55.4	92.3	3.3	318.4	11.4
15.6 - 16.5	3	8	45.0	149.0	5.4	468.3	16.8
14.6 - 15.5	2	10	39.0	65.0	2.3	533.3	19.1
13.6 - 14.5	12	22	32.7	381.3	13.7	914.5	32.8
12.6 - 13.5	12	33	28.9	337.7	12.1	1,252.2	44.9
11.6 - 12.5	15	48	22.9	343.3	12.3	1,595.5	57.2
10.6 - 11.5	17	65	18.7	311.6	11.2	1,907.2	68.4
9.6 - 10.5	23	88	14.5	338.4	12.1	2,245.6	80.5
8.6 - 9.5	8	97	10.6	88.5	3.2	2,334.2	83.7
7.6 - 8.5	18	115	8.2	150.8	5.4	2,484.9	89.1
6.6 - 7.5	28	143	6.0	170.6	6.1	2,655.6	95.2
5.6 - 6.5	20	163	4.2	83.7	3.0	2,739.3	98.2
4.6 - 5.5	12	175	2.8	32.2	1.2	2,771.5	99.4
3.6 - 4.5	12	187	1.5	18.0	.6	2,789.5	100.0
Total	187			2,789.5	100.0		
Average			14.9				

1/Rounded to whole numbers.

Table 27—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 3 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number - - -		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
15.6 - 16.5	2	2	49.2	82.0	2.6	82.0	2.6
14.6 - 15.5	0	2	0	0	0	82.0	2.6
13.6 - 14.5	7	8	34.1	230.8	7.3	312.8	9.9
12.6 - 13.5	17	25	29.6	493.8	15.7	806.5	25.6
11.6 - 12.5	20	45	24.4	487.5	15.5	1,294.0	41.1
10.6 - 11.5	28	73	19.5	551.2	17.5	1,845.2	58.5
9.6 - 10.5	38	112	15.5	595.6	18.9	2,440.8	77.6
8.6 - 9.5	30	142	12.7	380.0	12.1	2,820.8	89.5
7.6 - 8.5	13	155	8.9	119.1	3.8	2,939.9	93.4
6.6 - 7.5	17	172	6.5	109.0	3.5	3,048.9	96.9
5.6 - 6.5	18	190	4.7	86.1	2.7	3,135.0	99.6
4.6 - 5.5	2	192	2.5	4.2	.1	3,139.2	99.8
3.6 - 4.5	3	195	1.7	5.5	.2	3,144.7	99.9
2.6 - 3.5	2	197	1.1	1.8	.1	3,146.5	100.0
Total	197			3,146.5	100.0		
Average			16.0				

1/Rounded to whole numbers.

Table 28—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 4 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number - - -		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
13.6 - 14.5	8	8	34.3	286.1	9.2	286.1	9.2
12.6 - 13.5	13	22	28.9	384.9	12.3	671.0	21.5
11.6 - 12.5	30	52	25.2	755.9	24.2	1,425.8	45.7
10.6 - 11.5	28	80	19.7	558.3	17.9	1,985.1	63.5
9.6 - 10.5	23	103	15.3	356.5	11.4	2,341.6	74.9
8.6 - 9.5	27	130	12.0	320.2	10.2	2,661.9	85.2
7.6 - 8.5	25	155	9.4	234.7	7.5	2,896.6	92.7
6.6 - 7.5	22	177	6.5	140.9	4.5	3,037.5	97.2
5.6 - 6.5	13	190	4.3	58.0	1.9	3,095.5	99.1
4.6 - 5.5	7	197	2.8	18.4	.6	3,113.9	99.6
3.6 - 4.5	7	203	1.6	10.9	.4	3,124.8	100.0
Total	203			3,124.8	100.0		
Average			15.4				

1/Rounded to whole numbers.

Table 29—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 5 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number - - -		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
17.6 - 18.5	2	2	60.3	100.5	3.0	100.5	3.0
16.6 - 17.5	0	2	0	0	0	100.5	3.0
15.6 - 16.5	3	5	53.7	179.1	5.3	279.6	8.3
14.6 - 15.5	7	12	41.8	279.0	8.3	558.5	16.6
13.6 - 14.5	12	23	35.5	414.6	12.3	973.1	28.9
12.6 - 13.5	13	37	30.1	401.7	11.9	1,374.8	40.9
11.6 - 12.5	12	48	24.6	286.9	8.5	1,661.7	49.4
10.6 - 11.5	23	72	19.2	448.4	13.3	2,110.1	62.7
9.6 - 10.5	23	95	16.2	377.7	11.2	2,487.8	74.0
8.6 - 9.5	28	123	11.8	335.6	10.0	2,823.4	83.9
7.6 - 8.5	13	137	9.5	126.3	3.8	2,949.7	87.7
6.6 - 7.5	28	165	6.5	185.2	5.5	3,134.9	93.2
5.6 - 6.5	32	197	4.6	146.3	4.4	3,281.2	97.5
4.6 - 5.5	25	222	2.8	69.3	2.1	3,350.5	99.6
3.6 - 4.5	5	227	1.3	6.4	.2	3,356.9	99.8
2.6 - 3.5	8	235	.8	7.0	.2	3,363.9	100.0
Total	235			3,363.9	100.0		
Average			14.3				

1/Rounded to whole numbers.

Table 30—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 6 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number - - -		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
15.6 - 16.5	3	3	48.2	160.8	4.9	160.8	4.9
14.6 - 15.5	3	7	42.1	140.3	4.3	301.1	9.2
13.6 - 14.5	2	8	35.5	59.2	1.8	360.3	11.0
12.6 - 13.5	5	13	28.1	140.6	4.3	500.9	15.3
11.6 - 12.5	27	40	23.9	637.2	19.4	1,138.1	34.7
10.6 - 11.5	28	68	18.6	525.8	16.0	1,663.9	50.7
9.6 - 10.5	30	98	15.4	462.7	14.1	2,126.6	64.8
8.6 - 9.5	32	130	11.8	372.9	11.4	2,499.4	76.1
7.6 - 8.5	33	163	8.6	285.4	8.7	2,784.8	84.8
6.6 - 7.5	40	203	6.5	261.0	8.0	3,045.8	92.8
5.6 - 6.5	32	235	4.4	140.1	4.3	3,185.9	97.0
4.6 - 5.5	27	262	2.9	76.5	2.3	3,262.5	99.4
3.6 - 4.5	12	273	1.7	19.3	.6	3,281.8	99.9
2.6 - 3.5	2	275	1.1	1.9	.1	3,287.7	100.0
Total	275			3,287.7	100.0		
Average			11.9				

1/Rounded to whole numbers.

Table 31—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 7 at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number - - -		Cubic feet	Cubic feet	Percent	Cubic feet	Percent
14.6 - 15.5	5	5	43.4	217.1	6.0	217.1	6.0
13.6 - 14.5	10	15	36.0	359.8	9.9	576.9	15.9
12.6 - 13.5	7	22	30.0	200.0	5.5	776.9	21.4
11.6 - 12.5	18	40	25.6	468.7	12.9	1,245.6	34.3
10.6 - 11.5	22	62	20.5	445.2	12.3	1,690.8	46.6
9.6 - 10.5	45	107	16.3	732.2	20.2	2,423.0	66.8
8.6 - 9.5	48	155	12.8	617.2	17.0	3,040.2	83.8
7.6 - 8.5	33	188	9.2	308.2	8.5	3,348.4	92.3
6.6 - 7.5	25	213	6.6	166.1	4.6	3,514.6	96.8
5.6 - 6.5	12	225	4.4	51.0	1.4	3,565.6	98.3
4.6 - 5.5	17	242	2.9	48.5	1.3	3,614.1	99.6
3.6 - 4.5	7	248	2.0	13.1	.4	3,627.1	99.9
2.6 - 3.5	2	250	1.1	1.8	.1	3,628.9	100.0
Total	250			3,628.9	100.0		
Average			14.5				

1/Rounded to whole numbers.

Table 32—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 8 at end of period—1978

D.b.h. class	Trees per acre[1/]	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - - Number	- - -	Cubic feet	Cubic feet	Percent	Cubic feet	Percent
16.6 - 17.5	2	2	59.7	99.5	2.8	99.5	2.8
15.6 - 16.5	2	3	50.0	83.3	2.3	182.8	5.1
14.6 - 15.5	5	8	44.0	220.2	6.1	403.0	11.2
13.6 - 14.5	8	17	36.8	306.8	8.5	709.7	19.7
12.6 - 13.5	22	38	31.5	682.7	19.0	1,392.4	38.7
11.6 - 12.5	15	53	24.9	373.7	10.4	1,766.1	49.1
10.6 - 11.5	25	78	20.2	504.4	14.0	2,270.5	63.1
9.6 - 10.5	30	108	15.7	470.0	13.1	2,740.4	76.2
8.6 - 9.5	32	140	12.4	391.2	10.9	3,131.6	87.1
7.6 - 8.5	22	162	9.1	197.9	5.5	3,329.5	92.6
6.6 - 7.5	23	185	6.1	143.5	4.0	3,473.0	96.6
5.6 - 6.5	12	197	4.6	53.8	1.5	3,526.8	98.0
4.6 - 5.5	18	215	2.6	47.1	1.3	3,573.9	99.4
3.6 - 4.5	17	232	1.3	22.0	.6	3,595.9	100.0
2.6 - 3.5	2	233	.8	1.3	.0	3,597.2	100.0
Total	233			3,597.2	100.0		
Average			15.4				

[1/]Rounded to whole numbers.

Table 33—Stampede Creek: live trees per acre by d.b.h. class, volume per tree, volume per acre, and cumulative volume per acre, treatment 9 (control) at end of period—1978

D.b.h. class	Trees per acre 1/	Cumulative trees per acre	Volume per tree	Volume per acre		Cumulative volume per acre	
Inches	- - Number	- -	Cubic feet	Cubic feet	Percent	Cubic feet	Percent
16.6 - 17.5	2	2	59.3	98.8	2.0	98.8	2.0
15.6 - 16.5	0	2	0	0	0	98.8	2.0
14.6 - 15.5	2	3	45.9	76.5	1.6	175.3	3.6
13.6 - 14.5	2	5	37.5	62.4	1.3	237.7	4.8
12.6 - 13.5	8	13	31.3	258.9	5.3	496.6	10.1
11.6 - 12.5	20	33	26.0	520.7	10.6	1,017.3	20.7
10.6 - 11.5	42	75	20.7	862.7	17.6	1,880.0	38.3
9.6 - 10.5	37	112	16.1	589.0	12.0	2,469.0	50.3
8.6 - 9.5	52	163	12.8	658.9	13.3	3,127.8	63.8
7.6 - 8.5	50	213	9.5	473.5	9.6	3,601.3	73.4
6.6 - 7.5	60	273	6.7	403.0	8.2	4,004.3	81.6
5.6 - 6.5	70	343	4.7	326.1	6.6	4,330.4	88.3
4.6 - 5.5	95	438	2.8	262.9	5.4	4,593.4	93.6
3.6 - 4.5	92	530	1.5	141.5	2.9	4,734.8	96.5
2.6 - 3.5	130	660	.8	101.5	2.1	4,836.3	98.6
1.6 - 2.5	227	887	.3	68.6	1.4	4,904.9	100.0
Total	887			4,904.9	100.0		
Average			5.5				

[1/]Rounded to whole numbers.

Study area	*Cooperator*
Skykomish	Western Forestry Research Department Weyerhaeuser Company Centralia, Washington
Hoskins	School of Forestry Oregon State University Corvallis, Oregon
Rocky Brook	USDA Forest Service Pacific Northwest Region and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Clemons	Western Forestry Research Department Weyerhaeuser Company Centralia, Washington
Francis	Washington State Department of Natural Resources Olympia, Washington
Iron Creek	USDA Forest Service Pacific Northwest Region and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Stampede Creek	USDA Forest Service Pacific Northwest Region and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Sayward Forest	Canadian Forestry Service Department of the Environment Victoria, British Columbia
Shawnigan Lake	Canadian Forestry Service Department of the Environment Victoria, British Columbia

Consultative services have been provided by the University of Washington, Seattle, and the Bureau of Land Management, U.S. Department of the Interior.

WILLIAMSON, RICHARD L.; CURTIS, ROBERT O. 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; **1984.** 42 p.

Results of the Stampede Creek LOGS study in southwest Oregon are summarized, and results are compared with two more-advanced LOGS studies and, in general, are similar. To age 43, thinning in this low site III Douglas-fir *(Pseudotsuga menziesii* (Mirb.) Franco) stand resulted in some reduction in volume growth and moderate gains in diameter growth. Growth was strongly related to level of growing stock. Desirable density levels are recommended for young Douglas-fir stands.

KEYWORDS: Growing stock (-increment/yield, increment -) growing stock management, stand density, thinnings, Douglas-fir, *Pseudotsuga menziesii,* southwest Oregon, Oregon (southwest), series—Douglas-fir LOGS.

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