Levels-Of-Growing-Stock Cooperative Study in Douglas-fir: Report No. 16 – Sayward Forest and Shawnigan Lake

Dennis Beddows

Information Report BC-X-393

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
Victoria, British Columbia

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Table 1. Levels-of-growing-stock study treatment schedule, showing percent of gross basal area increment of control plots to be retained in growing stock.

	Treatment							
Thinning	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

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 started with a common level of growing stock established by a calibration thinning.

Thinning interval is controlled by the 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, USA, and on Vancouver Island, British Columbia, Canada. Site quality of these areas varies from I to IV.

This is a progress report on this cooperative study.

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In 1969, the Canadian Forest Service (CFS) joined the Levels-Of-Growing-Stock (LOGS) cooperative study in Douglas-fir, coordinated by the Pacific Northwest Research Station, U.S. Forest Service, Portland, Oregon. While following the cooperative study publication format, the CFS is publishing its own reports on work done under the LOGS program. Thus, this report is both Report No. 16 in the LOGS series and CFS Information Report BC-X-393.

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Aerial photo of the Level-of-Growing-Stock (LOGS) installation at Shawnigan Lake, British Columbia. July 28, 1998.

Figures

Abstract

Results from the two levels-of-growing-stock installations at Sayward Forest and Shawnigan Lake on Vancouver Island, British Columbia, Canada, are summarized. Volume growth at both the site-III Sayward Forest installation to age 51 and the site-IV Shawnigan Lake installation to age 52 has been strongly related to level of growing stock. Basal area growth followed a similar, though weaker, trend. Thinning has affected stand development through tree size distribution and live crown development. Periodic annual increments in volume at both installations are still two to three times the mean annual increment, indicating the potential for productivity gains as the treated stands age. Results to date from both installations are similar to results from other cooperative installations, generally differing from the more productive sites only in the rate and degree of response associated with a lower site quality.

Résumé

Les résultats de la recherche sur la densité du matériel sur pied aux installations de la forêt Sayward et de Shawnigan Lake dans l'île de Vancouver (Colombie-Britannique) au Canada sont résumés. Une relation étroite a été mise en évidence entre la densité et l'accroissement du volume jusqu'à 51 ans au site de la forêt Sayward (classe III) et jusqu'à 52 ans à celui de Shawnigan Lake (classe IV). Une tendance similaire, mais plus faible, a été observée pour l'accroissement de la surface terrière. L'éclaircie a influé sur le développement des peuplements en modifiant la distribution de la taille des arbres et en stimulant le développement du houppier. L'accroissement annuel périodique du volume aux deux installations est encore de deux à trois fois supérieur à l'accroissement annuel moyen, indiquant des gains potentiels de productivité avec le vieillissement des peuplements traités. Les résultats des deux installations jusqu'à maintenant sont similaires à ceux d'autres installations du projet conjoint, différant généralement des sites plus productifs seulement par la vitesse et l'intensité de la réaction des arbres, correspondant à la qualité inférieure des sites.

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

Williamson, Richard L.; Staebler, George R. 1965. A cooperative levels-of-growing-stock study in Douglas-fir. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station. Portland, OR. 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-111. 12 p.

Thinning regimes in young Douglas-fir stands are described. Some characteristics of individual stands 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-130. 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). Canadian Forestry Service, Pacific Forest Research Centre, Victoria, BC. Information Report BC-X-66. 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-210. 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-257. 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 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. Environment Canada, Canadian Forestry Service, Pacific Forest Research Centre, Victoria, BC. Information Report BC-X-223. 54 p.

Data are presented for the first 8 and 6 years at Sayward Forest and Shawnigan Lake, respectively. The effects of the calibration thinning 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.

Williamson, Richard L.; Curtis, Robert O. 1994. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 7 Preliminary results; Stampede Creek, and some comparisons with Iron Creek and Hoskins. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-323. 42 p.

Results of the Stampede Creek LOGS study in southwest Oregon are summarized through the first treatment period, and results 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.. Research Paper PNW-356. 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 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR.. Research Paper PNW-376. 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-448. 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 foot 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. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-442. 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.; Clendenen, Gary W. 1994. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 12 – the Iron Creek study: 1966-89. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-475. 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. 1996. Levels-of-growing-stock cooperative study in Douglas-fir: report no. 13 – the Francis Study: 1963-90. USDA Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, OR. Research Paper PNW-488. 91 p.

Results of the Francis installation are summarized together with results from additional first-thinning treatments started at age 25. Total volume growth on this mid-site-II Douglas-fir plantation has been strongly related to level of growing stock. Growth of lower levels of growing stock exceeded that of the control for only a brief period at age 30. Selection of a “best” treatment would depend on the unit of measure used: yield in total cubic-foot volume, merchantable cubic-foot volume, board-foot volume or dollar value. 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. General silvicultural prescriptions could be written to achieve the results of any of the treatments on similar sites.

Introduction

The Levels-Of-Growing-Stock (LOGS) Cooperative was established to examine the effects of different levels of growing stock on cumulative wood production, tree size development, and ratios of growth to growing stock in young Douglas-fir [*Pseudotsuga menziesii* (Mirb.) Franco] stands in the Pacific Northwest. The Cooperative, comprised of the USDA Forest Service, Washington State Department of Natural Resources, Weyerhaeuser Corp, Oregon State University, the British Columbia Ministry of Forests (BCMOF), and the Canadian Forest Service (CFS), was formed in the early 1960s and is coordinated by the Pacific Northwest Research Station of the USDA Forest Service at Portland, Oregon.

From 1961 to 1970, nine installations were established in young Douglas-fir stands in Oregon, Washington and British Columbia (B.C.), representing site classes II, III, and IV (King 1966). Each installation was established according to a comprehensive study plan developed to ensure standardized procedures among cooperators and comparability of results (Williamson and Staebler 1971). Detailed progress reports on individual installations are contained in the series of LOGS publications listed at the beginning of this report.

The two CFS/BCMOF installations, Sayward Forest and Shawnigan Lake, were the last of the nine to be established, and because of their lower site productivity these sites have been slower in their response than those high-site installations established earlier. Sayward Forest has completed the full schedule of treatments and Shawnigan Lake is in its fourth treatment period. Both have advanced enough to expect differences between treatments and to show possible differences in response from stands on better sites. An establishment report (Diggle 1972) and a progress report (Arnott and Beddows 1981) detailed the calibration data and some early results.

This report is one of a series of reports on individual LOGS installations and therefore follows an established format in order to easily compare results among reports. As well, during the decade when the nine installations were being established, English measure was the common measurement system in both countries. Canada converted to metric measure in the 1970s. Again, for purposes of comparability of results with previous reports, results from these two installations will be given in metric and English measure.

Objectives

The objective of the LOGS study plan was to determine how the amount of growing stock retained in repeatedly thinned stands of Douglas-fir affects cumulative wood production, tree size, and growth-growing stock ratios. The treatment regimes were designed to cover a broad range in growing stock levels in order to produce any combination of factors deemed optimum from a management standpoint. The treatments were not specific operational thinning regimes, but were intended to examine the relationship between growth and growing stock.

Methods

Description of the study areas

Sayward Forest

The Sayward Forest installation is on provincial Crown land located in the Sayward Forest 24 km (15 miles) west of Campbell River, B.C. (Figure 1). The installation was established in the autumn of 1969 in a plantation planted in the spring of 1950 with 2-year-old Douglas-fir seedlings. The site was evaluated as a site index of 111 feet (34 m) at age 50 (King 1966). Initial stand density was approximately 2471 stems/ha (1000 stems per acre) and had a minor natural fill-in component of western hemlock [*Tsuga heterophylla* (Raf.) Sarg.], western redcedar (*Thuja plicata* Donn ex D. Don), western white pine (*Pinus monticola* Dougl. ex D. Don) and lodgepole pine (*Pinus contorta* Dougl. ex Loud. var. *latifolia Engelm.*) (Diggle 1972).

The stand, situated at about 274 m (900 feet) above sea level, is on a gently rolling slope with a westerly aspect. The soil is a well-drained young podzol developed on a sandy, gravelly glacial till and is classified as a mini humo-ferric podzol (Canada Department of Agriculture 1970). Local average annual precipitation is 1494 mm (58.8 inches) per year, with 254 mm (10 inches) falling during the 149-day frost-free period. Temperatures are mild with an average growing season temperature of 14.7 ºC (58.4 ºF). Ground vegetation was predominately salal with lesser amounts of Oregon grape, braken fern, red huckleberry and willow.

As outlined in the LOGS study plan, the installation consists of twenty-seven 0.081-ha (1/5 acre) square plots; both Canadian installations have 10.1-m-wide (33-foot-wide) treated plot buffer surrounds (Figure 2). At establishment, the site was inspected for the occurrence of the root rot fungi *Armillaria mellea* and *Poria Weirii*. Two loci were located, plots were relocated to avoid them, and the infected trees were felled and their stumps pulled.

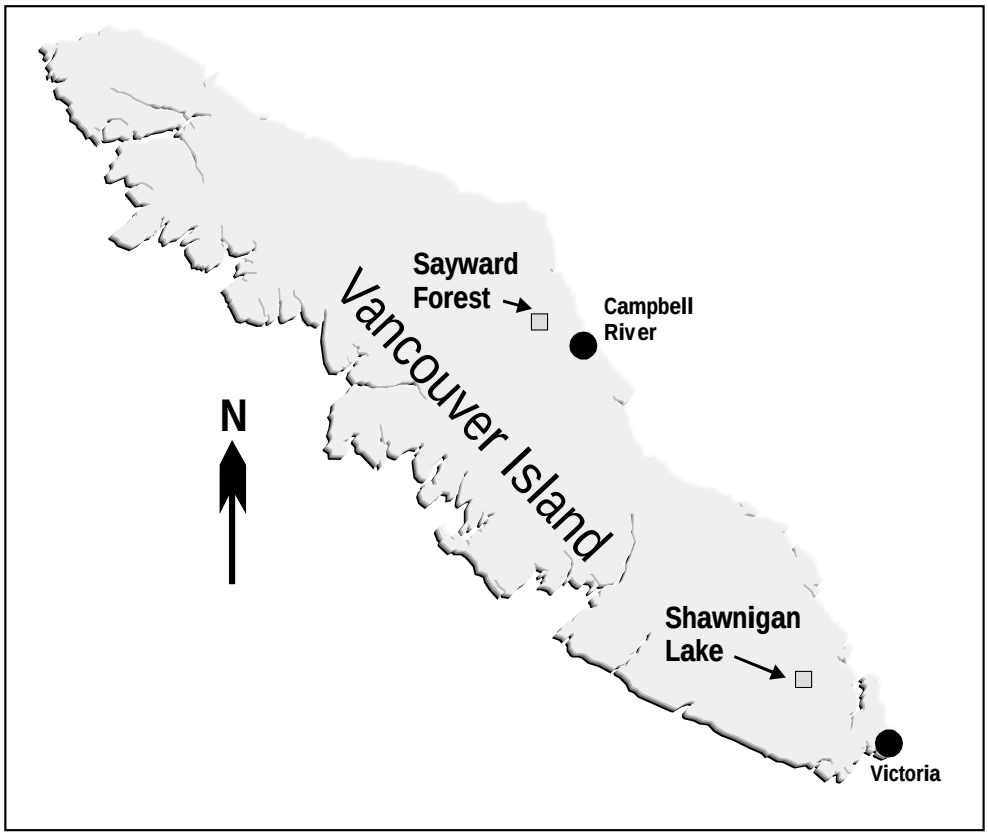

Figure 1. Location of the Sayward Forest and Shawnigan Lake levels-of-growing-stock study installations.

Shawnigan Lake

The Shawnigan Lake installation is located on provincial Crown land 8.0 km (5 miles) west of Shawnigan Lake, B.C. (Figure 1). The installation was established in the autumn of 1970 in a plantation planted in the spring of 1948 with 2-year-old Douglas-fir seedlings. The site was evaluated as a site index of 94 feet (29 m) at age 50 (King 1966). Initial stand density was approximately 2965 stems/ha (1200 stems/acre) and had a minor natural fill-in component of western hemlock, western redcedar, western white pine and lodgepole pine (Diggle 1972).

The plantation is situated on a flat to gently rolling low ridge 335 m (1100 feet) above sea level, with an easterly aspect. The soil is a sandy loam developed from underlying glacial till and is classified as a mini humo-ferric podzol (Canada Department of Agriculture 1970).

Local average annual precipitation is 1174 mm (46.2 inches) per year, with 178 mm (7 inches) falling during the 149-day frost-free period. Temperatures are mild with an average growing season temperature of 15.6 ºC (60.1 ºF). Ground vegetation was predominately salal with lesser amounts of Oregon grape, bracken fern, red huckleberry and willow.

As with the Sayward Forest installation, the standard LOGS plot layout was enhanced with treated plot buffer surrounds (Figure 3). Because of the size of the plantation and its uniformity, a series of extra plots were established at the same time. As well, an independent installation was established adjacent to the LOGS site to study the effects of thinning and nitrogen fertilization on stand yields and tree growth processes (Crown and Brett 1975).

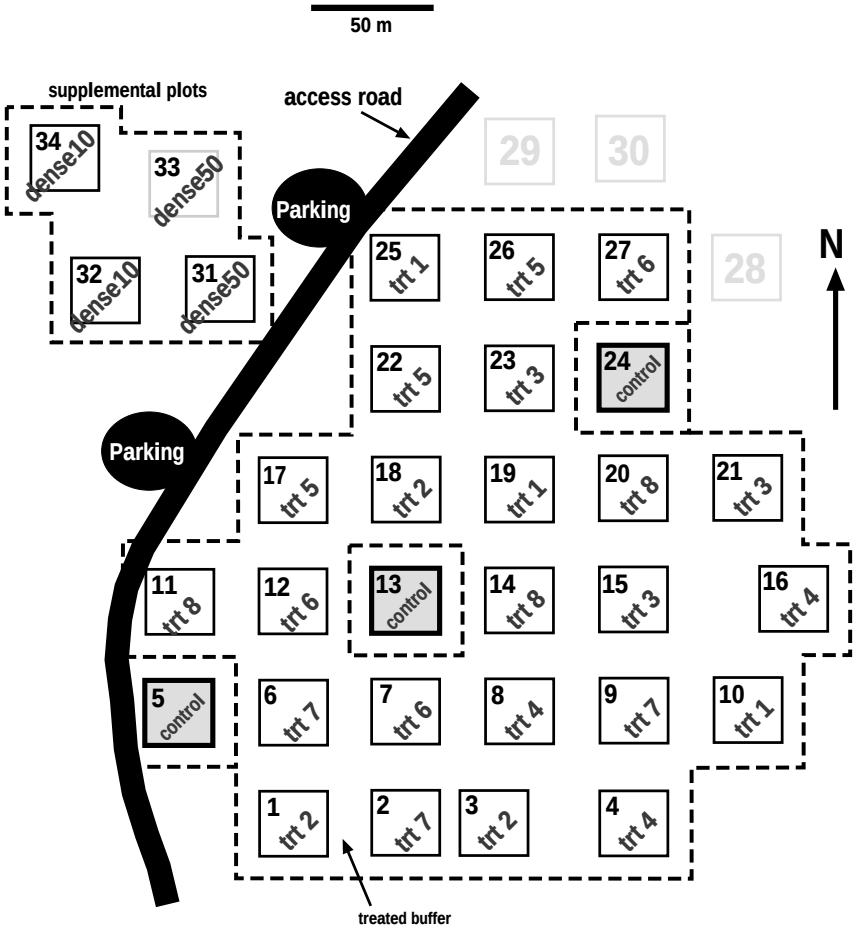

Figure 2. Plot layout of the Sayward Forest level-of-growing-stock installation.

Experimental design

A detailed description of the LOGS study excerpted (and paraphrased) from Williamson and Staebler (1971) is included in Appendix 1. In summary, each installation in the LOGS study plan consists of twenty-seven 0.081-ha (1/5-acre) square plots which allows for the testing of eight thinning regimes against a control; there are three replications of each treatment regime in a completely random design. After an initial calibration thinning, treatments assigned to the thinned plots are defined in terms of retained percentages of the gross basal area increment observed on the control plots. The treatments, after a calibration period, are applied over five subsequent periods; the interval between treatments is based on an average crop tree height increment of 3.1 m (10 feet).

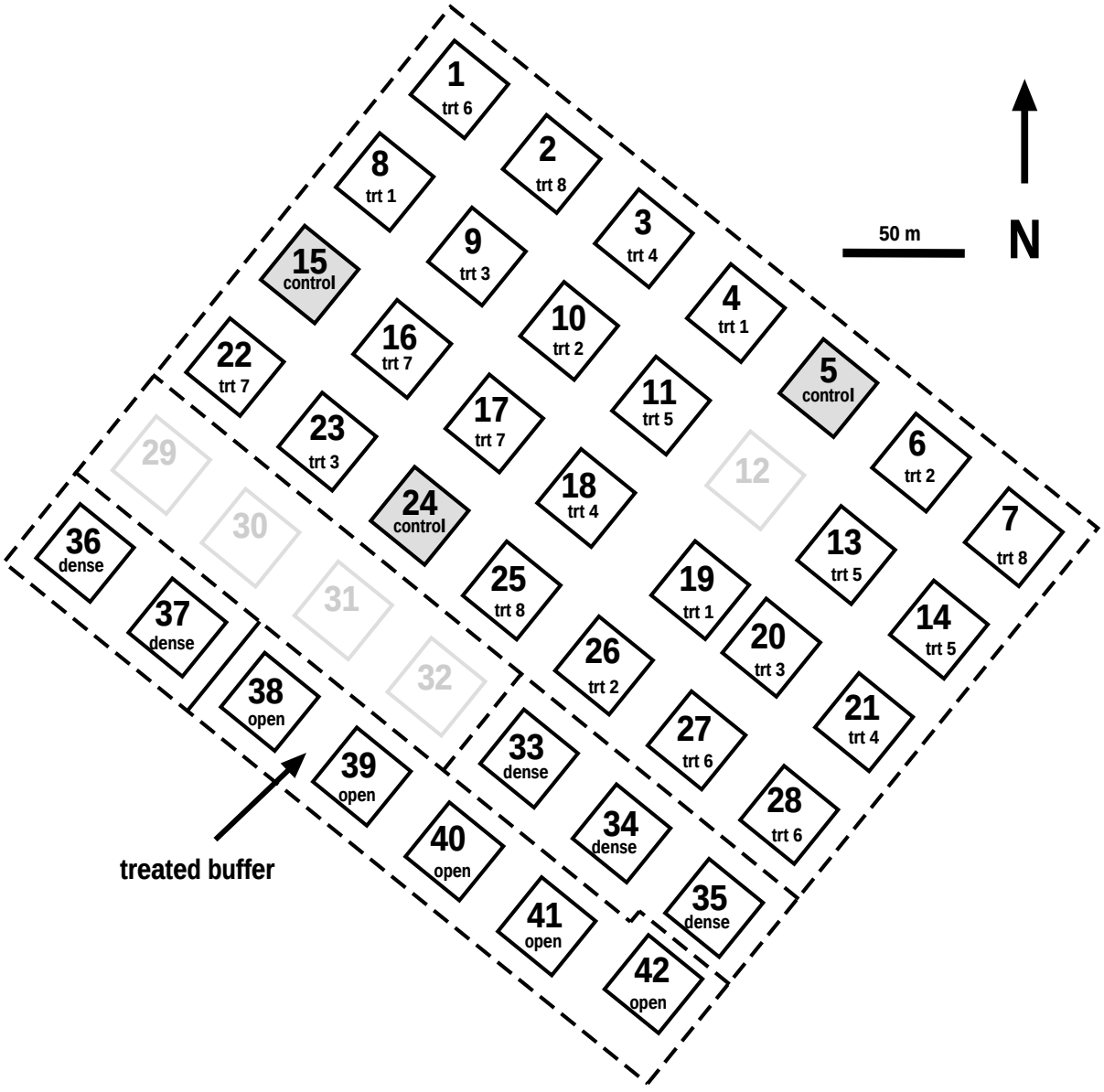

Figure 3. Plot layout of the Shawnigan Lake level-of-growing-stock installation.

Stand treatments

In order to allow comparisons, the initial calibration stocking density and the subsequent thinning treatments were rigidly controlled.

Calibration thinning

An initial calibration thinning was done on the 24 treatment plots to bring them to a common stocking. The stocking density was chosen so that the remaining trees would have abundant space for development during the interval to the first treatment thinning. The calibration stocking target was specified in the study plan using the formula:

$$S = 0.6167 \times QMD + 8$$

where S is the average spacing in feet and QMD is the quadratic mean diameter of the leave trees. Prior to estimating the QMD, crop trees – well-formed, uniformly spaced, dominant trees – were selected at a rate of 198 stems/ha (80/acre). Non-crop leave trees were then selected according to study criteria, i.e., no trees should be retained whose diameter was less than one-half the average diameter of the crop trees, and spacing of leave trees should be as uniform as possible.

The study plan further specified rigid guidelines, dependent on the control criterion chosen: when control criterion was the number of trees, the average diameter of leave trees should be within 15% of the installation mean; when control criterion was basal area, average diameter of leave trees should be within 10% of the installation mean.

Treatment thinnings

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 (see Table 1 on the 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.

Thinning guidelines were as follows:

1. No crop tree may be cut until all non-crop 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. This results in a d/D ratio (ratio of diameter of trees cut to diameter of available trees for cutting) of less than 1.0, and this can be characterized as a crown thinning. The d/D ratios were calculated for both installations (Sayward 0.85: Shawnigan 0.82) with no clear trends over time and treatment.
3. The diameters of cut trees should be distributed across the full range of trees available for cutting.

Study supplement – density variation

At establishment, variations on the initial calibration densities were initiated.

At Sayward, four plots were established with a higher initial calibration density – 1223 stems/ha (495 stems/acre). Two treatment thinning regimes, replicated twice, were applied in 1973, after the completion of the initial calibration period; treatment 5 (“dense50”) and treatment 1 (“dense10”). The plots were abandoned in 1975 as a result of program review and left with no further treatment or measurement until the fall of 1999, when they were remeasured. The results are presented with the Sayward summaries.

At Shawnigan, a series of plots were established with two initial calibration densities: a higher initial calibration density (“dense”) at 1322 stems/ha (535 stems/acre); and a lower initial calibration density (“open”) at 704 stems/ha (285 stems/acre). As with Sayward, these plots were abandoned in 1975, before the initial calibration period was complete, and left until remeasurement in 1996. The results are presented with the Shawnigan summaries.

Data collection and summarization

The LOGS study plan detailed the data collection protocol for all installations.

At establishment, each tree was identified with a tag, a permanent breast height was marked, and a diameter (dbh) was measured to the nearest 0.1 inches prior to 1975, and to the nearest millimetre thereafter. For each plot, heights were measured on a sample of trees distributed across the diameter range. These measurements were repeated at the end of the calibration period and at the end of each subsequent treatment period. Measurement dates for Sayward Forest are 1969, 1973, 1977, 1981, 1987, 1993 and 1999; for Shawnigan Lake the measurement dates were 1970, 1976, 1982, 1989, and 1996.

Total volume, inside bark, was calculated in cubic feet for each height sample tree by the volume equation of Bruce and DeMars (1974). Total volume was estimated for each tree by regressions of logarithm of volume on logarithm of dbh fit to the height sample tree measurements for each plot and measurement date. Plot volume was then calculated as the sum of the tree volumes. Periodic gross volume and basal area growth was calculated as the difference between live volume and basal area at the start and end of each growth period, plus mortality (and any measurable ingrowth, in the control plots only).

Other reports in the LOGS series (Marshall *et al.* 1992; Curtis and Clendenen 1994; Hoyer *et al.* 1996) have provided summarization by "merchantable volumes" to illustrate the implications of treatment results on future value. Utilization standards differ throughout the region and have changed many times since the establishment of the cooperative, making comparisons of merchantable volumes between installations difficult. However, characterizations of merchantable volumes are valuable in making comparisons between treatments within an installation to further illuminate their differences. In this report, merchantable volumes were summarized for each treatment using the calculated total tree volumes of all trees with a diameter greater than 17.5 cm (6.93 inches). Periodic diameter increment was calculated for trees surviving to the end of each period (Curtis and Marshall 1989).

Capitalizing on the experience gained elsewhere with the establishment of the previous seven LOGS installations, additional measurements of note were taken at both Sayward and Shawnigan Lake. All trees at both installations were stem mapped on an x-y coordinate system. Height-to-live crown was measured on all trees at both installations at establishment, and on a sample at Shawnigan 1996 and at Sayward in 1999.

As well, results from other LOGS sites indicate limitations in some original measurement variables. To overcome these limitations, additional stand development categories were calculated.

At establishment, the study plan called for the selection of designated crop trees (well-formed, uniformly spaced, dominant trees) at a rate of 16 per plot (198/ha; 80/acre). Two additional stand development variables were calculated for comparison with the crop tree variable: L198, the largest 198 trees per hectare (80/acre) by diameter; and L99, the largest 99 trees per hectare (40/acre) by diameter. Both additional variables were calculated by substituting mean volume and diameter of the largest 16 trees by diameter (L198), and the largest 8 trees by diameter (L99), per plot in the Bruce and De Mars (1974) volume equation and solving for height (Curtis and Marshall 1986; Curtis 1992; Marshall *et al.* 1992; Curtis and Clendenen 1994).

Mean annual increment (mai) and periodic annual increment (pai) were not specifically considered in the original study plan. However, previous results in the LOGS series have shown that the general trends in pai and mai are consistent across plots, treatments and installations (Curtis *et al.* 1997) and therefore have been included here.

Analyses

The study plan called for an analysis of variance (ANOVA) for each installation upon completion of the full treatment schedule. Of the two CFS/BCMOF installations, only Sayward has reached this point, and the results of the ANOVA are reported here. As well, results to date for both installations are presented in graphical and tabular form in a similar format to other installation results.

Results

Summary tables

Summary tables, in metric and imperial measure, for both installations are given in Appendix 2.

Plot statistics and treatment statistics for the live stand at each measurement are summarized in Tables 2a-5b and Tables 6a-9b, respectively, for Sayward, and in Tables 10a-13b and Tables 14a-17b, respectively, for Shawnigan Lake.

Trends in live stand statistics

Number of trees

Trends over time by treatment in trees per unit area are shown in Figure 4a (Sayward) and 4b (Shawnigan). The corresponding numerical values are given in Tables 6 (Sayward) and 14 (Shawnigan). Initial stocking of treatment plots after calibration was uniform in both installations. To date, the numbers of remaining trees reflect the levels of thinning as dictated by treatment parameters and the trend is consistent with other installations. The decrease in numbers of trees in the treated plots reflects the trees removed through thinning, while the decrease in the control is through suppression mortality. Tree numbers for the supplemental treatments at both Sayward and Shawnigan show a slight decline through root rot mortality over time.

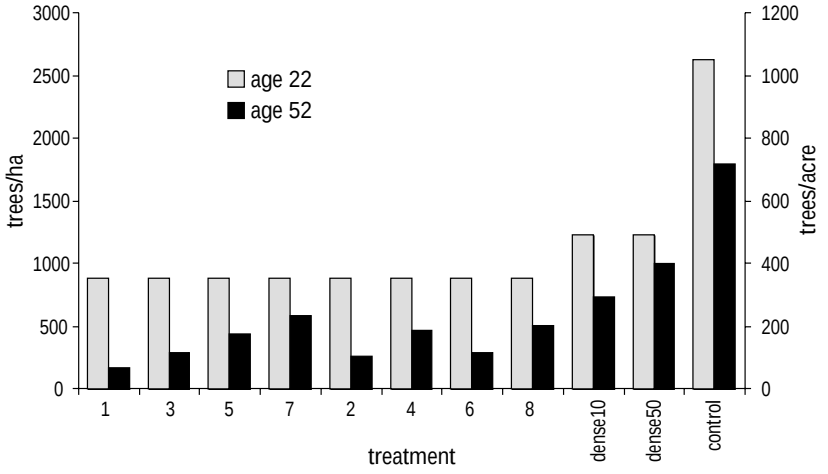

Figure 4a. Number of live trees by treatment over time – Sayward.

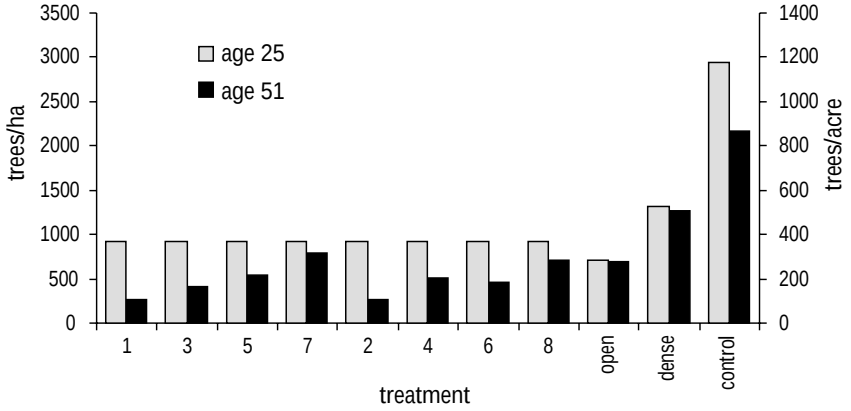

Figure 4b. Number of live trees by treatment over time – Shawnigan.

Diameter development

Trends over time by treatment in QMD are shown in Figures 5a (Sayward) and 5b (Shawnigan). The corresponding numerical values are given in Tables 7 (Sayward) and 15 (Shawnigan). The QMD response over time is consistent with results from other installations. At calibration, the QMD for the treatments were, by design, essentially the same, while the lesser control value reflects the large number of understorey, small-diameter trees. The response to treatments is as expected; lower densities produce larger diameter trees.

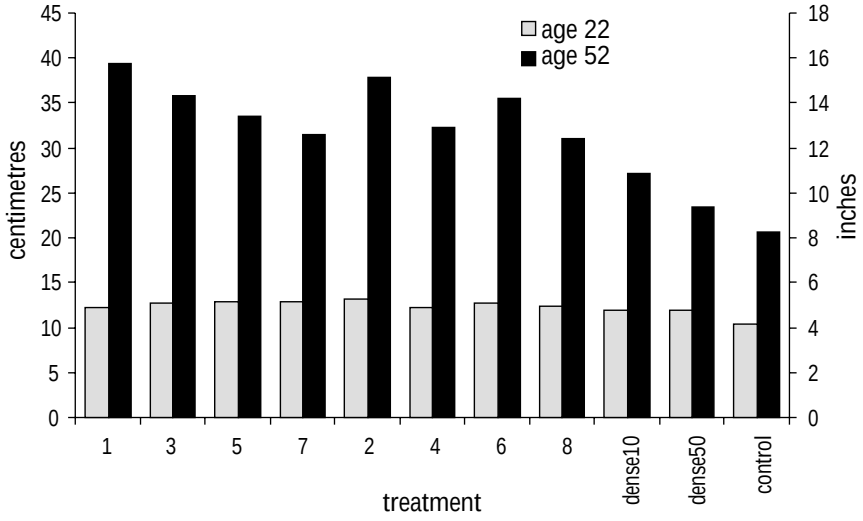

Figure 5a. Quadratic mean dbh by treatment over time – Sayward.

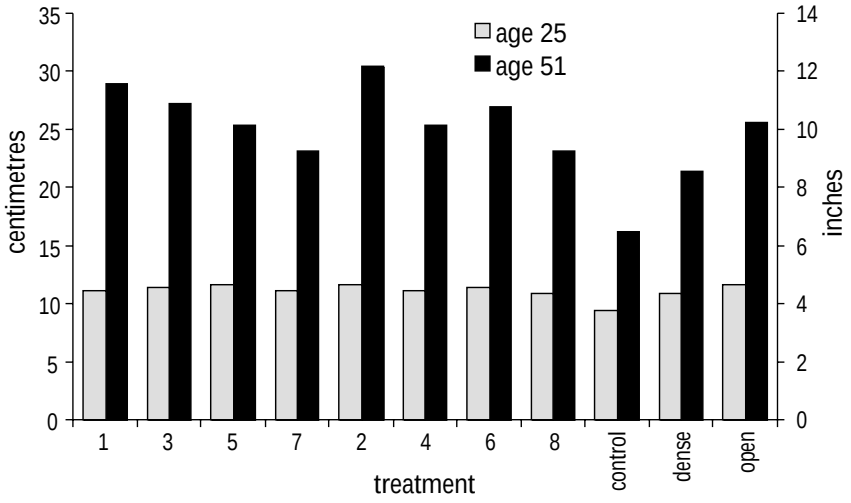

Figure 5b. Quadratic mean dbh by treatment over time – Shawnigan.

Basal area

Trends over time by treatment for basal area are shown in Figure 6a (Sayward) and 6b (Shawnigan). The corresponding numerical values are given in Tables 8 (Sayward) and 16 (Shawnigan). As with diameter response, the initial levels of basal area following calibration were tightly controlled to give a uniform level across treatments. The control value was greater as a reflection of the greater number of stems. The response over time to the treatments has produced a trend consistent with other installations, with the control values still greater than the treatments. Of note is the response of the "dense" and "open" treatments at Shawnigan Lake, both which have produced more basal area than the LOGS treatments; basal area in the "dense" treatment in approaching those of the control.

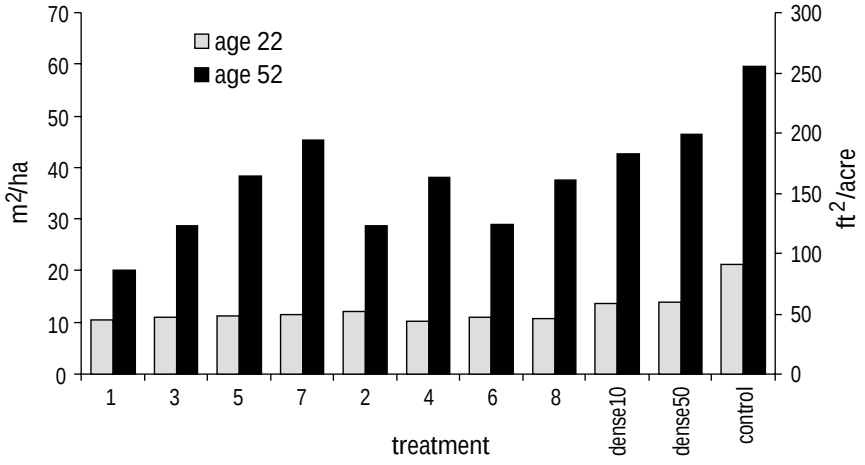

Figure 6a. Basal area by treatment over time – Sayward.

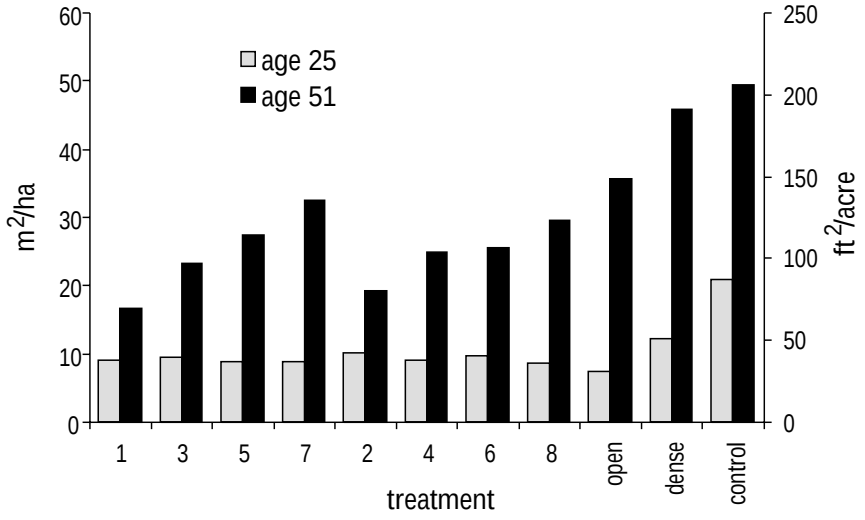

Figure 6b. Basal area by treatment over time – Shawnigan.

Relative density measures

Figures 7a (Sayward) and 7b (Shawnigan) show trends of Curtis's (1982) relative density measure, RD, over time for the thinning treatments. The RD values have been reported in previous reports (Curtis and Marshall 1986; Curtis 1992; Curtis and Clendenen 1994; Hoyer *et al.* 1996) and are included here for comparison purposes. The RD trends at both installations are consistent with those of other installations. The RD trend for each control is included as a reference point for the thinning treatments, and the asymptote represents an estimate of the maximum attainable density in an unthinned stand at each location.

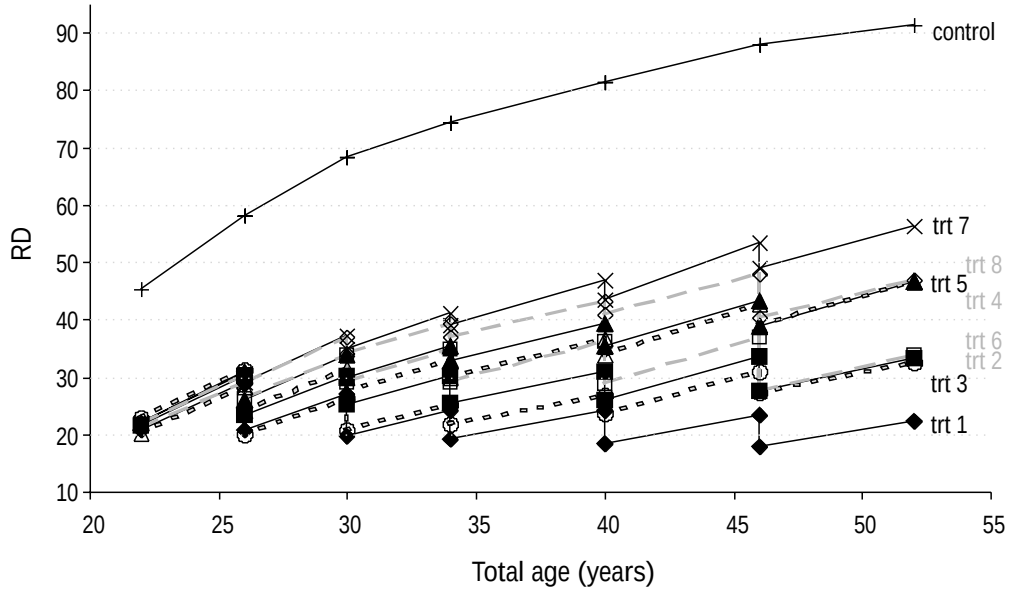

Figure 7a. Relative density [RD = basal area/SQRT(QMD)] by treatment over time - Sayward

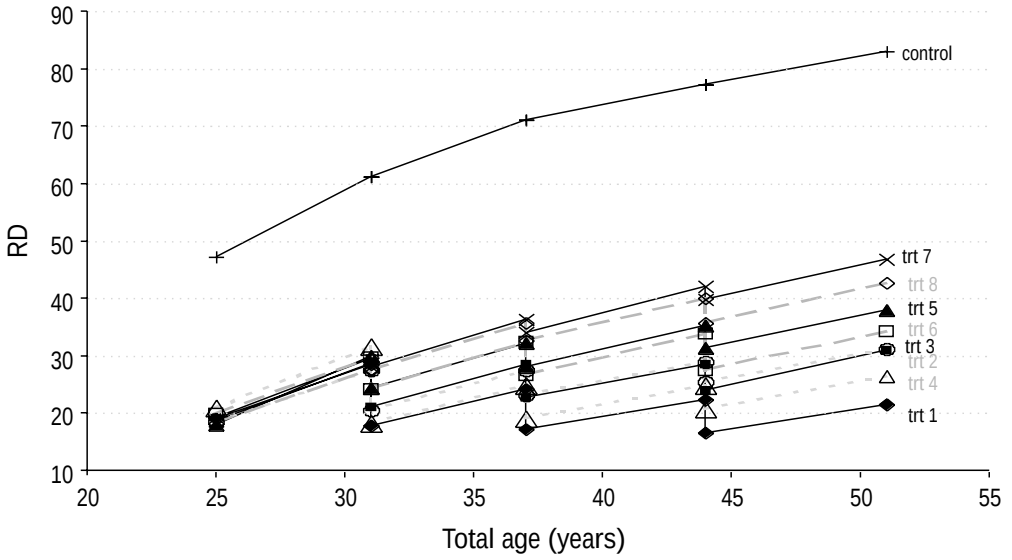

Figure 7b. Relative density [RD = basal area/SQRT(QMD)] by treatment over time - Shawnigan

Total volume

Trends in total volume over time by treatment are shown in Figure 8a (Sayward) and 8b (Shawnigan). The corresponding numerical values are given in Tables 9 (Sayward) and 17 (Shawnigan). Again, the trends are consistent with those of other installations, with the control producing the greatest total volume and the treatment volumes declining with increased level of thinning. Of note at Shawnigan Lake are the current volumes for the "dense" and "open" treatments: both are out-producing other treatments and, in the case of the "dense" treatment is out-producing the control.

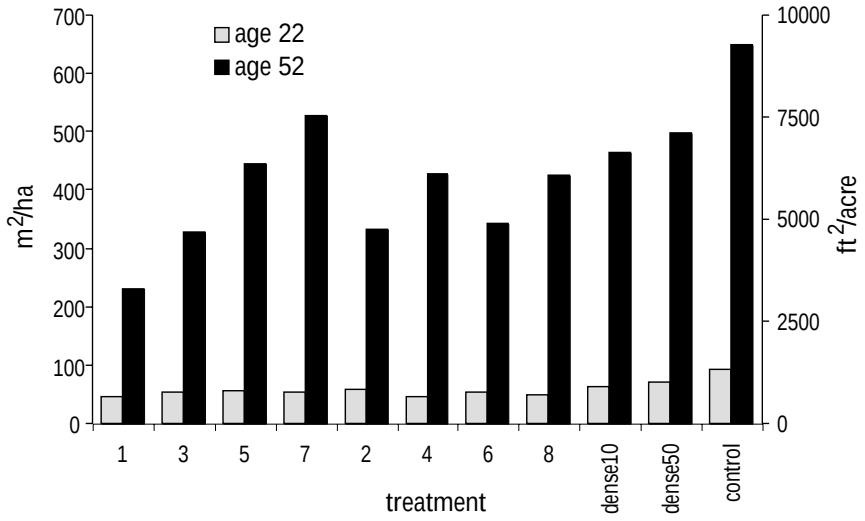

Figure 8a. Volume by treatment over time – Sayward.

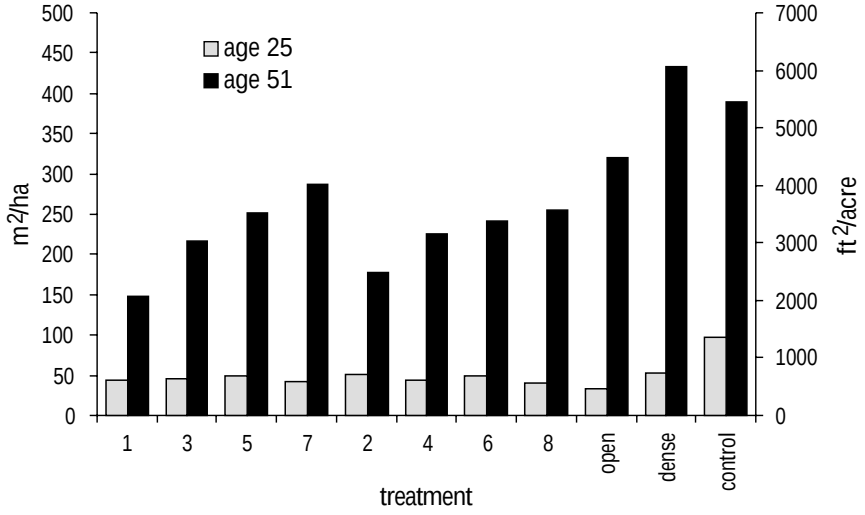

Figure 8b. Volume by treatment over time – Shawnigan.

Crop tree

At establishment, prior to the initial thinning, designated crop trees were selected at a rate of 198 per ha (80 per acre). Crop trees were selected on a combination of vigor and spacing with the intent that they would form the final crop, and, as such, these trees were favored throughout the treatment process. They were uniformly distributed and were not necessarily among the largest 198 per ha (80 trees per acre). The reasoning for crop selection was to provide a common measurement element with relative continuity through all the treatments and allow comparability among installations. However, as reported from a number of other installations, the effectiveness of such comparisons has diminished with replacement of crop trees over time because of damage or poor vigor. Height sampling, sample size and height estimations are an important variable in assessing growth results due to thinning, and there

are drawbacks with the original height sample methodology as reported in earlier LOGS reports (Curtis 1992; Curtis and Marshall 1986). Crop tree comparisons by treatment over time are shown in Tables 18 (Sayward) and 19 (Shawnigan).

Height development

Height trends by treatment over time are presented in Figures 9a (Sayward) and 9b (Shawnigan) and are summarized in Tables 20 (Sayward) and 21 (Shawnigan). There appears to be no relation to thinning treatment.

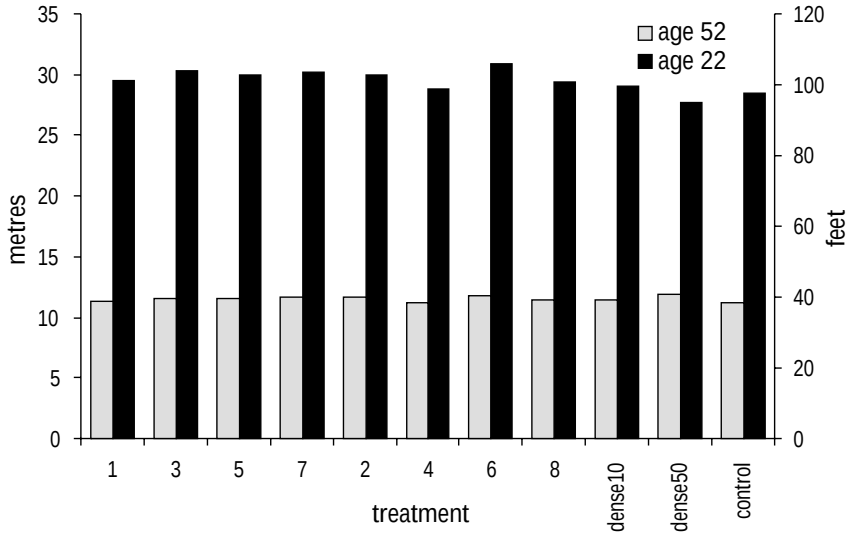

Figure 9a. Height comparison by treatment over time – Sayward.

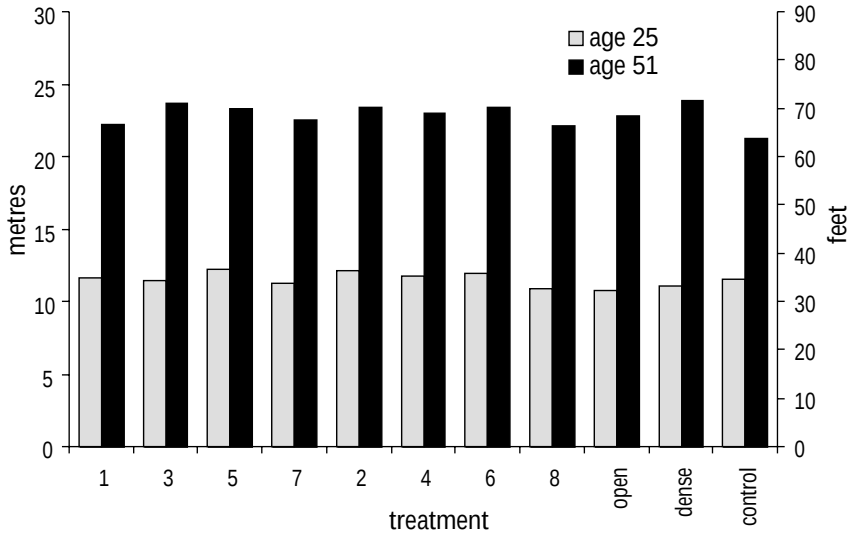

Figure 9b. Height comparison by treatment over time – Shawnigan.

Live crown development

Live crown development by treatment over time is presented in Figures 10a (Sayward to 1999) and 10b (Shawnigan to 1996). The results are similar to those from other installations (Curtis 1992; Marshall *et al.* 1992; Curtis and Clendenen 1994), with longer live crowns associated with lower density treatments.

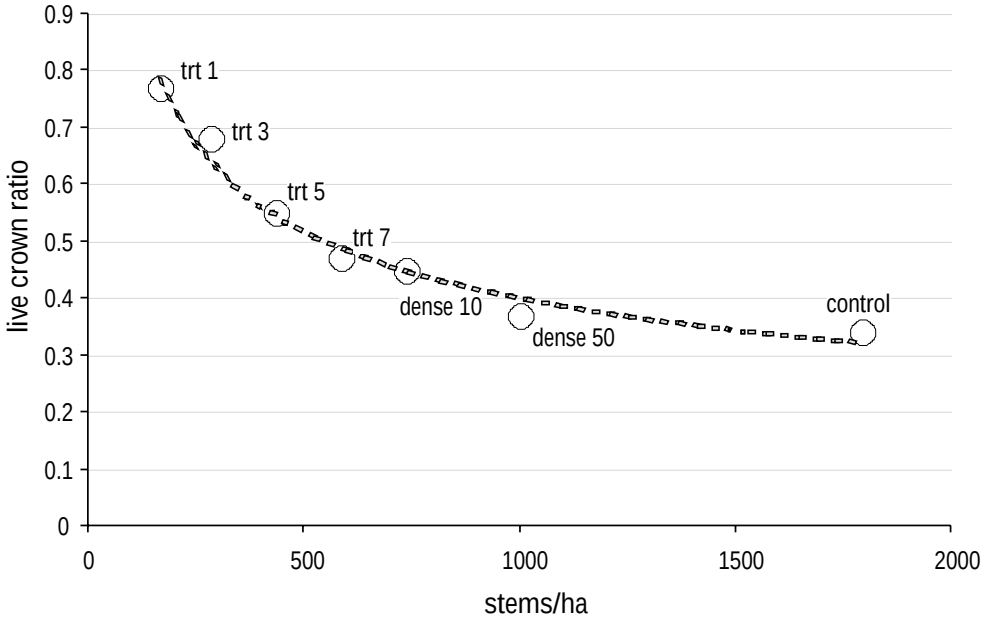

Figure 10a. Live crown ratio by density for selected treatments – Sayward.

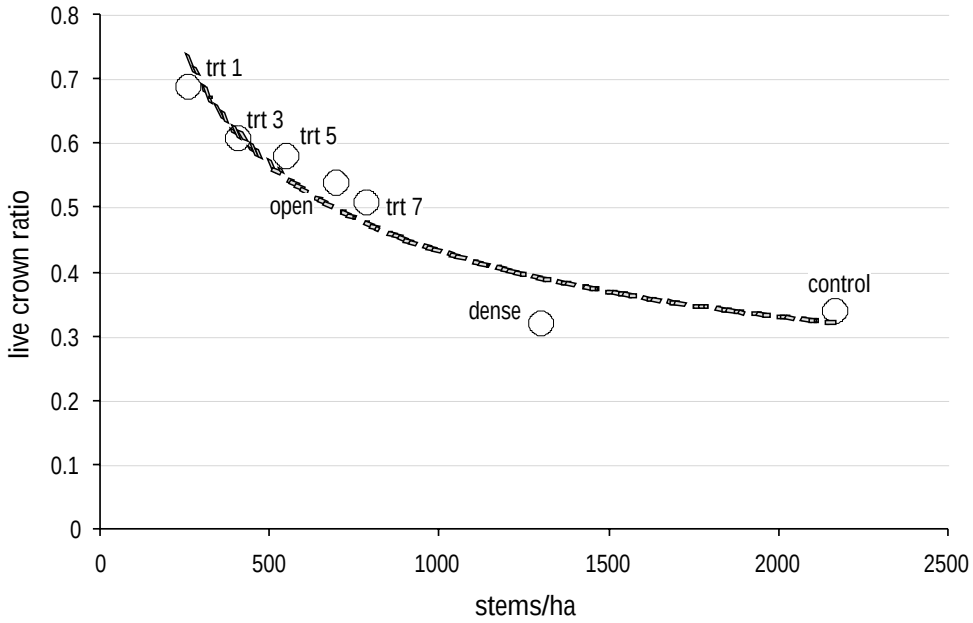

Figure 10b. Live crown ratio by density for selected treatments – Shawnigan.

Cumulative volume production

Cumulative volume results are presented in Figure 11 and Table 22 (Sayward) and in Figure 12 and Table 23 (Shawnigan). Volume removed during thinning is included in the increment for each thinning period. Volume removed at calibration has not been included. Mortality in the treatments was minor and has been rolled into a total mortality volume to date for each treatment. As mortality is becoming an increasingly important factor in the development of the control, control mortality is listed for each treatment period and these data are identified with footnotes.

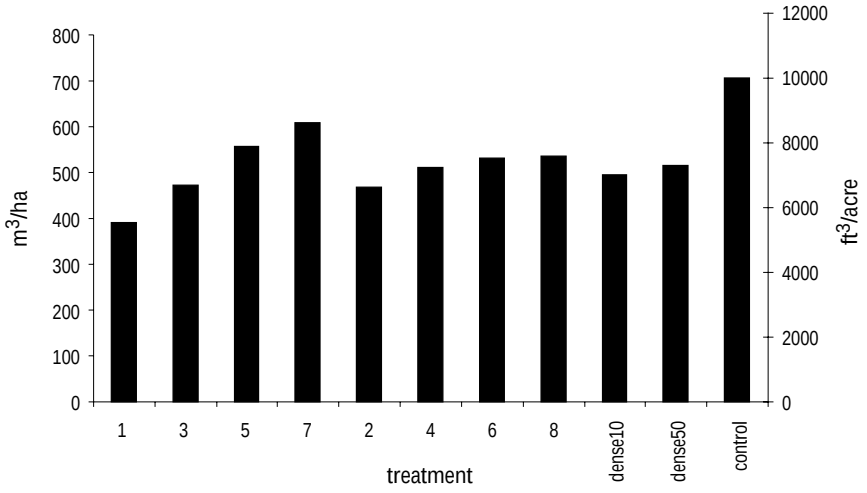

Figure 11. Cumulative volume to age 52 – Sayward.

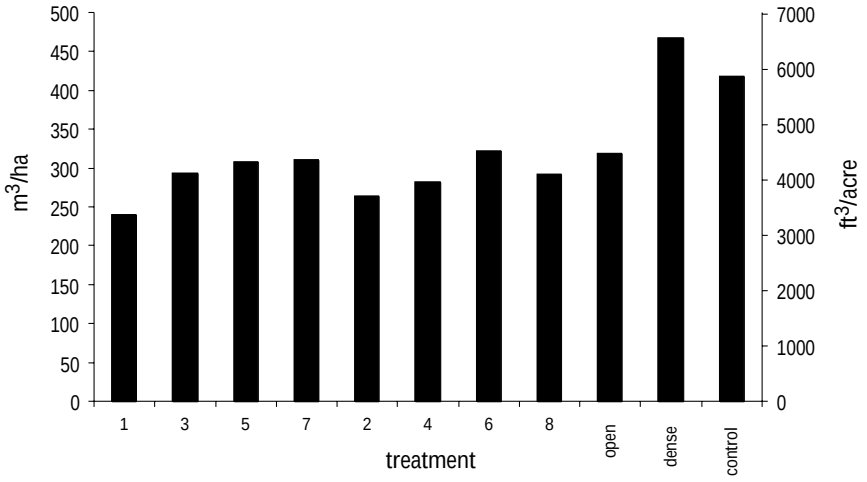

Figure 12. Cumulative volume to age 51 – Shawnigan.

Stand development

Stand development results for both installations are presented in Tables 24 to 27. Stem density distribution by tree size class for each treatment is presented in Tables 24 (Sayward) and 26 (Shawnigan). Volume distribution by tree size class for each treatment is presented in Tables 25 (Sayward) and 27 (Shawnigan). Included in the tables are treatment totals for all live trees and those in the "merchantable" dbh class. Merchantable class is defined as live trees larger than 17.5 cm dbh (6.8 inches dbh). As well, average dbh for all merchantable stems per treatment is listed.

The current total stem volume for all live trees by treatment for both installations is compared with merchantable volume in Figures 13a and b. To date, none of the treatments has exceeded the control in total volume production, with the exception of the "dense" supplemental treatment at Shawnigan. However, a number of treatments are nearing or have surpassed the control when merchantable volumes are compared.

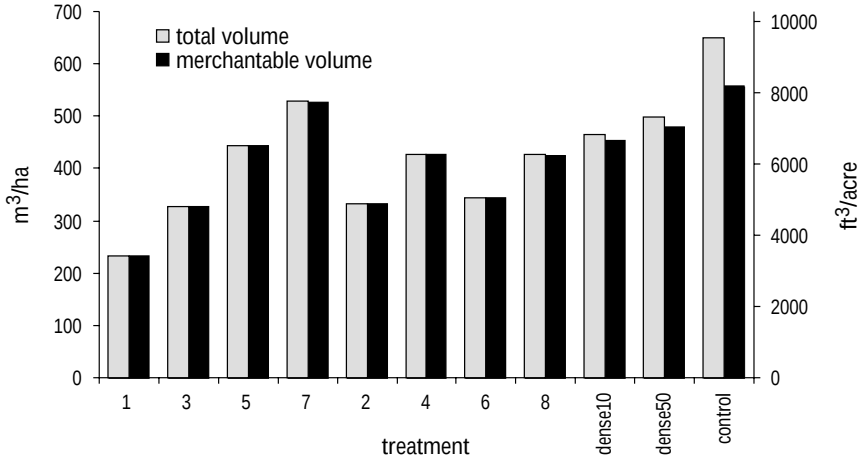

Figure 13a. Volume by treatment at age 52 – Sayward.

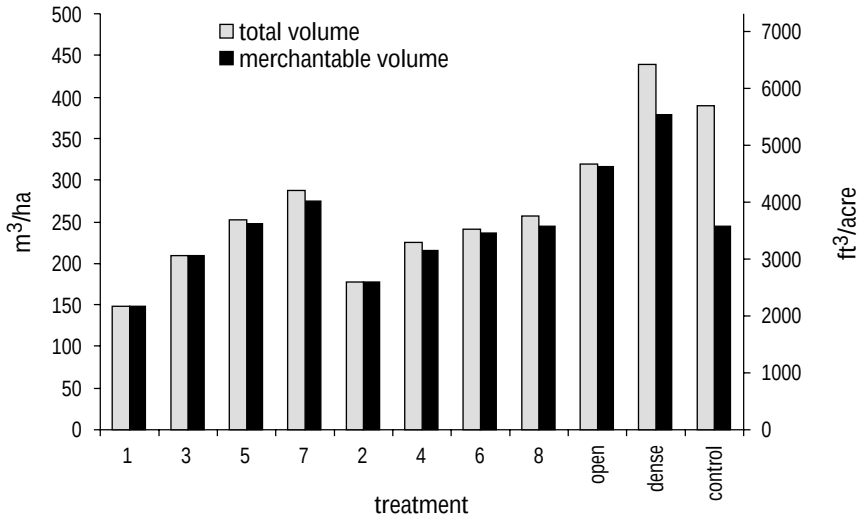

Figure 13b. Volume by treatment at age 51 – Shawnigan.

Periodic annual volume increment (PAI)

Periodic annual volume increment for both installations are presented in Tables 28 (Sayward) and 29 (Shawnigan). Mean annual increments (MAI) are included in both the tables and Figures 14 and 15 to illustrate stand growth responses to the treatments. The trends are consistent with other installations with PAI values about twice the MAI values, indicating in both stands the treatments are far from culmination.

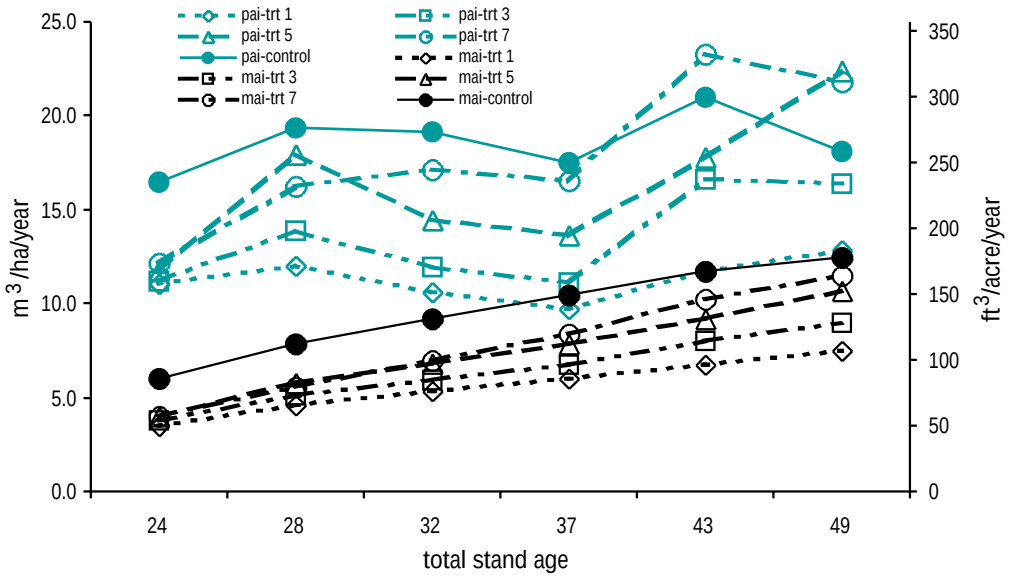

Figure 14a. Sayward pai and mai volume (fixed treatments).

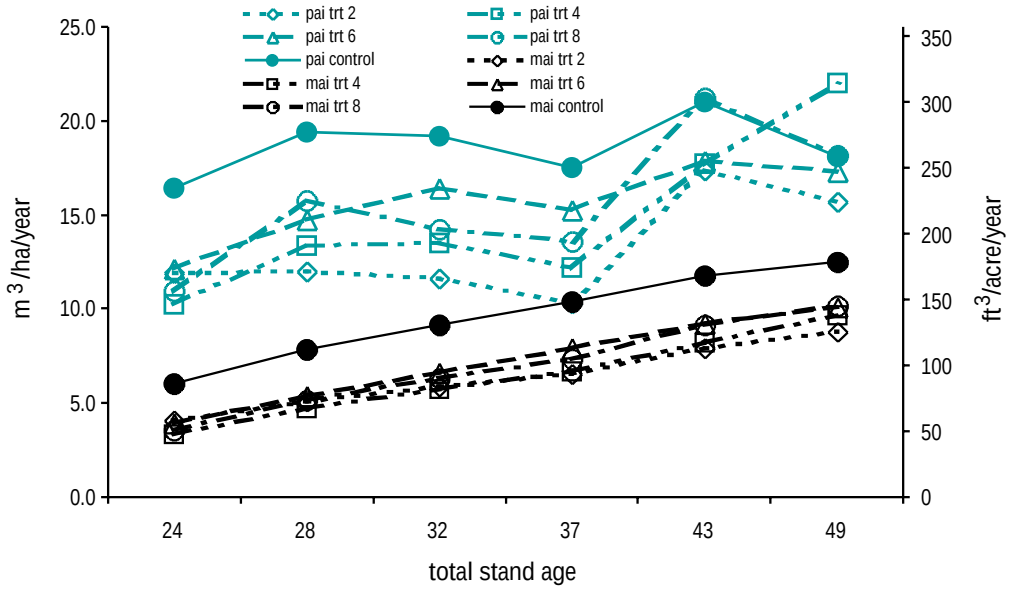

Figure 14b. Sayward pai and mai volume (increasing and decreasing treatments).

Analysis of variance

The original study plan (Williamson and Staebler 1965) called for an analysis of variance (ANOVA) testing differences among treatments in gross basal area periodic annual increment and growth percent, gross total stem volume periodic annual increment and growth percent, and, survivor QMD periodic annual increment (Table 30). The ANOVA results (Table 31) are generally consistent with those from other LOGS installations at the end of the full treatment schedule (Marshall *et al.* 1992; Hoyer *et al.* 1996; Curtis and Clendenen 1994).

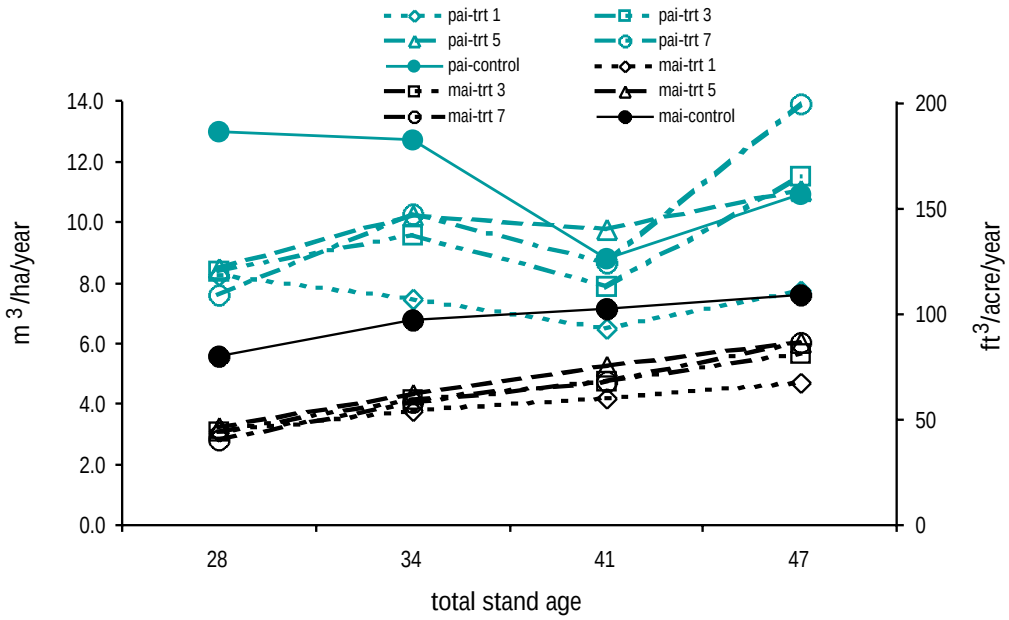

Figure 15a. Shawnigan pai and mai volume (fixed treatments).

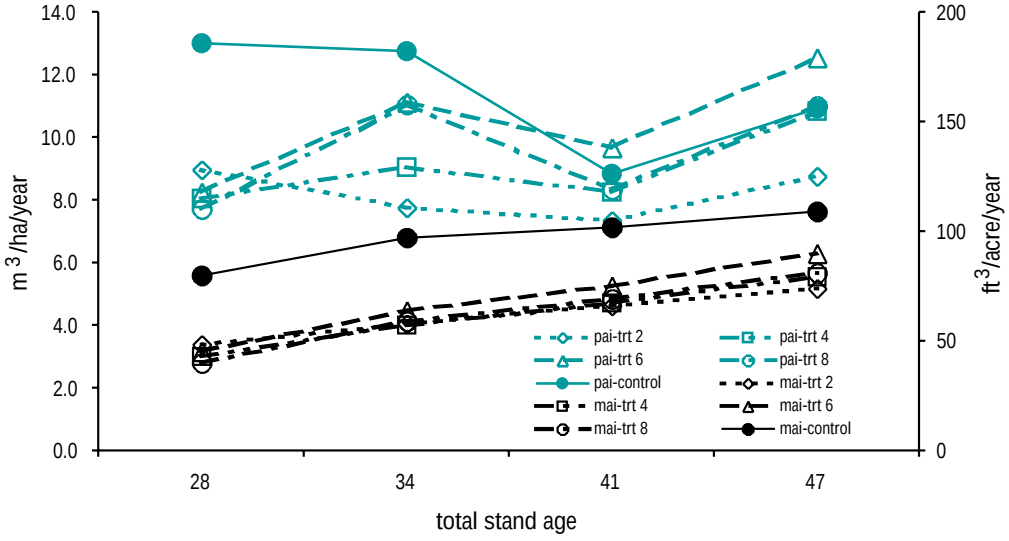

Figure 15b. Shawnigan pai and mai volume (increasing and decreasing treatments).

Discussion

Both installations were the last to be established in the cooperative and only Sayward has reached the end of the planned treatment schedule. The Shawnigan Lake installation is at least 10 years from completion. However, treatment results to date are similar to those from other LOGS installations (Curtis and Marshall 1986), and generally differ from the more productive sites only in the rate and degree of response associated with a lower site quality.

The LOGS treatments were designed to examine the relationship of growth to growing stock on a stand and individual tree basis and were never intended as a comparison of operationally feasible thinning regimes. In evaluating the results of the faster-growing, higher-site installations, earlier discussions have indicated, with hindsight, the need of a treatment consisting of a calibration cut only to allow a comparison with the LOGS treatment results and a common operational thinning density (Curtis *et al.* 1997). The resurrected supplemental treatments that studied density variation at both Sayward and Shawnigan offer some results that allow these comparisons.

The original purpose of the supplemental density variation treatments was to test the effect of differing initial densities on subsequent growth. When they were abandoned in the mid 1970s, the planned LOGS treatment schedule was never applied at Shawnigan and the plots at Sayward only received one treatment entry in 1973 (dense50, dense10). Therefore, the supplemental density variation results can be viewed as an operationally feasible pre-commercial thinning treatment.

Earlier results have revealed some difficulties in making meaningful comparisons across installations (Curtis *et al.* 1997) because of the range of initial densities among installations and the now-known relationship of gross growth of unthinned stands to density. However, treatment results within an installation are comparable because the treatments were defined on the basis that the control growth represents the site potential. Therefore, the results of the supplemental density variation treatments at each installation are comparable to the other treatments within the installation. As well, an argument can be made for some reasonable inferences when comparing the results of the density variation treatments between Sayward and Shawnigan based on the similarity in their initial stand densities (2624 stems/ha at Sayward; 2945 stems/ha at Shawnigan).

The original LOGS study plan and objectives were derived from a widely held assumption that essentially the same volume production could be produced over a wide range of stand densities (the Langsaeter hypothesis), with thinning merely redistributing a constant volume increment among a varying number of trees. The treatments were designed to test this assumption and to identify the density regime where the minimum amount of growing stock feasible would be retained without major growth loss. The results from the earlier and more productive site installations (Hoyer *et al.* 1996; Curtis and Clendenen 1994; Curtis 1992; Marshall *et al.* 1992; Curtis and Marshall 1986) have demonstrated that this assumption does not hold true for young Douglas-fir stands: volume production is strongly related to growing stock. The results from Sayward and Shawnigan confirm this; at this point in time, gross volume production has been greater for the controls than for any thinning treatments (Fig. 8 a and b) with the exception of the density variation “dense” treatment at Shawnigan. As detailed in Curtis *et al.* (1997), “increment increases with stocking, though at a decreasing rate up to a point which supression-related mortality becomes important ”.

Basal area production shows a similar trend to that of volume (Fig. 6), and, as would be expected, the lower-density treatments produced larger diameter trees (Fig. 5). Mortality, principally by root rot, has been minimal in the treatments, while mortality in the controls, mainly through suppression of the smaller trees, is increasing and having a significant impact on production (Table 32 – Sayward; Table 33 – Shawnigan).

As with other LOGS findings, trends of net total tree volume MAI and net total tree PAI (Figs. 14 and 15) clearly show that both installations are far from culmination, with current growth rates two and three times that of MAIs (Tables 28 and 29). Harvesting at this young age would involve large losses in total productivity relative to the potential.

The LOGS treatments were designed to examine the relationship of growth to growing stock on a stand and individual tree basis, with the reporting emphasis on a gross production comparison to the untended control. Very few analyses have been done on the value aspect of the treatment effects to produce useable timber, to enhance wood quality, and to consider the management of the non-timber values. A cursory comparison of treatments at this point in time would lead to the conclusion that there is little to gain from thinning (Fig. 8). However, when merchantable volume production, the effects on stand structure, and potential wood quality gains through live crown manipulation are compared, the returns from some thinning regimes are substantial.

Merchantable volume production in several thinning regimes is approaching or has exceeded the control (Fig. 13), and trends indicate further gains as suppression mortality continues to erode the diminishing productivity of the control. As in other installations, treatment 7 holds the most promise in competing with the control. Of particular interest, are the results of the supplemental density variation treatments at each installation, and the differences in these results between installations. As mentioned, the treatments are assessed by comparing their performance to the site potential as represented by the control. At the Sayward installation (of medium site quality), the two "dense" treatments have not overtaken the control or treatment 7 in total or merchantable volume, while at the Shawnigan installation (of lower site quality), the "dense" treatment has surpassed all treatments including the control in both total and merchantable volume and the "open" treatment has surpassed the control and treatment 7 in merchantable volume.

Treatment results so far are similar to those from other LOGS installations, generally differing only in the rate and degree of response associated with site productivity. This difference in site productivity is evident in looking at the stand structure of the controls at both installations (Figure 16; Tables 25a through 27b). The low-site Shawnigan installation carries a significant portion of its growing stock in smaller trees (less than 17.5 cm dbh) which are more susceptible to suppression mortality and contribute little to growth potential. At the higher-site Sayward installation, the diameter distribution is more normal, with a lesser portion of its growing stock in small, suppressed trees. This suggests that there is a better return on the thinning investment on the lower site where the remaining growing stock can better utilize the biological advantages obtained from thinning and further exploit the natural decline in productivity through growth stagnation and suppression mortality of the less forgiving lower site, as evidenced in the control.

Figure 16. Comparison of control stand density by diameter class distribution for Sayward (age 52) and Shawnigan (age 51).

Live crown development by treatment over time at both installations is consistent with results from others (Marshall *et al.* 1992; Curtis and Clendenen 1994)). Results clearly show the effects of live crown manipulation through thinning (Fig. 10). There is a strong relationship between stocking density and length of live crown. As outlined by Brix (1993), "the crown is the factory of the tree and in stand tending we attempt to influence the size and efficiency of the crown". In addition, live crown ratio has a direct influence on wood quality, through the production and location within the tree bole of juvenile wood (Jozsa and Middleton 1994); longer live crowns produce more pronounced stem taper and a higher proportion of juvenile wood.

From a practical point of view, the results validate and clarify the benefits of thinning in stand management and offer a number of options in influencing productivity and value. At Shawnigan, the "dense" treatment, essentially a precommercial thinning, produced a stand with a live crown ratio and basal area similar to the control, with a higher yield in total and merchantable volume production, and perhaps with increased log value due to a smaller proportion of juvenile wood relative to mature wood. As well, harvesting costs would be reduced with fewer nonmerchantable stems, a greater number of merchantable stems, and more efficient handling through larger piece sizes.

Even at this young age, the thinning treatments at both installations have produced stands that differ widely in appearance, tree size, crown characteristics and understorey development. The potential for further gains through an even moderately extended rotation would increase both volume and value of timber while creating stands and landscapes with increasing non-timber values.

Sayward has completed the original treatment schedule, and, as agreed by the LOGS cooperative, will continue to be maintained and measured into the future. Shawnigan was the last LOGS site to be established and will not complete the original treatment schedule for another 10 years. The LOGS study, through the cooperative, has answered a number of questions relevant to timber production first posed in the 1960s. Today, the silvicultural value of the installations continue to increase with the passage of time, and these sites have the potential to answer other questions raised by today's industrial, environmental, and social issues.

As outlined in Curtis *et al.* (1997), the LOGS installations have both continuing demonstration value and research uses beyond those discussed in the original plan. These include:

- evaluating trends in MAI and PAI in relation to age and treatment in answer to current questions about rotations and possible management options for reducing conflicts between timber production and other forest values;
- contributing to wildlife and biodiversity concerns by quantifying the visually striking differences in understorey composition and development among treatments and among sites;
- evaluating the effects of thinning on wood quality and value;
- demonstrating the enormous influence that thinning can have on stand development patterns and stand characteristics, even over a relatively short period; and,
- offering effective and visually striking examples of some alternatives for enhancing aesthetics and understory vegetation and stand structure while maintaining or enhancing timber values.

Of equal value and importance is the success of the cooperative itself. Long-term research projects have always been difficult to create and maintain, more so in recent years. The LOGS Cooperative is a successful example of an international, multi-agency, long-term research project carried out with a minimal bureaucracy. It has endured for more than 30 years through personnel changes, funding uncertainties, policy changes and the complacency of the status quo in silvicultural and mensurational research.

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Appendix 1

Description of Experiment

The following information is excerpted (and paraphrased) from Williamson and Staebler (1971).

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.

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 27 plots of one-fifth acre each.

Well formed, uniformly spaced, dominant trees at the rate of 80 per acre, or 16 per plot, are designated as crop trees before initial thinning. Each quarter of the plot must have no fewer than three suitable crop trees or no more than five – another criterion for stand uniformity.

All 24 treated plots are thinned initially to the same density to minimize the effect of variation 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 following formula,

Average spacing in feet = $(0.6167 \times \text{QMD})+8$.

If one concentrates on leaving a certain amount of basal area corresponding to an estimated averall QMD, then the residual number of trees may vary freely and the actual QMD may differ among plots plus or minus 10%. Alternately, if emphasis is on leaving a certain number of trees to correspond to an estimated overall QMD, then the basal area can differ among plots and the actual QMD may vary plus or minus 15% between plots.

The eight tested thinning regimes differ in the amount of basal area allowed to accumulate in the growing stock. The amount of growth retained in any thinning is a predetermined percentage of the gross increase found in the unthinned plots since the last thinning (Table 1, inside the 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.

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

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 QMD of cut trees should approximate that of trees 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 2a - 33b

(Note: Table 1 is on the inside front cover)

Table 2a. Number of live trees per hectare, by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	877	877	618	618	445	445	334	334	235	235	173	173
1	19	877	877	642	642	445	445	358	358	259	247	173	173
	25	877	877	519	519	334	334	247	247	185	185	148	148
	15	877	877	778	778	630	605	544	519	469	469	358	358
3	21	877	877	568	568	457	457	358	358	272	272	222	222
	23	877	877	655	655	531	531	420	420	346	346	272	272
	17	877	877	729	729	630	630	605	605	544	544	482	482
5	22	877	877	667	667	568	568	519	519	469	469	395	395
	26	877	877	741	741	655	655	581	581	494	482	432	432
	2	877	877	828	828	778	766	717	717	642	630	605	605
7	6	877	877	766	766	692	680	655	655	593	593	544	519
	9	877	877	877	877	828	803	778	778	717	717	605	605
						Increasing							
	1	877	877	531	531	395	395	321	321	259	259	222	222
2	3	877	877	494	494	358	358	309	297	272	272	235	222
	18	877	877	581	581	457	457	395	395	358	358	321	321
	4	877	877	766	766	642	642	593	593	519	519	445	445
4	8	877	877	667	667	556	556	494	494	432	432	408	408
	16	877	877	803	803	704	692	642	630	593	593	544	544
						Decreasing							
	7	877	877	729	729	593	581	469	469	346	334	247	247
6	12	877	877	877	877	791	778	655	655	519	519	383	383
	27	877	877	680	680	519	507	432	432	346	346	247	247
	11	877	877	877	877	791	791	717	717	630	605	544	544
8	14	877	877	877	877	791	766	729	704	630	618	507	507
	20	877	877	840	840	754	741	692	680	581	581	457	457
						Unthinned							
	5	3694	3793	3793	3447	3447	3299	3348	2978	2978	2558	2558	2199
control	13	2483	2558	2558	2409	2409	2298	2298	2162	2162	2039	2039	1804
	24	1693	1804	1804	1804	1804	1705	1705	1656	1656	1532	1532	1384
						Supplemental							
dense50	31	1223	1223	927									865
	33	1223	1223	1211									1137
dense10	32	1223	1223	704									667
	34	1223	1223	865									803

Table 2b. Number of live trees per acre, by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	355	355	250	250	180	180	135	135	95	95	70	70
1	19	355	355	260	260	180	180	145	145	105	100	70	70
	25	355	355	210	210	135	135	100	100	75	75	60	60
	15	355	355	315	315	255	245	220	210	190	190	145	145
3	21	355	355	230	230	185	185	145	145	110	110	90	90
	23	355	355	265	265	215	215	170	170	140	140	110	110
	17	355	355	295	295	255	255	245	245	220	220	195	195
5	22	355	355	270	270	230	230	210	210	190	190	160	160
	26	355	355	300	300	265	265	235	235	200	195	175	175
	2	355	355	335	335	315	310	290	290	260	255	245	245
7	6	355	355	310	310	280	275	265	265	240	240	220	210
	9	355	355	355	355	335	325	315	315	290	290	245	245
						Increasing							
	1	355	355	215	215	160	160	130	130	105	105	90	90
2	3	355	355	200	200	145	145	125	120	110	110	95	90
	18	355	355	235	235	185	185	160	160	145	145	130	130
	4	355	355	310	310	260	260	240	240	210	210	180	180
4	8	355	355	270	270	225	225	200	200	175	175	165	165
	16	355	355	325	325	285	280	260	255	240	240	220	220
						Decreasing							
	7	355	355	295	295	240	235	190	190	140	135	100	100
6	12	355	355	355	355	320	315	265	265	210	210	155	155
	27	355	355	275	275	210	205	175	175	140	140	100	100
	11	355	355	355	355	320	320	290	290	255	245	220	220
8	14	355	355	355	355	320	310	295	285	255	250	205	205
	20	355	355	340	340	305	300	280	275	235	235	185	185
						Unthinned							
	5	1495	1535	1535	1395	1395	1335	1335	1205	1205	1035	1035	890
control	13	1005	1035	1035	975	975	930	930	875	875	825	825	730
	24	685	730	730	730	730	690	690	670	670	620	620	560
						Supplemental							
dense50	31	495	495	375									350
	33	495	495	490									460
dense10	32	495	495	285									270
	34	495	495	350									325

Table 3a. Quadratic mean dbh (cm) of all live trees, by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	11.9	15.0	15.5	18.5	19.1	22.1	22.6	26.4	27.4	32.3	33.0	38.4
1	19	11.9	14.7	15.5	18.5	19.1	21.8	22.1	25.4	26.4	32.0	33.8	38.9
	25	13.0	16.3	17.0	20.6	21.8	25.1	26.2	30.5	31.2	36.6	35.8	41.4
	15	11.9	14.7	15.0	17.5	18.0	20.8	20.3	22.9	24.1	27.7	28.4	32.5
3	21	13.2	16.8	17.5	20.8	21.1	24.4	25.1	29.2	30.5	35.1	36.1	40.1
	23	12.7	16.0	16.3	19.3	19.6	22.1	22.6	25.9	26.4	31.5	32.0	36.6
	17	12.7	15.7	16.3	19.3	19.6	21.8	21.8	24.1	24.6	27.7	28.4	31.8
5	22	13.2	16.5	17.0	20.6	20.8	23.4	23.4	26.7	26.4	30.7	31.5	35.3
	26	12.7	16.0	16.3	19.1	19.3	21.8	22.1	25.1	25.7	29.5	30.0	33.3
	2	13.0	16.0	16.0	19.1	19.1	21.6	21.8	24.6	24.9	28.4	28.2	31.0
7	6	13.2	16.5	16.8	20.1	20.1	22.6	22.6	25.7	25.9	29.7	29.7	32.0
	9	12.4	15.5	15.5	18.3	18.5	20.6	20.8	23.1	23.6	27.4	28.2	31.2
						Increasing							
	1	13.5	16.5	17.0	20.3	20.8	24.1	24.6	29.0	29.5	35.8	36.1	40.9
2	3	13.7	16.5	17.5	21.1	21.8	25.1	24.9	28.7	29.0	34.0	35.1	39.6
	18	12.2	15.5	16.3	19.1	19.6	22.1	22.4	25.4	25.4	30.2	30.2	34.3
	4	12.2	15.0	15.0	18.0	18.0	20.8	20.6	23.6	24.1	29.2	29.7	33.3
4	8	12.7	16.0	16.0	19.3	19.6	22.6	22.6	26.2	26.4	31.0	31.0	34.5
	16	11.7	14.7	14.7	17.5	17.5	19.8	19.8	22.6	22.9	26.4	26.2	29.5
						Decreasing							
	7	13.0	16.3	16.3	19.6	19.8	22.9	23.4	26.9	27.9	33.8	33.8	38.6
6	12	11.9	14.5	14.5	16.8	17.3	19.6	19.8	22.4	22.9	26.7	27.2	31.0
	27	13.2	16.8	17.0	20.3	21.1	24.1	24.4	28.2	28.2	33.0	34.0	38.9
	11	12.2	15.2	15.2	18.0	18.5	20.6	20.6	23.1	23.6	27.2	27.4	29.7
8	14	12.2	15.5	15.5	18.3	18.5	20.6	20.6	23.1	23.4	26.9	27.2	30.5
	20	13.0	15.7	16.0	18.8	18.8	21.1	21.3	24.1	24.4	28.7	29.0	32.5
						Unthinned							
	5	8.9	10.4	10.4	11.9	11.9	13.0	13.0	14.5	14.5	16.5	16.5	18.0
control	13	10.4	12.2	12.2	14.0	14.0	15.2	15.2	16.8	16.8	18.5	18.5	20.6
	24	11.7	13.7	13.7	15.5	15.5	17.3	17.3	19.1	19.1	21.6	21.6	24.1
						Supplemental							
dense50	31	12.5	15.2	15.8									26.4
	33	11.4	13.7	13.7									22.4
dense10	32	12.1	14.8	16.3									27.7
	34	11.7	13.9	14.6									26.7

Table 3b. Quadratic mean dbh (inches) of all live trees, by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	4.7	5.9	6.1	7.3	7.5	8.7	8.9	10.4	10.8	12.7	13	15.1
1	19	4.7	5.8	6.1	7.3	7.5	8.6	8.7	10.0	10.4	12.6	13.3	15.3
	25	5.1	6.4	6.7	8.1	8.6	9.9	10.3	12.0	12.3	14.4	14.1	16.3
	15	4.7	5.8	5.9	6.9	7.1	8.2	8.0	9.0	9.5	10.9	11.2	12.8
3	21	5.2	6.6	6.9	8.2	8.3	9.6	9.9	11.5	12.0	13.8	14.2	15.8
	23	5.0	6.3	6.4	7.6	7.7	8.7	8.9	10.2	10.4	12.4	12.6	14.4
	17	5.0	6.2	6.4	7.6	7.7	8.6	8.6	9.5	9.7	10.9	11.2	12.5
5	22	5.2	6.5	6.7	8.1	8.2	9.2	9.2	10.5	10.4	12.1	12.4	13.9
	26	5.0	6.3	6.4	7.5	7.6	8.6	8.7	9.9	10.1	11.6	11.8	13.1
	2	5.1	6.3	6.3	7.5	7.5	8.5	8.6	9.7	9.8	11.2	11.1	12.2
7	6	5.2	6.5	6.6	7.9	7.9	8.9	8.9	10.1	10.2	11.7	11.7	12.6
	9	4.9	6.1	6.1	7.2	7.3	8.1	8.2	9.1	9.3	10.8	11.1	12.3
						Increasing							
	1	5.3	6.5	6.7	8.0	8.2	9.5	9.7	11.4	11.6	14.1	14.2	16.1
2	3	5.4	6.5	6.9	8.3	8.6	9.9	9.8	11.3	11.4	13.4	13.8	15.6
	18	4.8	6.1	6.4	7.5	7.7	8.7	8.8	10.0	10.0	11.9	11.9	13.5
	4	4.8	5.9	5.9	7.1	7.1	8.2	8.1	9.3	9.5	11.5	11.7	13.1
4	8	5.0	6.3	6.3	7.6	7.7	8.9	8.9	10.3	10.4	12.2	12.2	13.6
	16	4.6	5.8	5.8	6.9	6.9	7.8	7.8	8.9	9.0	10.4	10.3	11.6
						Decreasing							
	7	5.1	6.4	6.4	7.7	7.8	9.0	9.2	10.6	11.0	13.3	13.3	15.2
6	12	4.7	5.7	5.7	6.6	6.8	7.7	7.8	8.8	9.0	10.5	10.7	12.2
	27	5.2	6.6	6.7	8.0	8.3	9.5	9.6	11.1	11.1	13.0	13.4	15.3
	11	4.8	6.0	6.0	7.1	7.3	8.1	8.1	9.1	9.3	10.7	10.8	11.7
8	14	4.8	6.1	6.1	7.2	7.3	8.1	8.1	9.1	9.2	10.6	10.7	12
	20	5.1	6.2	6.3	7.4	7.4	8.3	8.4	9.5	9.6	11.3	11.4	12.8
						Unthinned							
	5	3.5	4.1	4.1	4.7	4.7	5.1	5.1	5.7	5.7	6.5	6.5	7.1
control	13	4.1	4.8	4.8	5.5	5.5	6.0	6.0	6.6	6.6	7.3	7.3	8.1
	24	4.6	5.4	5.4	6.1	6.1	6.8	6.8	7.5	7.5	8.5	8.5	9.5
						Supplemental							
dense50	31	4.9	6	6.2									10.4
	33	4.5	5.4	5.4									8.8
dense10	32	4.8	5.8	6.4									10.9
	34	4.6	5.5	5.8									10.5

Table 4a. Basal area (m^2/ha) of all live trees, by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	9.8	15.6	11.8	16.6	12.8	16.9	13.4	18.1	13.9	19.1	14.8	19.9
1	19	9.8	15.2	11.9	17.2	12.7	16.5	13.7	18.2	14.3	19.8	15.4	20.5
	25	11.6	18.2	11.9	17.3	12.5	16.7	13.2	18.0	14.1	19.4	15.0	19.9
	15	9.7	14.9	13.6	18.8	16.2	19.8	17.7	21.5	19.8	28.3	22.6	29.8
3	21	12.1	19.3	13.6	19.6	16.0	21.2	17.7	23.8	19.7	26.2	22.6	28.0
	23	11.2	17.4	13.6	19.1	15.9	20.5	16.7	22.2	18.9	27.0	21.7	28.4
	17	11.0	17.3	15.2	21.2	19.1	23.5	22.4	27.7	25.8	33.0	30.6	38.2
5	22	11.9	18.7	15.2	21.9	19.3	24.6	22.2	28.7	25.8	34.9	30.7	38.9
	26	11.2	17.5	15.3	21.3	19.2	24.4	22.2	29.1	25.6	33.1	30.3	37.7
	2	11.5	17.7	16.9	23.3	22.3	28.2	26.6	33.9	31.3	39.7	38.0	45.9
7	6	12.1	18.9	16.9	24.1	21.9	27.4	26.2	33.5	31.2	40.8	37.9	43.8
	9	10.6	16.6	16.6	23.0	22.2	26.9	26.2	32.7	31.1	42.3	37.6	46.6
						Increasing							
	1	12.6	18.8	12.0	17.3	13.6	17.9	15.3	21.0	17.7	26.3	22.7	29.1
2	3	12.7	19.0	11.9	17.1	13.5	17.9	15.1	19.2	17.8	24.9	22.5	27.5
	18	10.4	16.5	11.8	16.3	13.6	17.4	15.5	20.1	18.3	25.7	23.1	29.5
	4	10.2	15.4	13.6	19.5	16.6	21.6	19.8	26.0	23.9	34.8	30.6	38.9
4	8	11.0	17.8	13.6	19.5	16.8	22.2	19.7	26.4	23.9	31.7	30.5	38.3
	16	9.4	14.7	13.6	19.3	17.2	21.6	19.9	25.2	24.1	32.6	29.1	36.9
						Decreasing							
	7	11.6	18.0	15.2	21.8	18.3	23.8	19.9	26.9	21.4	29.9	22.1	28.8
6	12	9.8	14.6	14.7	19.5	18.7	23.3	20.0	25.5	21.2	28.8	22.1	28.7
	27	12.0	19.3	15.3	21.9	18.0	23.3	20.0	26.9	21.6	29.6	22.5	29.4
	11	10.2	16.0	16.0	22.2	21.2	26.3	24.0	30.0	27.7	36.4	32.3	37.8
8	14	10.4	16.3	16.3	23.2	21.1	25.6	24.2	29.5	26.8	34.9	29.6	36.8
	20	11.3	17.3	16.9	23.1	21.1	25.8	24.5	30.8	27.2	37.4	30.1	38.1
						Unthinned							
	5	23.3	32.0	32.0	38.8	38.8	43.6	43.6	48.5	48.5	54.5	54.5	56.5
control	13	21.5	29.8	29.8	37.0	37.0	42.1	42.1	47.8	47.8	54.8	54.8	59.3
	24	18.1	26.5	26.5	34.3	34.3	39.8	39.8	47.7	47.7	56.5	56.5	63.1
						Supplemental							
dense50	31	15.1	22.1	18.1									47.7
	33	12.7	18.1	17.9									45.1
dense10	32	14.2	21	14.6									39.9
	34	13	18.7	14.6									45.2

Table 4b. Basal area (ft^2/acre) of all live trees, by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	42.7	67.8	51.4	72.5	55.6	73.4	58.2	79.0	60.4	83.2	64.3	86.5
1	19	42.5	66.1	52.0	75.1	55.4	71.9	59.6	79.4	62.2	86.1	67.2	89.4
	25	50.4	79.2	52.0	75.5	54.6	72.7	57.7	78.6	61.6	84.3	65.3	86.5
	15	42.4	65.0	59.3	81.9	70.4	86.2	76.9	93.6	86.3	123.4	98.4	129.6
3	21	52.8	84.0	59.2	85.2	69.7	92.2	77.0	103.8	85.8	114.3	98.5	121.9
	23	49.0	75.8	59.4	83.2	69.4	89.1	72.9	96.8	82.4	117.8	94.7	123.8
	17	47.9	75.4	66.3	92.3	83.4	102.2	97.6	120.5	112.4	143.7	133.3	166.3
5	22	51.8	81.4	66.2	95.4	84.0	107.0	96.7	125.2	112.3	151.9	133.8	169.3
	26	48.7	76.3	66.5	92.8	83.6	106.4	96.5	126.7	111.7	144.2	132	164.1
	2	50.2	76.9	73.4	101.7	97.0	122.8	115.8	147.5	136.4	172.9	165.7	200.1
7	6	52.9	82.2	73.5	104.8	95.4	119.4	114.3	145.9	135.7	177.8	165.1	190.6
	9	46.0	72.2	72.2	100.0	96.9	117.3	114.2	142.5	135.3	184.4	163.9	202.8
						Increasing							
	1	54.9	81.9	52.1	75.2	59.2	78.0	66.5	91.5	77.2	114.5	98.8	126.9
2	3	55.5	82.6	51.9	74.7	58.8	77.9	65.8	83.5	77.6	108.3	98.2	119.9
	18	45.5	71.7	51.5	71.2	59.4	75.7	67.6	87.7	79.6	111.8	100.7	128.6
	4	44.4	67.1	59.1	84.8	72.4	94.1	86.3	113.1	104.3	151.4	133.4	169.4
4	8	48.1	77.4	59.2	85.0	73.0	96.5	85.6	114.9	104.0	137.9	132.9	167
	16	41.0	64.0	59.1	83.9	75.0	94.3	86.9	109.9	105.0	142.0	126.9	160.6
						Decreasing							
	7	50.4	78.4	66.4	94.9	79.8	103.7	86.9	117.3	93.2	130.4	96.4	125.6
6	12	42.6	63.8	64.0	85.1	81.6	101.3	87.2	110.9	92.5	125.3	96.3	125.1
	27	52.2	83.9	66.8	95.5	78.2	101.3	87.3	117.0	94.1	129.0	98.1	128
	11	44.6	69.6	69.6	96.6	92.2	114.4	104.6	130.5	120.6	158.6	140.9	164.7
8	14	45.2	71.0	71.0	100.9	91.9	111.6	105.2	128.5	116.9	152.0	129.1	160.4
	20	49.4	75.4	73.7	100.7	91.9	112.5	106.7	134.2	118.5	162.9	131.2	166.1
						Unthinned							
	5	101.3	139.3	139.3	168.9	168.9	189.8	189.8	211.4	211.4	237.4	237.4	245.9
control	13	93.7	129.6	129.6	161.0	161.0	183.4	183.4	208.4	208.4	238.6	238.6	258.2
	24	78.7	115.5	115.5	149.6	149.6	173.4	173.4	207.9	207.9	246.3	246.3	274.7
						Supplemental							
dense50	31	65.9	96.1	79									207.6
	33	55.5	79	78.1									196.5
dense10	32	61.6	91.5	63.8									174
	34	56.8	81.4	63.5									197

Table 5a. Total volume (m^3/ha) of all live trees by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	44.0	84.4	64.9	110.2	84.9	125.5	100.4	153.9	120.4	185.5	144.9	220.6
1	19	44.2	82.6	65.7	113.9	84.5	123.9	103.2	161.6	127.8	203.7	159.9	241.8
	25	52.7	106.1	71.4	122.4	89.3	136.9	109.5	172.5	135.6	206.9	159.7	232.7
	15	46.3	80.5	73.6	124.6	107.9	148.5	132.6	178.6	165.5	271.2	218.0	324.5
3	21	61.5	115.1	82.0	142.9	117.1	172.6	144.5	229.9	190.3	284.7	246.0	333.1
	23	52.7	98.9	78.3	132.4	111.0	158.2	129.8	198.7	169.7	277.4	223.6	326.5
	17	51.9	97.9	87.0	145.5	132.2	180.8	172.5	249.1	233.7	321.8	301.3	448.5
5	22	59.9	112.4	91.8	189.8	137.1	201.2	181.6	257.1	230.6	353.8	312.5	456.3
	26	54.4	98.0	85.6	145.0	130.8	192.0	174.2	266.9	235.5	343.8	314.9	427.4
	2	55.8	103.8	99.4	164.9	157.7	235.2	222.2	329.6	306.1	419.5	402.3	530.0
7	6	59.3	112.7	101.2	170.9	155.5	226.4	216.6	319.1	297.7	435.2	404.6	526.7
	9	48.9	93.2	93.2	153.1	149.0	206.5	201.2	287.9	274.6	429.1	384.4	526.7
						Increasing							
	1	61.1	110.5	73.6	120.0	95.0	143.9	123.5	196.3	166.2	280.2	241.9	349.7
2	3	62.3	115.4	72.9	123.9	97.8	146.1	123.5	180.8	167.9	268.9	244.5	325.1
	18	49.7	89.7	65.1	111.0	92.5	134.1	119.7	175.3	159.2	255.7	230.3	324.7
	4	46.9	83.1	73.3	125.4	107.3	162.6	149.0	223.2	206.8	344.6	304.6	443.0
4	8	51.4	101.8	77.9	133.1	114.8	176.7	156.7	244.9	222.5	332.7	320.4	440.3
	16	43.5	79.1	72.8	126.2	113.1	158.1	145.9	204.5	195.2	348.1	263.7	401.1
						Decreasing							
	7	57.1	111.0	94.5	157.2	133.2	204.5	166.5	262.4	212.4	332.7	246.0	357.3
6	12	46.3	78.0	78.0	125.6	120.7	172.3	148.3	222.9	186.1	282.8	218.7	305.4
	27	57.5	116.6	93.3	160.3	132.9	205.2	177.0	280.9	226.0	331.0	255.5	368.8
	11	49.2	93.3	93.3	150.7	144.7	206.7	188.9	270.8	251.2	385.1	342.2	421.5
8	14	46.9	87.7	87.7	158.3	144.6	194.7	182.6	254.1	232.0	335.6	286.7	406.9
	20	52.3	99.4	97.4	157.8	144.8	204.0	194.2	284.5	252.9	397.7	322.0	446.7
						Unthinned							
	5	104.5	167.5	167.5	242.4	242.4	327.9	327.9	410.7	410.7	519.1	519.1	594.9
control	13	90.3	154.8	154.8	232.5	232.5	304.0	304.0	399.3	399.3	510.9	510.9	630.5
	24	79.1	149.3	149.3	228.7	228.7	301.7	301.7	438.4	438.4	593.8	593.7	724.6
						Supplemental							
dense50	31	80.5	135.3	113									556.4
	33	58.4	100	98.9									441.8
dense10	32	67	125	91									431
	34	59.9	104.8	83.3									496.7

Table 5b. Total volume (ft^3/acre) of all live trees by treatment, plot, treatment period, year and stand age (years) - Sayward

		Calibration period		1st period		2nd period		3rd period		4th period		5th period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	Plot	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed							
	10	629	1206	928	1575	1213	1794	1435	2200	1720	2651	2071	3152
1	19	631	1181	939	1628	1207	1770	1475	2310	1826	2911	2285	3456
	25	753	1516	1021	1749	1276	1956	1565	2465	1938	2957	2283	3326
	15	661	1150	1052	1781	1542	2122	1895	2552	2365	3876	3116	4637
3	21	879	1645	1172	2042	1673	2466	2065	3285	2720	4069	3516	4760
	23	753	1414	1119	1892	1586	2261	1855	2840	2425	3965	3196	4666
	17	742	1399	1244	2079	1889	2584	2465	3560	3340	4599	4306	6410
5	22	856	1607	1312	2713	1959	2875	2595	3675	3295	5056	4466	6521
	26	778	1401	1224	2072	1869	2744	2490	3815	3365	4914	4500	6108
	2	797	1483	1421	2356	2254	3362	3175	4710	4375	5995	5749	7575
7	6	848	1611	1446	2443	2223	3235	3095	4560	4255	6220	5782	7527
	9	699	1332	1332	2188	2130	2951	2875	4115	3925	6132	5493	7527
						Increasing							
	1	873	1579	1052	1715	1358	2057	1765	2805	2375	4004	3457	4997
2	3	891	1649	1042	1770	1398	2088	1765	2584	2400	3843	3494	4646
	18	710	1282	931	1586	1322	1917	1710	2505	2275	3655	3292	4640
	4	670	1187	1048	1792	1534	2324	2130	3190	2955	4925	4353	6331
4	8	735	1455	1113	1902	1640	2526	2240	3500	3180	4755	4579	6292
	16	621	1130	1041	1803	1617	2259	2085	2923	2790	4975	3768	5732
						Decreasing							
	7	816	1587	1351	2247	1903	2922	2380	3750	3035	4755	3515	5107
6	12	661	1115	1115	1795	1725	2463	2120	3185	2660	4042	3125	4364
	27	822	1666	1334	2291	1899	2933	2530	4015	3230	4731	3651	5270
	11	703	1334	1334	2154	2068	2954	2700	3870	3590	5504	4891	6024
8	14	670	1253	1253	2262	2066	2783	2610	3631	3315	4796	4097	5815
	20	747	1420	1392	2255	2069	2915	2775	4066	3615	5684	4602	6384
						Unthinned							
	5	1494	2394	2394	3464	3464	4686	4686	5869	5869	7418	7418	8502
control	13	1291	2212	2212	3323	3323	4344	4344	5707	5707	7301	7301	9011
	24	1130	2133	2133	3269	3269	4312	4312	6266	6266	8486	8485	10355
						Supplemental							
dense50	31	1150	1933	1615									7952
	33	834	1429	1413									6314
dense10	32	958	1786	1301									6160
	34	856	1498	1191									7099

Table 6a. Number of live trees per hectare by treatment, treatment period, year and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
					Fixed							
1	877	877	593	593	408	408	314	314	227	222	166	166
3	877	877	667	667	539	524	440	432	363	363	284	284
5	877	877	712	712	618	618	568	568	502	499	437	437
7	877	877	823	823	766	749	717	717	650	647	586	586
					Increasing							
2	877	877	536	536	403	403	341	339	297	297	259	255
4	877	877	746	746	635	630	576	573	514	512	465	465
					Decreasing							
6	877	877	761	761	635	623	519	519	403	400	292	292
8	877	877	865	865	778	766	712	699	613	610	502	502
					Unthinned							
control	2624	2718	2718	2553	2553	2451	2451	2266	2266	2021	2044	1796
					Supplemental							
dense50	1223	1223	1070									1001
dense10	1223	1223	786									736

Table 6b. Number of live trees per acre by treatment, treatment period, year and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
					Fixed							
1	355	355	240	240	165	165	127	127	92	90	67	67
3	355	355	270	270	218	212	178	175	147	147	115	115
5	355	355	288	288	250	250	230	230	203	202	177	177
7	355	355	333	333	310	303	290	290	263	262	237	237
					Increasing							
2	355	355	217	217	163	163	138	137	120	120	105	103
4	355	355	302	302	257	255	233	232	208	207	188	188
					Decreasing							
6	355	355	308	308	257	252	210	210	163	162	118	118
8	355	355	350	350	315	310	288	283	248	247	203	203
					Unthinned							
control	1062	1100	1100	1033	1033	992	992	917	917	818	827	727
					Supplemental							
dense50	495	495	433									405
dense10	495	495	318									298

Table 7a. Quadratic mean dbh (cm) of all live trees by treatment, treatment period, year and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
					Fixed							
1	12.2	15.2	16.0	19.3	20.1	23.1	23.6	27.4	28.4	33.5	34.0	39.4
3	12.7	15.7	16.3	19.3	19.6	22.4	22.6	25.7	26.9	31.5	31.8	35.8
5	13.0	16.0	16.5	19.6	19.8	22.4	22.4	25.4	25.7	29.2	29.7	32.5
7	13.0	16.0	16.0	19.1	19.3	21.6	21.8	24.4	24.9	28.4	28.7	31.5
					Increasing							
2	13.2	16.3	17.0	20.1	20.8	23.9	23.9	27.4	27.9	33.3	33.5	37.8
4	12.2	15.2	15.2	18.3	18.3	21.1	21.1	23.9	24.4	28.7	28.7	32.3
					Decreasing							
6	12.7	15.7	16.0	18.8	19.3	21.8	22.6	25.9	26.4	30.7	31.2	35.6
8	12.5	15.5	15.5	18.3	18.5	20.8	20.8	23.4	21.3	27.4	27.9	31.0
					Unthinned							
control	10.4	12.2	12.2	13.7	13.7	15.2	15.2	16.8	16.8	19.1	18.5	20.6
					Supplemental							
dense50	11.9	14.5	14.7									23.4
dense10	11.9	14.5	15.5									27.2

Table 7b. Quadratic mean dbh (inches) of all live trees by treatment, treatment period, year and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
					Fixed							
1	4.8	6.0	6.3	7.6	7.9	9.1	9.3	10.8	11.2	13.2	13.4	15.5
3	5.0	6.2	6.4	7.6	7.7	8.8	8.9	10.1	10.6	12.4	12.5	14.1
5	5.1	6.3	6.5	7.7	7.8	8.8	8.8	10.0	10.1	11.5	11.7	12.8
7	5.1	6.3	6.3	7.5	7.6	8.5	8.6	9.6	9.8	11.2	11.3	12.4
					Increasing							
2	5.2	6.4	6.7	7.9	8.2	9.4	9.4	10.8	11.0	13.1	13.2	14.9
4	4.8	6.0	6.0	7.2	7.2	8.3	8.3	9.4	9.6	11.3	11.3	12.7
					Decreasing							
6	5.0	6.2	6.3	7.4	7.6	8.6	8.9	10.2	10.4	12.1	12.3	14
8	4.9	6.1	6.1	7.2	7.3	8.2	8.2	9.2	8.4	10.8	11.0	12.2
					Unthinned							
control	4.1	4.8	4.8	5.4	5.4	6.0	6.0	6.6	6.6	7.5	7.3	8.1
					Supplemental							
dense50	4.7	5.7	5.8									9.6
dense10	4.7	5.7	6.1									10.7

Table 8a. Basal area (m^2/ha) of all live trees by treatment, treatment period, year, and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed						
1	10.4	16.3	11.9	17.1	12.7	16.7	13.4	18.1	14.1	19.4	15.1	20.1
3	11.0	17.2	13.6	19.1	16.0	20.5	17.4	22.5	19.5	27.2	22.3	28.7
5	11.4	17.8	15.2	21.5	19.2	24.2	22.2	28.5	25.7	33.7	30.5	38.2
7	11.4	17.7	16.8	23.5	22.1	27.5	26.4	33.4	31.2	41.0	37.9	45.4
						Increasing						
2	11.9	18.1	11.9	16.9	13.6	17.7	15.3	20.1	18.0	25.6	22.8	28.7
4	10.2	16.0	13.6	19.4	16.9	21.8	19.8	25.8	24.0	33.0	30.1	38.0
						Decreasing						
6	11.1	17.3	15.1	21.1	18.3	23.4	20.0	26.4	21.4	29.4	22.2	29.0
8	10.7	16.5	16.4	22.8	21.1	25.9	24.2	30.1	27.2	36.2	30.7	37.6
						Unthinned						
control	21.1	29.2	29.2	36.4	36.4	41.8	41.8	48.0	48.0	55.3	55.3	59.6
						Supplemental						
dense50	13.9	20.1	18									46.4
dense10	13.6	19.9	14.6									42.6

Table 8b. Basal area (ft^2/acre) of all live trees by treatment, treatment period, year, and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed						
1	45.2	71	51.8	74.4	55.2	72.7	58.5	79	61.4	84.5	65.6	87.5
3	48.1	74.9	59.3	83.4	69.8	89.2	75.6	98.1	84.8	118.5	97.2	125.1
5	49.5	77.7	66.3	93.5	83.7	105.2	96.9	124.1	112.1	146.6	133	166.6
7	49.7	77.1	73	102.2	96.4	119.8	114.8	145.3	135.8	178.4	164.9	197.8
						Increasing						
2	52	78.7	51.8	73.7	59.1	77.2	66.6	87.6	78.2	111.5	99.2	125.1
4	44.5	69.5	59.1	84.6	73.5	95	86.3	112.6	104.4	143.8	131.1	165.7
						Decreasing						
6	48.4	75.4	65.7	91.8	79.9	102.1	87.1	115.1	93.3	128.2	96.9	126.2
8	46.4	72	71.4	99.4	92	112.8	105.5	131.1	118.7	157.8	133.7	163.8
						Unthinned						
control	91.9	127.1	127.1	158.6	158.6	182.2	182.2	209.2	209.2	240.8	240.7	259.6
						Supplemental						
dense50	60.7	87.6	78.6									202.1
dense10	59.2	86.5	63.7									185.5

Table 9a. Total volume (m^3/ha) of all live trees by treatment, treatment period, year and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed						
1	47.0	91.0	67.4	115.5	86.2	128.7	104.4	162.7	127.9	198.6	154.8	231.7
3	53.5	98.2	77.9	133.3	112.0	159.7	135.6	202.4	175.1	277.8	229.2	328.0
5	55.4	102.8	88.2	160.1	133.4	191.3	176.1	257.7	233.2	339.9	309.6	444.0
7	54.6	103.2	98.0	163.0	154.1	222.7	213.3	312.2	292.8	427.9	397.0	527.8
						Increasing						
2	57.7	105.2	70.5	118.3	95.1	141.4	122.2	184.1	164.4	268.3	238.9	333.1
4	47.2	88.0	74.7	128.2	111.7	165.8	150.6	224.2	208.2	314.2	296.2	428.1
						Decreasing						
6	53.6	101.9	88.7	147.7	128.9	194.0	163.9	255.4	208.3	315.4	240.0	343.8
8	49.5	93.5	92.8	155.6	144.7	201.8	188.6	269.8	245.4	372.5	317.0	425.9
						Unthinned						
control	91.3	157.2	157.2	234.5	234.5	311.2	311.2	416.1	416.1	541.2	541.2	650.0
						Supplemental						
dense50	69.4	117.6	105.9									499.1
dense10	63.5	114.9	87.2									463.9

Table 9b. Total volume (ft^3/acre) of all live trees by treatment, treatment period, year and stand age (years) - Sayward

	Calibration period		1st period		2nd period		3rd period		4th period		5th period	
	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut	after cut	
Treatment	1969 (22)	1973 (26)	1973 (26)	1977 (30)	1977 (30)	1981 (34)	1981 (34)	1987 (40)	1987 (40)	1993 (46)	1993 (46)	1999 (52)
						Fixed						
1	671	1301	963	1651	1232	1840	1492	2325	1828	2838	2213	3311
3	764	1403	1114	1905	1600	2283	1938	2892	2503	3970	3276	4688
5	792	1469	1260	2288	1906	2734	2516	3683	3333	4857	4424	6346
7	781	1475	1400	2329	2202	3183	3048	4462	4185	6115	5674	7543
						Increasing						
2	825	1503	1008	1690	1359	2021	1747	2631	2350	3835	3414	4761
4	675	1257	1067	1832	1597	2370	2152	3204	2975	4490	4233	6118
						Decreasing						
6	766	1456	1267	2111	1842	2773	2343	3650	2977	4508	3430	4914
8	707	1336	1326	2224	2068	2884	2695	3856	3507	5323	4530	6087
						Unthinned						
control	1305	2246	2246	3352	3352	4447	4447	5947	5947	7735	7735	9289
						Supplemental						
dense50	992	1681	1514									7133
dense10	907	1642	1246									6630

Table 10a. Number of live trees per hectare by treatment, plot, treatment period, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
					Fixed				
	4	927	927	605	605	420	420	309	309
1	8	927	927	544	544	383	383	272	272
	19	927	927	445	445	297	284	198	198
	9	927	914	692	692	556	556	457	457
3	20	927	927	605	605	482	482	371	371
	23	927	927	630	630	469	445	383	383
	11	927	927	680	667	556	556	494	494
5	13	927	927	754	754	655	655	568	568
	14	927	927	778	778	680	667	568	568
	16	927	927	927	927	840	840	778	778
7	17	927	927	902	902	877	877	840	840
	22	927	927	877	853	791	791	741	729
					Increasing				
	6	927	927	519	519	383	383	297	297
2	10	927	927	482	482	358	358	284	284
	26	927	927	420	420	297	297	222	222
	3	927	927	778	766	642	630	581	581
4	18	927	927	630	618	482	482	420	420
	21	927	914	704	704	581	581	507	507
					Decreasing				
	1	927	927	865	865	729	729	581	568
6	27	927	927	593	593	457	457	358	358
	28	927	927	741	741	593	581	457	457
	2	927	927	927	927	853	853	754	754
8	7	927	927	927	902	840	828	741	729
	25	927	927	902	902	778	766	642	642
					Unthinned				
	5	2644	2632	2632	2595	2595	2385	2385	2162
control	15	2916	2842	2842	2743	2743	2743	2496	2175
	24	3274	3237	3237	3027	3027	2607	2607	2150
					Supplemental				
	33	1322	1322						1273
	34	1322	1322						1322
dense	35	1322	1322						1149
	36	1322	1322						1297
	37	1322	1322						1285
	38	704	704						704
	39	704	704						704
open	40	704	704						704
	41	704	704						692
	42	704	704						704

Table 10b. Number of live trees per acre by treatment, plot, treatment period, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
					Fixed				
	4	375	375	245	245	170	170	125	125
1	8	375	375	220	220	155	155	110	110
	19	375	375	180	180	120	115	80	80
	9	375	370	280	280	225	225	185	185
3	20	375	375	245	245	195	195	150	150
	23	375	375	255	255	190	180	155	155
	11	375	375	275	270	225	225	200	200
5	13	375	375	305	305	265	265	230	230
	14	375	375	315	315	275	270	230	230
	16	375	375	375	375	340	340	315	315
7	17	375	375	365	365	355	355	340	340
	22	375	375	355	345	320	320	300	295
					Increasing				
	6	375	375	210	210	155	155	120	120
2	10	375	375	195	195	145	145	115	115
	26	375	375	170	170	120	120	90	90
	3	375	375	315	310	260	255	235	235
4	18	375	375	255	250	195	195	170	170
	21	375	370	285	285	235	235	205	205
					Decreasing				
	1	375	375	350	350	295	295	235	230
6	27	375	375	240	240	185	185	145	145
	28	375	375	300	300	240	235	185	185
	2	375	375	375	375	345	345	305	305
8	7	375	375	375	365	340	335	300	295
	25	375	375	365	365	315	310	260	260
					Unthinned				
	5	1070	1065	1065	1050	1050	965	965	875
control	15	1180	1150	1150	1110	1110	1110	1010	880
	24	1325	1310	1310	1225	1225	1055	1055	870
					Supplemental				
	33	535	535						515
	34	535	535						535
dense	35	535	535						465
	36	535	535						525
	37	535	535						520
	38	285	285						285
	39	285	285						285
open	40	285	285						285
	41	285	285						280
	42	285	285						285

Table 11a. Quadratic mean dbh (cm) of all lives trees by treatment, plot, treatment period, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
					Fixed				
	4	10.9	14.0	14.7	17.8	18.5	22.1	22.4	26.4
1	8	10.9	14.5	15.2	18.5	18.8	22.4	23.1	27.4
	19	11.7	15.7	17.0	21.3	21.8	26.4	27.7	33.0
	9	10.9	14.5	14.7	18.0	18.0	21.3	21.3	24.6
3	20	11.9	15.5	16.0	19.3	19.6	23.1	23.9	29.2
	23	11.2	15.2	15.7	19.1	19.8	23.4	23.4	27.4
	11	11.7	15.5	16.0	19.8	20.1	23.4	23.4	26.7
5	13	11.7	15.0	15.2	18.3	18.5	21.6	21.8	25.1
	14	11.4	14.7	15.0	18.0	18.3	21.3	21.8	24.6
	16	10.7	14.5	14.5	17.5	17.8	20.6	20.6	23.1
7	17	11.4	14.7	14.7	17.5	17.5	19.8	19.8	22.1
	22	11.2	15.0	15.2	18.3	18.5	21.1	21.1	23.9
					Increasing				
	6	11.4	14.7	15.7	19.1	20.1	23.9	24.6	29.0
2	10	11.7	15.2	16.5	19.8	20.3	23.9	24.9	29.0
	26	12.2	16.3	17.8	21.8	22.4	27.2	28.2	33.3
	3	10.9	14.0	14.2	17.0	17.5	20.1	20.1	22.9
4	18	11.4	15.5	15.7	19.3	20.1	23.6	23.9	27.7
	21	11.4	14.7	14.7	17.8	18.3	21.6	21.6	25.4
					Decreasing				
	1	10.9	14.2	14.2	17.3	17.5	20.3	20.8	23.9
6	27	12.2	16.0	17.0	20.8	21.3	25.4	25.7	30.2
	28	11.4	15.2	15.5	18.8	19.1	22.4	23.1	26.9
	2	10.7	14.0	14.0	16.8	16.8	19.3	19.6	21.8
8	7	11.2	14.7	14.7	17.5	17.5	19.8	20.3	22.6
	25	10.9	14.7	14.7	18.0	18.3	21.1	21.8	24.9
					Unthinned				
	5	9.9	11.7	11.7	13.0	13.0	14.5	14.5	16.5
control	15	9.4	11.4	11.4	13.0	13.0	14.7	14.7	17.0
	24	9.1	11.2	11.2	13.0	13.0	15.0	15.0	17.5
					Supplemental				
	33	11.4	14.7						21.8
	34	10.9	14.2						21.1
dense	35	10.4	13.7						20.8
	36	10.7	14.7						21.8
	37	10.7	14.5						21.6
	38	11.9	16.8						27.9
	39	11.4	13.2						26.2
open	40	12.4	16.5						26.4
	41	11.2	14.7						23.6
	42	11.2	14.7						23.6

Table 11b. Quadratic mean dbh (inches) of all lives trees by treatment, plot, treatment period, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period		1st period		2nd period		3rd period	
		after cut 1970 (25)	before cut 1976 (31)	after cut 1976 (31)	before cut 1982 (37)	after cut 1982 (37)	before cut 1989 (44)	after cut 1989 (44)	before cut 1996 (51)
Fixed									
	4	4.3	5.5	5.8	7	7.3	8.7	8.8	10.4
1	8	4.3	5.7	6	7.3	7.4	8.8	9.1	10.8
	19	4.6	6.2	6.7	8.4	8.6	10.4	10.9	13.0
	9	4.3	5.7	5.8	7.1	7.1	8.4	8.4	9.7
3	20	4.7	6.1	6.3	7.6	7.7	9.1	9.4	11.5
	23	4.4	6	6.2	7.5	7.8	9.2	9.2	10.8
	11	4.6	6.1	6.3	7.8	7.9	9.2	9.2	10.5
5	13	4.6	5.9	6	7.2	7.3	8.5	8.6	9.9
	14	4.5	5.8	5.9	7.1	7.2	8.4	8.6	9.7
	16	4.2	5.7	5.7	6.9	7	8.1	8.1	9.1
7	17	4.5	5.8	5.8	6.9	6.9	7.8	7.8	8.7
	22	4.4	5.9	6	7.2	7.3	8.3	8.3	9.4
Increasing									
	6	4.5	5.8	6.2	7.5	7.9	9.4	9.7	11.4
2	10	4.6	6	6.5	7.8	8	9.4	9.8	11.4
	26	4.8	6.4	7	8.6	8.8	10.7	11.1	13.1
	3	4.3	5.5	5.6	6.7	6.9	7.9	7.9	9.0
4	18	4.5	6.1	6.2	7.6	7.9	9.3	9.4	10.9
	21	4.5	5.8	5.8	7	7.2	8.5	8.5	10.0
Decreasing									
	1	4.3	5.6	5.6	6.8	6.9	8	8.2	9.4
6	27	4.8	6.3	6.7	8.2	8.4	10	10.1	11.9
	28	4.5	6	6.1	7.4	7.5	8.8	9.1	10.6
	2	4.2	5.5	5.5	6.6	6.6	7.6	7.7	8.6
8	7	4.4	5.8	5.8	6.9	6.9	7.8	8.0	8.9
	25	4.3	5.8	5.8	7.1	7.2	8.3	8.6	9.8
Unthinned									
	5	3.9	4.6	4.6	5.1	5.1	5.7	5.7	6.5
control	15	3.7	4.5	4.5	5.1	5.1	5.8	5.8	6.7
	24	3.6	4.4	4.4	5.1	5.1	5.9	5.9	6.9
Supplemental									
	33	4.5	5.8						8.6
	34	4.3	5.6						8.3
dense	35	4.1	5.4						8.2
	36	4.2	5.8						8.6
	37	4.2	5.7						8.5
	38	4.7	6.6						11
	39	4.5	5.2						10.3
open	40	4.9	6.5						10.4
	41	4.4	5.8						9.3
	42	4.4	5.8						9.3

Table 12a. Basal area (m^2/ha) of all live trees by treatment, plot, treatment period, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
					Fixed				
	4	8.7	14.3	10.4	15.1	11.2	16.1	12.0	16.9
1	8	8.7	15.2	9.8	14.7	10.7	15.1	11.5	16.2
	19	10.0	17.9	10.2	16.0	11.0	15.7	11.8	17.0
	9	8.8	15.2	12.0	17.4	14.2	19.7	16.4	21.9
3	20	10.2	17.2	12.0	17.7	14.5	20.1	16.6	25.0
	23	9.3	17.0	12.1	18.1	14.3	18.9	16.5	22.7
	11	9.8	17.7	13.8	20.5	17.7	23.7	21.3	27.5
5	13	7.4	16.5	13.9	19.8	17.6	24.0	21.3	28.0
	14	9.4	16.0	13.8	19.9	17.7	24.0	21.3	27.1
	16	8.4	15.2	15.2	22.5	20.7	27.7	25.8	32.5
7	17	9.3	15.9	15.5	21.4	20.9	26.9	26.0	32.6
	22	9.1	16.5	15.8	22.2	21.1	27.9	26.1	32.4
					Decreasing				
	6	9.7	16.0	10.1	14.9	12.0	17.0	14.1	19.5
2	10	9.8	17.1	10.2	15.0	11.7	16.1	13.9	18.8
	26	10.7	19.2	10.3	15.6	11.7	17.1	13.9	19.4
	3	8.6	14.3	12.3	17.6	15.4	20.0	18.5	23.9
4	18	9.5	17.2	12.1	18.3	15.1	21.2	18.7	25.2
	21	9.3	15.4	12.0	17.6	15.1	21.2	18.7	25.4
					Increasing				
	1	8.6	14.5	13.8	20.2	17.4	23.6	19.6	25.2
6	27	10.7	18.9	13.3	20.2	16.4	23.2	18.6	25.6
	28	9.7	16.7	13.8	20.6	16.9	22.9	19.0	25.9
	2	8.4	14.2	14.2	20.1	18.8	25.0	22.4	28.5
8	7	9.1	15.5	15.5	21.4	20.2	25.6	23.8	28.9
	25	8.6	15.8	15.5	23.0	20.2	26.9	24.0	31.4
					Unthinned				
	5	19.9	28.2	28.2	34.5	34.5	39.7	39.7	46.0
control	15	20.6	29.3	29.3	36.7	36.7	43.2	43.2	49.8
	24	22.0	31.9	31.9	39.5	39.5	45.2	45.2	52.2
					Supplemental				
	33	13.3	22.8						48.2
	34	12.6	21.2						45.9
dense	35	11.5	19.4						39.3
	36	11.9	22.2						48.5
	37	11.8	22.0						47.4
	38	7.9	15.6						40.9
	39	7.1	13.8						37.8
open	40	8.4	15.3						38.9
	41	6.9	12.2						30.5
	42	6.8	12.1						30.8

Table 12b. Basal area (ft^2/acre) of all live trees by treatment, plot, treatment period, year and stand age (years) - Shawnigan

		Calibration period		1st period		2nd period		3rd period	
		after cut	before cut	after cut	before cut	after cut	before cut	after cut	before cut
Treatment	Plot	1970 (25)	1976 (31)	1976 (31)	1982 (37)	1982 (37)	1989 (44)	1989 (44)	1996 (51)
					Fixed				
	4	37.9	62.1	45.5	65.6	48.8	70.1	52.4	73.7
1	8	37.9	66.2	42.8	64.2	46.6	65.9	49.9	70.6
	19	43.7	78.0	44.5	69.7	47.9	68.4	51.6	74.1
	9	38.3	66.1	52.1	75.8	61.9	85.6	71.5	95.3
3	20	44.3	75.0	52.3	77.2	63.0	87.4	72.2	108.9
	23	40.3	73.9	52.5	78.8	62.4	82.3	72.0	98.9
	11	42.9	76.9	60.3	89.5	76.9	103.3	93.0	120.0
5	13	32.3	71.8	60.4	86.1	76.7	104.6	92.7	122.0
	14	40.9	69.7	60.1	86.7	77.1	104.6	93.0	118.1
	16	36.6	66.3	66.3	97.8	90.2	120.6	112.5	141.4
7	17	40.7	69.4	67.7	93.3	91.1	117.2	113.3	141.9
	22	39.6	71.9	68.8	96.7	91.7	121.4	113.6	141.1
					Increasing				
	6	42.2	69.8	44.2	65.1	52.1	74.0	61.6	85.1
2	10	42.8	74.3	44.5	65.3	51.1	70.0	60.6	81.8
	26	46.8	83.5	44.8	67.9	51.1	74.3	60.4	84.4
	3	37.4	62.3	53.4	76.6	66.9	87.2	80.8	104.0
4	18	41.2	74.8	52.5	79.6	65.9	92.5	81.6	109.9
	21	40.6	67.3	52.3	76.8	65.6	92.4	81.5	110.7
					Decreasing				
	1	37.4	63.1	60.1	88.0	75.9	102.7	85.5	109.9
6	27	46.5	82.2	58.0	87.8	71.4	101.2	81.0	111.4
	28	42.1	72.7	60.3	89.9	73.5	99.8	82.9	112.8
	2	36.8	61.9	61.9	87.7	81.8	108.8	97.4	124.1
8	7	39.5	67.7	67.7	93.4	87.8	111.3	103.8	126.1
	25	37.5	68.7	67.4	100.0	87.9	117.3	104.6	136.8
					Unthinned				
	5	86.8	122.9	122.9	150.3	150.3	172.8	172.8	200.2
control	15	89.8	127.5	127.5	159.9	159.9	188.0	188.0	217.1
	24	95.7	139.0	139.0	172.0	172.0	197.0	197.0	227.6
					Supplemental				
	33	58.0	99.5						209.8
	34	55.0	92.5						200.0
dense	35	50.0	84.5						171.0
	36	52.0	96.5						211.1
	37	51.5	96.0						206.5
	38	34.5	68.0						178.0
	39	31.0	60.0						164.5
open	40	36.5	66.5						169.5
	41	30.0	53.0						133.0
	42	29.5	52.5						134.0

Table 13a. Total volume (m^3/ha) of all live trees by treatment, plot, treatment periods, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
					Fixed				
	4	42.3	77.9	58.8	96.6	73.3	116.8	87.8	135.7
1	8	38.0	81.7	53.8	93.0	67.9	111.0	85.3	138.8
	19	54.1	123.6	75.0	132.9	91.5	141.2	107.8	168.9
	9	41.1	85.9	68.4	118.8	97.8	150.1	125.6	188.9
3	20	54.9	107.3	75.8	136.9	112.5	174.5	146.0	240.7
	23	41.5	95.8	68.4	128.8	102.3	153.4	134.6	220.1
	11	51.0	107.5	85.2	153.1	132.4	201.9	182.7	257.3
5	13	48.9	95.4	80.6	139.1	120.3	189.3	168.8	252.5
	14	48.6	95.9	83.1	140.9	126.2	192.8	172.6	246.0
	16	38.3	82.1	82.1	151.8	140.2	207.3	193.7	285.3
7	17	44.4	88.3	86.2	139.4	136.2	202.0	195.6	279.9
	22	42.9	92.7	88.9	151.4	143.9	221.1	207.0	295.2
					Increasing				
	6	46.6	90.2	58.3	97.6	78.6	128.3	108.7	161.7
2	10	50.1	99.9	60.7	106.8	84.6	128.5	113.3	172.6
	26	55.6	123.6	68.1	122.5	92.9	153.6	126.5	197.2
	3	40.4	80.1	68.9	117.6	103.7	149.2	138.3	198.2
4	18	44.7	100.7	71.1	132.4	110.3	175.8	155.6	234.8
	21	47.7	97.1	73.1	126.1	108.2	171.2	151.4	240.9
					Decreasing				
	1	37.2	74.9	71.7	130.2	112.9	172.6	145.3	213.8
6	27	56.1	117.8	84.4	156.7	128.3	207.1	166.0	262.4
	28	53.3	101.9	84.7	153.9	126.1	190.1	146.8	245.3
	2	36.6	76.7	76.7	129.7	121.4	181.6	163.4	225.0
8	7	44.9	89.6	89.6	156.7	147.3	192.8	181.1	243.9
	25	39.3	93.1	84.6	163.0	143.7	212.6	191.7	298.4
					Unthinned				
	5	90.8	153.8	153.8	215.2	215.2	270.6	270.6	329.8
control	15	96.4	177.4	177.4	472.4	262.5	331.5	331.5	416.4
	24	101.0	191.4	191.4	273.9	273.9	337.0	337.0	422.1
					Supplemental				
	33	59.2	139.5						477.7
	34	55.6	119.4						411.9
dense	35	49.0	107.6						334.1
	36	52.1	128.5						476.9
	37	51.2	130.4						469.0
	38	36.5	85.1						385.6
	39	31.6	75.4						354.3
open	40	38.8	89.1						362.2
	41	29.9	64.5						255.7
	42	29.4	60.0						241.3

Table 13b. Total volume (ft^3/acre) of all live trees by treatment, plot, treatment periods, year and stand age (years) - Shawnigan

Treatment	Plot	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
					Fixed				
	4	604	1114	840	1381	1047	1669	1255	1939
1	8	543	1168	769	1329	971	1586	1219	1983
	19	773	1767	1072	1900	1307	2018	1540	2414
	9	588	1228	978	1698	1398	2145	1795	2699
3	20	785	1534	1083	1957	1608	2494	2086	3440
	23	593	1369	977	1841	1462	2192	1924	3146
	11	729	1536	1217	2188	1892	2885	2611	3677
5	13	699	1364	1152	1988	1719	2705	2413	3608
	14	695	1370	1187	2013	1804	2755	2467	3516
	16	547	1174	1174	2169	2003	2962	2768	4077
7	17	635	1262	1232	1992	1947	2887	2795	4000
	22	613	1325	1271	2164	2056	3160	2959	4219
					Increasing				
	6	666	1289	833	1395	1123	1834	1553	2311
2	10	716	1428	867	1527	1209	1836	1619	2466
	26	794	1766	973	1750	1328	2195	1808	2818
	3	578	1145	985	1680	1482	2132	1977	2832
4	18	639	1439	1016	1892	1577	2512	2224	3356
	21	682	1388	1044	1802	1546	2447	2164	3443
					Decreasing				
	1	531	1070	1024	1861	1614	2466	2076	3056
6	27	802	1684	1206	2240	1834	2960	2372	3750
	28	762	1457	1210	2199	1802	2717	2098	3506
	2	523	1096	1096	1853	1735	2596	2335	3216
8	7	641	1281	1281	2239	2105	2756	2588	3485
	25	561	1330	1209	2330	2053	3039	2739	4264
					Unthinned				
	5	1297	2198	2198	3075	3075	3867	3867	4713
control	15	1378	2535	2535	6751	3751	4738	4738	5951
	24	1443	2736	2736	3914	3914	4816	4816	6032
					Supplemental				
	33	846	1994						6827
	34	795	1707						5887
dense	35	700	1538						4775
	36	745	1836						6815
	37	732	1864						6702
	38	521	1216						5511
	39	451	1078						5064
open	40	554	1274						5176
	41	428	922						3655
	42	420	857						3449

Table 14a. Number of live trees per hectare by treatment, treatment period, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	927	927	531	531	366	363	259	259
3	927	922	642	642	502	494	403	403
5	927	927	736	734	630	625	544	544
7	927	927	902	895	835	835	786	783
				Increasing				
2	927	927	474	474	346	346	267	267
4	927	922	704	697	568	563	502	502
				Decreasing				
6	927	927	734	734	593	588	465	462
8	927	927	919	909	823	815	712	709
				Unthinned				
control	2945	2903	2903	2787	2787	2496	2496	2162
				Supplemental				
dense	1322	1322						1295
open	704	704						694

Table 14b. Number of live trees per acre by treatment, treatment period, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	375	375	215	215	148	147	105	105
3	375	373	260	260	203	200	163	163
5	375	375	298	297	255	253	220	220
7	375	375	365	362	338	338	318	317
				Increasing				
2	375	375	192	192	140	140	108	108
4	375	373	285	282	230	228	203	203
				Decreasing				
6	375	375	297	297	240	238	188	187
8	375	375	372	368	333	330	288	287
				Unthinned				
control	1192	1175	1175	1128	1128	1010	1010	875
				Supplemental				
dense	535	535	535					524
open	285	285	285					281

Table 15a. Quadratic mean dbh (cm) of all live trees by treatment, treatment period, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	11.2	14.7	15.7	19.3	19.8	23.6	24.4	29.0
3	11.4	15.0	15.5	18.8	19.1	22.6	22.9	27.2
5	11.7	15.0	15.5	18.8	19.1	22.1	22.4	25.4
7	11.2	14.7	14.7	17.8	18.0	20.6	20.6	23.1
				Increasing				
2	11.7	15.5	16.8	20.3	20.8	24.9	25.9	30.5
4	11.2	14.7	15.0	18.0	18.5	21.8	21.8	25.4
				Decreasing				
6	11.4	15.2	15.5	19.1	19.3	22.6	23.1	26.9
8	10.9	14.5	14.5	17.5	17.5	20.1	20.6	23.1
				Unthinned				
control	9.4	11.4	11.4	13.0	13.0	14.7	14.7	17.0
				Supplemental				
dense	10.9	14.5						21.6
open	11.7	15.2						25.7

Table 15b. Quadratic mean dbh (inches) of all live trees by treatment, treatment period, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	4.4	5.8	6.2	7.6	7.8	9.3	9.6	11.4
3	4.5	5.9	6.1	7.4	7.5	8.9	9	10.7
5	4.6	5.9	6.1	7.4	7.5	8.7	8.8	10
7	4.4	5.8	5.8	7	7.1	8.1	8.1	9.1
				Increasing				
2	4.6	6.1	6.6	8	8.2	9.8	10.2	12
4	4.4	5.8	5.9	7.1	7.3	8.6	8.6	10
				Decreasing				
6	4.5	6	6.1	7.5	7.6	8.9	9.1	10.6
8	4.3	5.7	5.7	6.9	6.9	7.9	8.1	9.1
				Unthinned				
control	3.7	4.5	4.5	5.1	5.1	5.8	5.8	6.7
				Supplemental				
dense	4.3	5.7						8.5
open	4.6	6						10.1

Table 16a. Basal area (m^2/ha) of all live trees by treatment, treatment period, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	9.1	15.8	10.2	15.3	11.0	15.6	11.8	16.7
3	9.4	16.5	12.0	17.7	14.3	19.5	16.5	23.3
5	8.9	16.7	13.8	20.1	17.7	23.9	21.3	27.5
7	9.0	15.9	15.5	22.0	20.9	27.5	26.0	32.5
				Increasing				
2	10.1	17.4	10.2	15.2	11.8	16.7	14.0	19.2
4	9.1	15.6	12.1	17.8	15.2	20.8	18.7	24.8
				Decreasing				
6	9.6	16.7	13.7	20.3	16.9	23.2	19.1	25.6
8	8.7	15.2	15.1	21.5	19.7	25.8	23.4	29.6
				Unthinned				
control	20.8	29.8	29.8	36.9	36.9	42.7	42.7	49.3
				Supplemental				
dense	12.2	21.5						45.8
open	7.4	13.8						35.8

Table 16b. Basal area (ft^2/acre) of all live trees by treatment, treatment period, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	39.8	68.8	44.3	66.5	47.8	68.1	51.3	72.8
3	41	71.7	52.3	77.3	62.4	85.1	71.9	101.3
5	38.7	72.8	60.3	87.4	76.9	104.3	92.9	120
7	39	69.2	67.6	95.9	91	119.7	113.1	141.5
				Increasing				
4	39.7	68.1	52.7	77.7	66.1	90.7	81.3	108.2
2	43.9	75.9	44.5	66.1	51.4	72.8	60.9	83.8
				Decreasing				
6	42	72.7	59.5	88.6	73.6	101.2	83.1	111.4
8	37.9	66.1	65.7	93.7	85.8	112.5	101.9	129
				Unthinned				
control	90.8	129.8	129.8	160.7	160.7	185.9	185.9	215
				Supplemental				
dense	53.3	93.8						199.7
open	32.3	60						155.8

Table 17a. Total volume (m^3/ha) of all live trees by treatment, treatment periods, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	44.8	94.5	62.6	107.5	77.5	123.0	93.6	147.8
3	45.8	96.4	70.9	128.2	104.2	159.3	135.4	216.6
5	49.5	100.3	82.9	144.4	126.3	194.7	174.7	251.9
7	41.8	87.7	85.8	147.5	140.1	210.1	198.8	286.8
				Increasing				
2	50.7	104.5	62.3	108.9	85.4	136.8	116.2	177.2
4	44.3	92.6	71.0	125.3	107.4	165.4	148.5	224.6
				Decreasing				
6	48.8	98.2	80.3	146.9	122.5	189.9	152.7	240.5
8	40.2	86.5	83.6	149.8	137.4	195.7	178.7	255.7
				Unthinned				
control	96.1	174.2	174.2	250.5	250.5	322.4	313.1	389.4
				Supplemental				
dense	53.5	125.1						433.9
open	33.2	74.8						319.8

Table 17b. Total volume (ft^3/acre) of all live trees by treatment, treatment periods, year and stand age (years) - Shawnigan

Treatment	Calibration period after cut 1970 (25)	Calibration period before cut 1976 (31)	1st period after cut 1976 (31)	1st period before cut 1982 (37)	2nd period after cut 1982 (37)	2nd period before cut 1989 (44)	3rd period after cut 1989 (44)	3rd period before cut 1996 (51)
				Fixed				
1	640	1350	894	1537	1108	1758	1338	2112
3	655	1377	1013	1832	1489	2277	1935	3095
5	708	1433	1185	2063	1805	2782	2497	3600
7	598	1254	1226	2108	2002	3003	2841	4099
				Increasing				
2	725	1494	891	1557	1220	1955	1660	2532
4	633	1324	1015	1791	1535	2364	2122	3210
				Decreasing				
6	698	1404	1147	2100	1750	2714	2182	3437
8	575	1236	1195	2141	1964	2797	2554	3655
				Unthinned				
control	1373	2490	2490	3580	3580	4474	4474	5565
				Supplemental				
dense	764	1788						6201
open	475	1069						4571

Table 18a. Crop tree comparison per hectare, by treatment, over time - Sayward

Treatment		Initial Stand 1969 (age 22)				Present Stand 1999 (age 52)			
		number of trees	QMD[3]	Basal area (m^2)	Volume (m^3)	number of trees	QMD[3]	Basal area (m^2)	Volume (m^3)
					Fixed				
	all trees	877	12.2	10.4	47.0	166	39.4	20.1	231.7
1	crop trees	198	14.2	3.1	15.4	166	39.4	20.1	231.7
	L198[1]	198	15.2	3.6	18.1	166	39.4	20.1	231.7
	L99[2]	99	15.7	2.0	10.1	99	42.4	13.9	162.4
	all trees	877	12.7	11.0	53.5	284	35.8	28.7	328.0
3	crop trees	198	14.7	3.3	16.7	198	38.1	22.7	264.2
	L198[1]	198	15.7	3.9	19.4	198	38.9	23.4	274.1
	L99[2]	99	17.0	2.2	11.3	99	41.7	13.5	184.4
	all trees	877	13.0	11.4	55.4	437	32.5	38.2	444.0
5	crop trees	198	15.0	3.4	16.9	198	36.1	20.2	239.7
	L198[1]	198	16.0	4.0	19.7	198	37.8	22.2	265.5
	L99[2]	99	17.0	2.3	11.1	99	40.1	12.5	256.7
	all trees	877	13.0	11.4	54.6	586	31.5	45.4	527.8
7	crop trees	198	14.5	3.2	16.2	198	34.5	18.6	220.8
	L198[1]	198	15.5	3.7	19.0	198	37.3	21.7	263.2
	L99[2]	99	16.3	2.1	10.6	99	39.6	12.2	150.7
					Increasing				
	all trees	877	13.2	11.9	57.7	255	37.8	28.7	333.1
2	crop trees	198	15.0	3.4	17.1	198	39.1	23.8	278.3
	L198[1]	198	16.5	4.2	21.1	198	39.9	24.8	291.3
	L99[2]	99	17.3	2.3	11.6	99	42.9	14.3	170.7
	all trees	877	12.2	10.2	47.2	465	32.3	38.0	428.1
4	crop trees	198	13.5	2.9	13.6	198	34.8	18.8	217.1
	L198[1]	198	14.5	3.3	16.2	198	36.8	21.0	245.3
	L99[2]	99	15.5	1.8	9.1	99	38.9	11.7	138.5
					Decreasing				
	all trees	877	12.7	11.1	53.6	292	35.6	29.0	343.8
6	crop trees	198	14.5	3.2	16.2	198	37.6	22.0	268.1
	L198[1]	198	15.0	3.6	17.9	198	38.4	22.9	280.7
	L99[2]	99	15.7	2.0	9.7	99	40.6	12.8	161.6
	all trees	877	12.4	10.7	49.5	502	31.0	37.6	425.9
8	crop trees	198	14.5	3.2	15.6	198	33.5	17.4	199.9
	L198[1]	198	15.5	3.7	17.9	198	35.8	19.9	232.1
	L99[2]	99	16.5	2.1	10.6	99	37.8	11.1	131.8
					Unthinned				
	all trees	2624	10.4	21.1	91.2	1796	20.6	59.6	650.0
control	crop trees	198	14.0	3.1	14.8	198	28.4	12.5	146.8
	L198[1]	198	15.0	3.6	17.5	198	31.0	14.9	178.4
	L99[2]	99	15.7	2.0	9.7	99	32.8	8.3	100.7

[1] Largest 198 trees per hectare by dbh
[2] Largest 99 trees per hectare by dbh
[3] Quadratic mean diameter at breast height (cm)

Table 18b. Crop tree comparison per acre, by treatment, over time - Sayward

Treatment		Initial Stand 1969 (age 22)				Present Stand 1999 (age 52)			
		number of trees	QMD[3]	Basal area (ft^2)	Volume (ft^3)	number of trees	QMD[3]	Basal area (ft^2)	Volume (ft^3)
					Fixed				
	all trees	355	4.8	45.2	671	67	15.5	87.5	3311
1	crop trees	80	5.6	13.5	220	67	15.5	87.5	3311
	L80[1]	80	6.0	15.5	258	67	15.5	87.5	3311
	L40[2]	40	6.2	8.5	145	40	16.7	60.5	2321
	all trees	355	5.0	48.1	764	115	14.1	125.1	4688
3	crop trees	80	5.8	14.5	239	80	15.0	98.7	3776
	L80[1]	80	6.2	17.0	277	80	15.3	102.0	3917
	L40[2]	40	6.7	9.5	161	40	16.4	59.0	2635
	all trees	355	5.1	49.5	792	177	12.8	166.6	6346
5	crop trees	80	5.9	15.0	241	80	14.2	88.2	3426
	L80[1]	80	6.3	17.5	282	80	14.9	96.7	3795
	L40[2]	40	6.7	10.0	159	40	15.8	54.6	3668
	all trees	355	5.1	49.7	781	237	12.4	197.8	7543
7	crop trees	80	5.7	14.0	232	80	13.6	80.9	3155
	L80[1]	80	6.1	16.0	271	80	14.7	94.4	3762
	L40[2]	40	6.4	9.0	152	40	15.6	53.1	2153
					Increasing				
	all trees	355	5.2	52.0	825	103	14.9	125.1	4761
2	crop trees	80	5.9	15.0	244	80	15.4	103.7	3978
	L80[1]	80	6.5	18.5	301	80	15.7	108.0	4163
	L40[2]	40	6.8	10.0	166	40	16.9	62.2	2439
	all trees	355	4.8	44.5	675	188	12.7	165.7	6118
4	crop trees	80	5.3	12.5	194	80	13.7	82.1	3103
	L80[1]	80	5.7	14.5	231	80	14.5	91.4	3505
	L40[2]	40	6.1	8.0	130	40	15.3	50.8	1980
					decreasing				
	all trees	355	5.0	48.4	766	118	14.0	126.2	4914
6	crop trees	80	5.7	14.0	232	80	14.8	95.9	3832
	L80[1]	80	5.9	15.5	256	80	15.1	99.8	4011
	L40[2]	40	6.2	8.5	139	40	16.0	55.9	2309
	all trees	355	4.9	46.4	707	203	12.2	163.8	6087
8	crop trees	80	5.7	14.0	223	80	13.2	75.7	2857
	L80[1]	80	6.1	16.0	256	80	14.1	86.7	3317
	L40[2]	40	6.5	9.0	152	40	14.9	48.5	1883
					unthinned				
	all trees	1062	4.1	91.9	1304	727	8.1	259.6	9289
control	crop trees	80	5.5	13.5	212	80	11.2	54.6	2098
	L80[1]	80	5.9	15.5	250	80	12.2	64.8	2550
	L40[2]	40	6.2	8.5	138	40	12.9	36.0	1439

[1] Largest 80 trees per acre by dbh
[2] Largest 40 trees per acre by dbh
[3] Quadratic mean diameter at breast height (inches)

Table 19a. Crop tree comparison per hectare, by treatment, over time - Shawnigan

Treatment		Initial Stand 1970 (age 25)				Present Stand 1996 (age 51)			
		number of trees	QMD[3]	Basal area (m^2)	Volume (m^3)	number of trees	QMD[3]	Basal area (m^2)	Volume (m^3)
					Fixed				
	all trees	927	11.2	9.1	44.8	259	29.0	16.7	147.8
1	crop trees	198	13.0	2.6	13.4	198	30.0	14.0	127.5
	L198[1]	198	14.0	3.0	15.9	198	30.5	14.4	131.2
	L99[2]	99	14.5	1.6	8.9	99	32.8	8.3	77.9
	all trees	927	11.4	9.4	45.8	403	27.2	23.3	216.6
3	crop trees	198	13.0	2.6	13.3	198	28.4	12.5	118.8
	L198[1]	198	14.0	3.0	15.4	198	29.2	13.3	127.8
	L99[2]	99	14.7	1.7	8.7	99	31.0	7.5	72.6
	all trees	927	11.7	8.9	49.5	544	25.4	27.5	251.9
5	crop trees	198	13.2	2.7	14.7	198	28.2	12.3	116.9
	L198[1]	198	14.0	3.1	16.9	198	29.7	13.6	131.3
	L99[2]	99	14.7	1.7	9.6	99	31.5	7.7	76.2
	all trees	927	11.2	9.0	41.8	786	23.1	32.6	288.2
7	crop trees	198	13.0	2.6	12.9	198	26.2	10.7	98.1
	L99[2]	198	13.7	2.9	14.3	198	27.9	12.2	113.8
	L99[2]	99	14.2	1.6	8.0	99	29.7	6.8	64.9
					Increasing				
	all trees	927	11.7	10.1	50.7	267	30.5	19.2	177.2
2	crop trees	198	14.2	3.1	16.3	198	31.5	15.5	145.3
	L198[1]	198	14.7	3.3	17.8	198	32.0	16.0	150.6
	L99[2]	99	15.5	1.9	10.1	99	34.3	9.1	87.7
	all trees	927	11.2	9.1	44.3	502	25.4	24.8	224.6
4	crop trees	198	13.2	2.7	14.1	198	28.7	12.8	120.1
	L198[1]	198	14.0	3.1	16.2	198	29.7	13.8	130.2
	L99[2]	99	15.0	1.7	9.4	99	31.8	7.9	76.1
					Decreasing				
	all trees	927	11.4	9.6	48.8	465	26.9	25.6	241.0
6	crop trees	198	13.2	2.7	14.3	198	28.7	12.7	122.7
	L198[1]	198	14.2	3.2	16.8	198	30.5	14.3	139.7
	L99[2]	99	15.2	1.8	9.7	99	32.3	8.1	81.2
	all trees	927	10.9	8.7	40.2	712	23.1	29.8	257.4
8	crop trees	198	12.7	2.5	11.8	198	25.9	10.4	92.6
	L80[1]	198	13.5	2.8	13.8	198	27.7	11.8	107.4
	L99[2]	99	14.2	1.6	7.8	99	29.2	6.6	61.2
					Unthinned				
	all trees	2945	9.4	20.8	96.1	2162	17.0	49.4	389.4
control	crop trees	198	13.5	2.8	14.0	198	23.1	8.3	73.1
	L198[1]	198	15.5	3.7	18.6	198	26.2	10.6	96.2
	L99[2]	99	16.5	2.1	10.8	99	27.4	5.9	54.5
					Supplemental				
	all trees	1322	10.9	12.2	53.5	1265	21.3	47.0	439.4
dense	crop trees	198	13.7	2.9	14.0	198	26.9	11.2	110.7
	L198[1]	198	14.5	3.2	15.9	198	29.0	13.0	130.5
	L99[2]	99	15.2	1.8	9.2	99	30.5	7.2	73.0
	all trees	704	11.7	7.4	33.2	694	25.7	35.8	319.8
open	crop trees	198	13.2	2.7	12.9	198	28.7	12.8	117.7
	L198[1]	198	14.0	3.0	14.6	198	30.0	14.0	130.4
	L99[2]	99	14.7	1.7	8.5	99	31.2	7.6	71.7

[1] Largest 198 trees per hectare by dbh [2] Largest 99 trees per hectare by dbh [3] Quadratic mean diameter at breast height (cm)

Table 19b. Crop tree comparison per acre, by treatment, over time - Shawnigan

Treatment		Initial Stand 1970 (age 25)				Present Stand 1996 (age 51)			
		number of trees	QMD[3]	Basal area (ft^2)	Volume (ft^3)	number of trees	QMD[3]	Basal area (ft^2)	Volume (ft^3)
					Fixed				
	all trees	375	4.4	39.8	640	105	11.4	72.8	2112
1	crop trees	80	5.1	11.4	192	80	11.8	61.2	1822
	L80[1]	80	5.5	13	227	80	12	62.8	1875
	L40[2]	40	5.7	7.1	127	40	12.9	36.2	1113
	all trees	375	4.5	41	655	163	10.7	101.3	3095
3	crop trees	80	5.1	11.5	190	80	11.2	54.3	1698
	L80[1]	80	5.5	13.1	220	80	11.5	58.1	1827
	L40[2]	40	5.8	7.3	125	40	12.2	32.6	1037
	all trees	375	4.6	38.7	708	220	10	120	3600
5	crop trees	80	5.2	11.8	210	80	11.1	53.6	1671
	L80[1]	80	5.5	13.4	242	80	11.7	59.4	1876
	L40[2]	40	5.8	7.4	137	40	12.4	33.6	1089
	all trees	375	4.4	39	598	318	9.1	142.2	4119
7	crop trees	80	5.1	11.4	184	80	10.3	46.6	1402
	L80[1]	80	5.4	12.5	204	80	11	53	1627
	L40[2]	40	5.6	6.9	115	40	11.7	29.7	927
					Increasing				
	all trees	375	4.6	43.9	725	108	12	83.8	2532
2	crop trees	80	5.6	13.4	233	80	12.4	67.4	2076
	L80[1]	80	5.8	14.5	255	80	12.6	69.6	2152
	L40[2]	40	6.1	8.1	145	40	13.5	39.6	1253
	all trees	375	4.4	39.7	633	203	10	108.2	3210
4	crop trees	80	5.2	11.9	202	80	11.3	55.7	1716
	L80[1]	80	5.5	13.4	231	80	11.7	60	1861
	L40[2]	40	5.9	7.6	134	40	12.5	34.3	1088
					Decreasing				
	all trees	375	4.5	42	698	188	10.6	111.7	3444
6	crop trees	80	5.2	11.9	204	80	11.3	55.5	1754
	L80[1]	80	5.6	13.9	240	80	12	62.4	1996
	L40[2]	40	6	7.9	139	40	12.7	35.2	1161
	all trees	375	4.3	37.9	575	288	9.1	129.9	3679
8	crop trees	80	5	10.7	169	80	10.2	45.3	1324
	L80[1]	80	5.3	12.2	197	80	10.9	51.5	1535
	L40[2]	40	5.6	6.8	112	40	11.5	28.8	874
					Unthinned				
	all trees	1192	3.7	90.8	1373	875	6.7	215	5565
control	crop trees	80	5.3	12.4	200	80	9.1	36.1	1044
	L80[1]	80	6.1	16	266	80	10.3	46	1375
	L40[2]	40	6.5	9.1	154	40	10.8	25.7	779
					Supplemental				
	all trees	535	4.3	53.3	764	512	8.4	204.8	6280
dense	crop trees	80	5.4	12.7	200	80	10.6	48.7	1582
	L80[1]	80	5.7	14.1	227	80	11.4	56.6	1865
	L40[2]	40	6	7.9	132	40	12	31.3	1043
	all trees	285	4.6	32.3	475	281	10.1	155.8	4571
open	crop trees	80	5.2	11.8	184	80	11.3	55.6	1682
	L80[1]	80	5.5	13.2	209	80	11.8	61	1864
	L40[2]	40	5.8	7.5	122	40	12.3	33.1	1025

[1] Largest 80 trees per acre by dbh [2] Largest 40 trees per acre by dbh [3] Quadratic mean diameter at breast height (inches)

Table 20. Crop tree height comparison by treatment over time - Sayward

Treatment	Height in feet		Height in metres	
	stand age 22	stand age 52	stand age 22	stand age 52
		Fixed		
1	37.1	96.7	11.3	29.5
3	38.0	99.4	11.6	30.3
5	37.9	98.5	11.6	30.0
7	38.2	99.2	11.6	30.2
		Increasing		
2	38.2	98.5	11.6	30.0
4	36.8	94.7	11.2	28.9
		Decreasing		
6	38.5	101.4	11.7	30.9
8	37.5	96.5	11.4	29.4
		Unthinned		
control	36.8	93.6	11.2	28.3
		Supplemental		
dense50	38.9	90.9	11.9	27.7
dense10	37.7	95.2	11.5	29

Table 21. Crop tree height comparison by treatment over time - Shawnigan

Treatment	Height in feet		Height in metres	
	stand age 25	stand age 51	stand age 25	stand age 51
		Fixed		
1	38.1	72.9	11.6	22.2
3	37.7	77.7	11.5	23.7
5	40.2	76.5	12.3	23.3
7	36.8	73.8	11.2	22.5
		Increasing		
2	39.8	76.8	12.1	23.4
4	38.6	75.5	11.8	23.0
		Decreasing		
6	39.1	76.9	11.9	23.4
8	35.7	72.6	10.9	22.1
		Unthinned		
control	37.8	69.7	11.5	21.3
		Supplemental		
dense	36.2	78.2	11.0	23.8
open	35.2	74.9	10.7	22.8

Table 22a. Cumulative volume (m^3/ha) by treatment - Sayward

	Treatments										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
	1	3	5	7	2	4	6	8	contol	dense50	dense10
Initial volume 1969	47	53.5	55.4	54.6	57.7	47.2	53.6	49.5	91.3	69.4	63.5
increment 1969-1973	44.1	44.7	47.4	48.6	47.4	40.7	48.3	44	65.8 0.3[a]	48.2	55.9
increment 1973-1977	48.1	55.3	71.9	65	47.7	53.5	59.1	62.8	77.4 3[b]		
increment 1977-1981	42.5	47.8	57.9	68.6	46.3	54.1	65.1	57.1	76.6 3.9[c]		
increment 1981-1987	58.3	66.8	81.7	98.9	61.9	73.6	91.5	81.2	105 4.4[d]		
increment 1987-1993	70.7	102.6	106.6	135	103.9	106	107.1	127.1	125.1 18.3[e]		
increment 1999-1999	76.8	98.8	134.5	130.8	94.3	131.9	103.8	109	108.7 27.6[f]	393.2	376.7
mortality 1969-1999	3.5	2.5	1.4	8.2	8.2	3.3	3.2	6.2	57.5	3.7	4.3
Total	**391**	**472**	**556.8**	**609.9**	**467.4**	**510.5**	**531.7**	**536.9**	**707.4**	**514.5**	**495.9**

[a] control mortality 1969-73 [b] control mortality 1973-77 [c] control mortality 1977-81 [d] control mortality 1981-87
[e] control mortality 1987-93 [f] control mortality 1993-99 [g] increment 1973-99

Table 22b. Cumulative volume (ft^3/acre) by treatment - Sayward

	Treatments										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
	1	3	5	7	2	4	6	8	contol	dense50	dense10
Initial volume 1969	671	764	792	781	825	675	766	707	1305	992	907
increment 1969-1973	630	639	677	694	678	582	690	629	941 4[a]	689	735
increment 1973-1977	688	791	1028	929	682	765	844	898	1106 43[b]		
increment 1977-1981	608	683	828	981	662	773	931	816	1095 55[c]		
increment 1981-1987	833	954	1167	1414	884	1052	1307	1161	1500 63[d]		
increment 1987-1993	1010	1467	1524	1930	1485	1515	1531	1816	1788 261[e]		
increment 1999-1999	1098	1412	1922	1869	1347	1885	1484	1557	1554 394[f]	5619[g]	5384[g]
mortality 1969-1999	50	36	20	118	117	48	46	89	820	53	61
Total	**5588**	**6746**	**7958**	**8716**	**6680**	**7295**	**7599**	**7673**	**10109**	**7353**	**7087**

[a] control mortality 1969-73 [b] control mortality 1973-77 [c] control mortality 1977-81 [d] control mortality 1981-87
[e] control mortality 1987-93 [f] control mortality 1993-99 [g] increment 1973-99

Table 23a. Cumulative volume (m^3/ha) by treatment - Shawnigan

	Treatments										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
	1	3	5	7	2	4	6	8	contol	dense	open
Initial volume 1970	44.8	45.8	49.5	41.8	50.7	44.3	48.8	40.2	96.1	53.5	33.2
increment 1970-76	49.7	50.5	50.7	45.9	53.8	48.4	49.4	46.3	78.2 0.9[a]	71.7	41.2
increment 1976-82	45	57.3	61.4	61.7	46.6	54.3	66.7	66.2	76.3 4.1[b]		
increment 1982-89	45.5	55.1	68.4	70	51.4	58	67.5	58.3	62.6 9.3[c]		
increment 1989-96	54.2	81.2	77.2	88	61	76.1	87.8	77	76.3 15[d]	336.2[e]	245[e]
mortality 1970-96	1.3	3.4	0.3	2.9	0	2	2.4	3.9		6.3	0.1
Total	**240.2**	**293.3**	**307.6**	**310.4**	**263.6**	**283.1**	**322.6**	**291.6**	**418.6**	**467.6**	**319.9**

[a] control mortality 1970-76 [b] control mortality 1976-82 [c] control mortality 1982-89
[d] control mortality 1989-96 [e] increment 1976-96

Table 23b. Cumulative volume (ft^3/acre) by treatment - Shawnigan

	Treatments										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
	1	3	5	7	2	4	6	8	contol	dense	open
Initial volume 1970	640	655	708	598	725	633	698	575	1373	764	475
increment 1970-76	710	722	725	656	769	691	706	661	1117 13[a]	1024	594
increment 1976-82	643	819	878	882	666	776	953	946	1090 58[b]		
increment 1982-89	650	788	977	1001	735	829	964	833	894 133[c]		
increment 1989-96	774	1160	1103	1258	872	1088	1255	1101	1091 214[d]	4805[e]	3502[e]
mortality 1970-96	18	48	5	41	0	29	34	56		90	1
Total	**3435**	**4192**	**4396**	**4436**	**3767**	**4046**	**4610**	**4172**	**5983**	**6683**	**4572**

[a] control mortality 1970-76 [b] control mortality 1976-82 [c] control mortality 1982-89
[d] control mortality 1989-96 [e] increment 1976-96

Table 24a. Density distribution (stems/ha) by tree size class 1999 (stand age 52) - Sayward

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - cm	1	3	5	7	2	4	6	8	control	dense50	dense10
<17.6		4		8				8	729	124	68
17.6-22.5		4	29	37	4	29	12	12	474	371	154
22.6-27.5		25	45	128	8	70	21	132	404	272	204
27.6-32.5	21	58	119	161	37	152	66	152	124	161	204
32.6-37.5	41	82	148	152	86	144	82	148	54	62	68
37.6-42.5	62	70	78	82	58	54	91	37	12	12	19
42.6-47.5	33	37	16	8	58	16	21	4			19
47.6-52.5	8	4			4						
total	165	284	437	577	255	465	292	494	1796	1002	736
total merchantable*	165	280	437	568	255	465	292	486	1067	878	668
ave merch dbh cm	39.4	36.1	33.4	31.8	37.9	32.3	35.5	28.1	24.4	25.3	28.1

* merchantable = >17.5 cm dbh

Table 24b. Density distribution (stems/acre) by tree size class 1999 (stand age 52) - Sayward

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - inches	1	3	5	7	2	4	6	8	control	dense50	dense10
<6.93		2		3				3	295	50	28
6.93-8.86		2	12	15	2	12	5	5	192	150	62
8.87-10.83		10	18	52	3	28	8	53	163	110	83
10.84-12.80	8	23	48	65	15	62	27	62	50	65	83
12.81-14.76	17	33	60	62	35	58	33	60	22	25	28
14.77-16.73	25	28	32	33	23	22	37	15	5	5	8
16.74-18.70	13	15	7	3	23	7	8	2			8
18.71-20.67	3	2			2						
total	67	115	177	234	103	188	118	200	727	405	298
total merchantable*	67	113	177	230	103	188	118	197	432	355	270
ave merch dbh cm	15.5	14.2	13.1	12.5	14.9	12.7	14	11.1	9.6	10	11.1

* merchantable = >6.89" dbh

Table 25a. Volume distribution (m^3/ha) by tree size class 1999 (stand age 52) - Sayward

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - cm	1	3	5	7	2	4	6	8	control	dense50	dense10
<17.6		0.7		1.8				1.8	92.9	20	11.1
17.6-22.5		1.5	9.0	11.9	1.6	9.5	4.0	4.5	154.5	115.7	50.1
22.6-27.5		12.9	26.1	70.5	3.9	37.1	10.3	71.4	217.5	142.8	107.7
27.6-32.5	17.0	41.6	98.5	134.2	28.7	116.0	46.0	119.3	100.0	129.6	153.1
32.6-37.5	47.0	87.3	161.6	168.6	95.6	158.9	94.1	166.7	64.4	70.8	75.4
37.6-42.5	88.4	103.2	117.4	125.5	85.2	76.8	146.8	54.5	20.8	20.2	29.6
42.6-47.5	60.4	71.5	31.3	15.2	108.4	29.8	42.7	7.7			36.9
47.6-52.5	19.0	9.4			9.8						
total	231.7	328	444.1	527.8	333.1	428.1	343.8	425.9	650	499.1	463.9
total merchantable*	231.7	327.3	444.1	526	333.1	428.1	343.8	424.1	557.1	479.1	452.8

* merchantable = >17.5 cm dbh

Table 25b. Volume distribution (ft^3/acre) by tree size class 1999 (stand age 52) - Sayward

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - inches	1	3	5	7	2	4	6	8	control	dense50	dense10
<6.93		10		26				26	1328	286	159
6.93-8.86		21	129	170	22	136	57	64	2208	1654	716
8.87-10.83		184	373	1008	56	530	147	1021	3108	2041	1539
10.84-12.80	243	595	1408	1918	410	1658	657	1705	1429	1852	2188
12.81-14.76	672	1247	2310	2410	1366	2271	1345	2382	920	1012	1078
14.77-16.73	1263	1474	1678	1794	1218	1098	2097	779	297	289	423
16.74-18.70	863	1022	448	218	1550	426	610	110			527
18.71-20.67	271	134			140						
total	3311	4688	6347	7543	4760	6118	4913	6087	9289	7133	6630
total merchantable*	3311	4678	6347	7517	4760	6118	4913	6061	7962	6847	6471

* merchantable = >6.89" dbh

Table 26a. Density distribution (stems/ha) by tree size class 1996 (stand age 51) - Shawnigan

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - cm	1	3	5	7	2	4	6	8	control	dense	open
<17.6			29	95		66	25	86	1413	410	30
17.6-22.5	41	70	136	292	16	99	78	239	523	467	168
22.6-27.5	66	198	218	301	66	202	194	301	189	306	311
27.6-32.5	91	115	136	95	107	103	124	78	33	128	161
32.6-37.5	62	21	21	4	66	25	45	8	4	10	35
37.6-42.5			4		12	8					
total	259	404	544	787	251	503	466	712	2163	1322	704
total merchantable*	259	404	515	692	251	437	441	626	750	912	675
ave merch dbh cm	28.6	26.5	25.8	23.8	30.2	26.2	26.9	23.9	21.9	23.4	25.8

* merchantable = >17.5 cm dbh

Table 26b. Density distribution (stems/acre) by tree size class 1996 (stand age 51) - Shawnigan

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - inches	1	3	5	7	2	4	6	8	control	dense	open
<6.93			12	38		27	10	35	572	166	12
6.93-8.86	17	28	55	118	7	40	32	97	212	189	68
8.87-10.83	27	80	88	122	27	82	78	122	77	124	126
10.84-12.80	37	47	55	38	43	42	50	32	13	52	65
12.81-14.76	25	8	8	2	27	10	18	3	2	4	14
14.77-16.73			2		5	3					
total	105	163	220	318	102	204	189	288	875	535	285
total merchantable*	105	163	208	280	102	177	178	253	304	369	273
ave merch dbh cm	11.3	10.4	10.2	9.4	11.9	10.3	10.6	9.4	8.6	9.2	10.2

* merchantable = >6.89" dbh

Table 27a. Volume distribution (m^3/ha) by tree size class 1996 (stand age 51) - Shawnigan

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - cm	1	3	5	7	2	4	6	8	control	dense	open
<17.6			4	14.2		9.9	3.7	12.5	144.0	61.7	4.2
17.6-22.5	10.1	20.3	38.6	80.1	4.2	27.4	20.3	62.4	138.5	135.1	45.4
22.6-27.5	24.8	92.3	96.7	129.1	28.8	86.4	87.9	125.1	83.7	144.7	134.3
27.6-32.5	56.4	78.4	86.6	61.2	67.9	67.2	85.1	49.4	19.7	88.6	104.2
32.6-37.5	56.5	18.8	19.6	3.6	60.4	24.4	44.1	8.1	3.5	10.1	31.7
37.6-42.5			6.4		15.8	9.3					
total	147.7	209.7	251.9	288.2	177.1	224.6	241	257.4	389.4	440.2	319.8
total merchantable*	147.7	209.7	247.9	274	177.1	214.7	237.3	244.9	245.4	378.5	315.6

* merchantable = >17.5 cm dbh

Table 27b Volume distribution (ft^3/acre) by tree size class 1996 (stand age 51) - Shawnigan

	treatment										
	Fixed				Increasing		Decreasing		Unthinned	Supplemental	
dbh class - inches	1	3	5	7	2	4	6	8	control	dense	open
<6.93			58	203		141	53	178	2058	882	60
6.93-8.86	144	290	552	1145	60	392	290	892	1979	1930	649
8.87-10.83	354	1319	1382	1845	412	1235	1256	1787	1197	2069	1920
10.84-12.80	806	1120	1237	875	971	960	1216	706	282	1266	1489
12.81-14.76	807	268	280	52	863	349	630	115	50	145	454
14.77-16.73			91		226	133					
total	2111	2997	3600	4119	2531	3210	3444	3679	5565	6291	4570
total merchantable*	2111	2997	3543	3916	2531	3068	3391	3500	3507	5409	4510

* merchantable = >6.89" dbh

Table 28a. Periodic Annual Increment (PAI) and Mean Annual Increment (MAI) - Volume (m^3/ha/year) - Sayward

	1969-73		1973-77		1977-81		1981-87		1987-93		1993-99	
treatment	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI
						Fixed						
1	11.1	3.5	12.0	4.6	10.6	5.3	9.7	6.0	11.8	6.8	12.8	7.5
3	11.2	3.8	13.9	5.1	12.0	5.9	11.1	6.7	16.7	8.0	16.4	9.0
5	11.8	4.0	18.0	5.8	14.5	6.9	13.6	7.8	17.8	9.2	22.4	10.7
7	12.2	4.0	16.2	5.6	17.1	7.0	16.5	8.4	23.3	10.2	21.8	11.5
						Increasing						
2	11.9	4.1	12.0	5.1	11.6	5.9	10.3	6.5	17.4	7.9	15.7	8.8
4	10.2	3.4	13.4	4.7	13.5	5.7	12.2	6.7	17.7	8.2	22.0	9.7
						Decreasing						
6	12.1	3.9	14.8	5.4	16.4	6.6	15.3	7.9	17.8	9.2	17.3	10.1
8	11.0	3.6	15.7	5.2	14.3	6.3	13.6	7.3	21.2	9.2	18.2	10.2
						Unthinned						
control	16.4	6.0	19.4	7.8	19.2	9.2	17.5	10.4	21.0	11.8	18.1	12.5

Table 28b. Periodic Annual Increment (PAI) and Mean Annual Increment (MAI) - Volume (ft^3/acre/year) - Sayward

	1969-73		1973-77		1977-81		1981-87		1987-93		1993-99	
treatment	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI
						Fixed						
1	158	50	172	66	152	76	139	86	168	97	183	107
3	160	54	198	73	171	85	159	96	238	115	235	129
5	169	57	257	83	207	98	195	112	254	131	320	153
7	174	57	232	80	245	100	236	120	333	146	312	165
						Increasing						
2	170	58	171	73	166	84	147	93	248	113	225	126
4	146	48	191	67	193	82	175	96	253	117	314	139
						Decreasing						
6	173	56	211	77	235	95	218	113	255	132	247	145
8	157	51	225	74	204	90	194	105	303	131	260	146
						Unthinned						
control	235	86	277	112	274	131	250	149	300	168	259	179

Table 29a. Periodic Annual Increment (PAI) and Mean Annual Increment (MAI) - Volume (m^3/ha/year) - Shawnigan

	1970-76		1976-82		1982-89		1989-96	
treatment	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI
				Fixed				
1	8.3	3.1	7.5	3.8	6.5	4.2	7.8	4.7
3	8.4	3.1	9.6	4.1	7.9	4.8	11.6	5.7
5	8.5	3.2	10.2	4.3	9.8	5.3	11.1	6.0
7	7.6	2.8	10.3	4.1	8.7	4.8	13.9	6.0
				Increasing				
2	9.0	3.4	7.8	4.1	7.4	4.6	8.8	5.2
4	8.1	3.0	9.0	4.0	8.3	4.7	10.9	5.5
				Decreasing				
6	8.3	3.2	11.1	4.5	9.7	5.3	12.5	6.3
8	7.7	2.8	11.1	4.1	8.3	4.8	11.0	5.7
				Unthinned				
control	13.0	5.6	12.7	6.8	8.8	7.1	10.9	7.6

Table 29b. Periodic Annual Increment (PAI) and Mean Annual Increment (MAI) - Volume (ft^3/acre/year) - Shawnigan

	1970-76		1976-82		1982-89		1989-96	
treatment	PAI	MAI	PAI	MAI	PAI	MAI	PAI	MAI
				Fixed				
1	118	44	107	54	93	60	111	67
3	120	44	137	59	113	68	165	81
5	121	46	146	62	140	75	158	86
7	109	40	147	58	124	68	199	86
				Increasing				
2	128	48	111	58	105	66	125	74
4	115	43	129	57	118	67	155	79
				Decreasing				
6	118	45	159	64	138	75	179	90
8	110	40	158	59	119	69	157	81
				Unthinned				
control	186	80	182	97	126	102	156	109

Table 30. Analysis of Variance - Sayward

Source of variation	Degrees of freedom (5 treatment periods)
Treatments:	
A -- fixed percentage treatments vs, variable percentage treatments	1
B -- fixed percentage treatments (linear effects)	1
B -- fixed percentage treatments(quadratic effects)	1
B -- fixed percentage treatments(cubic effects)	1
C -- increasing percentage treatments vs. decreasing percentage treatments	1
D -- between levels of increasing percentage treatments	1
E -- between levels of decreasing percentage treatments	1
Error (a) for testing treatments	16
Periods (P)	4
Treatment x period interactions	
P x A	4
P x B (linear effects)	4
P x B (quadratic effects)	4
P x B (cubic effects)	4
P x C	4
P x D	4
P x E	4
Error (b) for testing interactions	16
Total	119

Table 31. Analysis of variance results for periodic annual gross volume increment and growth percent, periodic annual gross basal area increment and growth percent, and survivor quadratic mean diameter periodic annual increment - Sayward.

P - values and mean square errors[1]

	Volume				Basal Area					
	pai		growth percent		pai		growth percent		Survivor QMD pai	
A --- Fixed vs. variable	0.4148		0.6736		0.293		0.664		0.589	
B --- Fixed (linear)	0.0001	**	0.0014	**	0.0001	**	0.0001	**	0.0001	**
B --- Fixed (quadratic)	0.4639		0.8234		0.492		0.6542		0.468	
B --- Fixed (cubic)	0.6266		0.4883		0.871		0.7968		0.791	
C --- Increasing vs. decreasing	0.1211		0.0191	*	0.128		0.0222	*	0.233	
D --- Between increasing	0.0034	**	0.4684		0.002	**	0.5375		0.026	*
E --- Between decreasing	0.7201		0.0134	*	0.6882		0.0067	*	0.01	*
Error a -- mean squares	44828.5		16.9		16.2		12.25		0.1328	
P (periods)	0.001	**	0.0001	**	0.0001	**	0.001	**	0.0001	**
P x A	0.0829		0.1978		0.285		0.4194		0.761	
P x B (linear)	0.0068	**	0.3659		0.009	**	0.0874		0.008	**
P x B (quadratic)	0.3678		0.4111		0.539		0.8176		0.995	
P x B (cubic)	0.1573		0.2257		0.274		0.222		0.531	
P x C	1.0681		0.3652		0.503		0.3593		0.962	
P x D	0.0785		0.8849		0.595		0.6177		0.533	
P x E	0.1916		0.2881		0.393		0.2603		0.41	
Error b -- mean square	28381		20.9		9.85		6.43		0.0361	

[1] The P - value is the probability of a larger F-value, given the null hypothesis of no difference among means is true. Significance levels are given as: * is 0.01<p<0.05 and ** is 0.00 <p< 0.01.

Table 32a. Mortality by treatment and treatment period - Sayward Forest

Treatment	Number of trees/ha Treatment Period						Basal area (m^2/ha) Treatment Period						Volume (m^3/ha) Treatment Period					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
										Fixed								
1					4.94						0.34						3.53	
3			7.41	7.41					0.14	0.21					0.93	1.59		
5					4.94						0.14						1.36	
7			12.4		4.94	4.94			0.31		0.19	0.34			2.26		1.89	4.08
										Increasing								
2				4.94		4.94				0.3		0.46				2.83		5.35
4				4.94	4.94					0.18	0.19					0.12	1.87	
										Decreasing								
6			12.4		4.94				0.2		0.2				1.47		1.76	
8			12.4	12.4	7.41				0.18	0.4	0.21				1.06	3.23	1.94	
										Unthinned								
control	19.8	166	119	153	104	247	0.07	0.57	0.61	0.71	2.3	2.96	0.3	3.01	3.86	4.78	18.3	27.6

Table 32b. Mortality by treatment and treatment period - Sayward Forest

Treatment	Number of trees/acre Treatment Period						Basal area (ft^2/acre) Treatment Period						Volume (ft^3/acre) Treatment Period					
	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6
										Fixed								
1					2						1.5						50.5	
3			3	3					0.59	0.9					13.3	22.7		
5					2						0.6						19.5	
7			5		2	2			1.34		0.84	1.49			32.3		27	58.3
										Increasing								
2				2		2				1.3		2.01				40.5		76.5
4				2	2					0.78	0.81					1.7	26.7	
										Decreasing								
6			5		2				0.85		0.85				21		25.2	
8			5	5	3				0.79	1.76	0.92				15.2	46.2	27.7	
										Unthinned								
control	8	67	48	62	42	100	0.31	2.47	2.66	3.11	10	12.9	4.3	43	55.2	68.3	261	394

Table 33a. Mortality by treatment and treatment period - Shawnigan Lake

Treatment	Number of trees/ha treatment period 1	2	3	4	Basal area (m^2/ha) treatment period 1	2	3	4	Volume (m^3/ha) treatment period 1	2	3	4
						Fixed						
1			4.9421				0.1515				1.2455	
3			7.4132				0.4086				3.3377	
5		4.9421	4.9421			0.0505				0.3009	0.2099	
7		7.4132		4.9421		0.2158		0.163		1.4694		1.4204
						Increasing						
2												
4		7.4132	4.9421			0.1309	0.1584			0.8397	1.2035	
						Decreasing						
6			4.9421	4.9421			0.2181	0.0712			1.8892	0.4898
8		7.4132	7.4132	4.9421		0.1033	0.2112	0.1951		0.7347	1.5254	1.6793
						Unthinned						
control	42.008	116.14	291.58	333.59	0.1699	0.6382	1.4876	2.1189	0.8956	4.0234	9.3203	14.939
						Supplemental						
dense				57[a]				3.6[a]				6.3[a]
open				12[a]				0.01[a]				0.5[a]

[a] 1970-1996 period

Table 33b. Mortality by treatment and treatment period - Shawnigan Lake

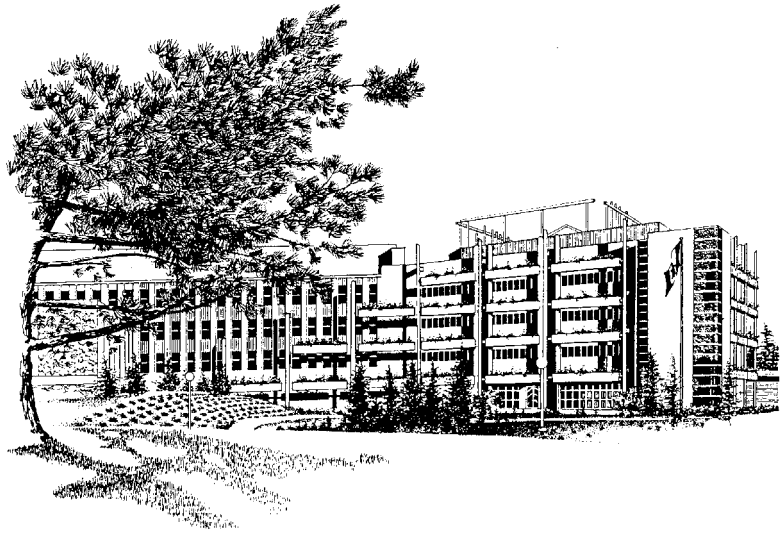
Treatment	Number of trees/acre treatment period 1	2	3	4	Basal area (ft^2/acre) treatment period 1	2	3	4	Volume (ft^3/acre) treatment period 1	2	3	4
						Fixed						
1			2				0.66				17.8	
3			3				1.78				47.7	
5		2	2			0.22	0.14			4.3	3	
7		3		2		0.94		0.71		21		20.3
						Increasing						
2												
4		3	2			0.57	0.69			12	17.2	
						Decreasing						
6			2	2			0.95	0.31			27	7
8		3	3	2		0.45	0.92	0.85		10.5	21.8	24
						Unthinned						
control	17	47	118	135	0.74	2.78	6.48	9.23	12.8	57.5	133.2	213.5
						Supplemental						
dense				23[a]				15.75[a]				90.0[a]
open				5[a]				0.04[a]				0.7[a]

[a] 1970-1996 period

Appendix 3

The Nine Study Areas

Study Area	Cooperator
Skykomish Clemons	Western Forestry Research Department Weyerhaeuser Company Tacoma, WA
Hoskins	College of Forestry Oregon State University Corvallis, OR
Rocky Brook Stampede Creek Iron Creek	USDA Forest Service Pacific Northwest Research Station Pacific Northwest Region Portland, OR
Francis	State of Washington Department of Natural Resources Olympia, WA
Sayward Forest Shawnigan Lake	Canadian Forest Service Pacific Forestry Centre Victoria, BC
	British Columbia Ministry of Forests Research Branch Victoria, BC



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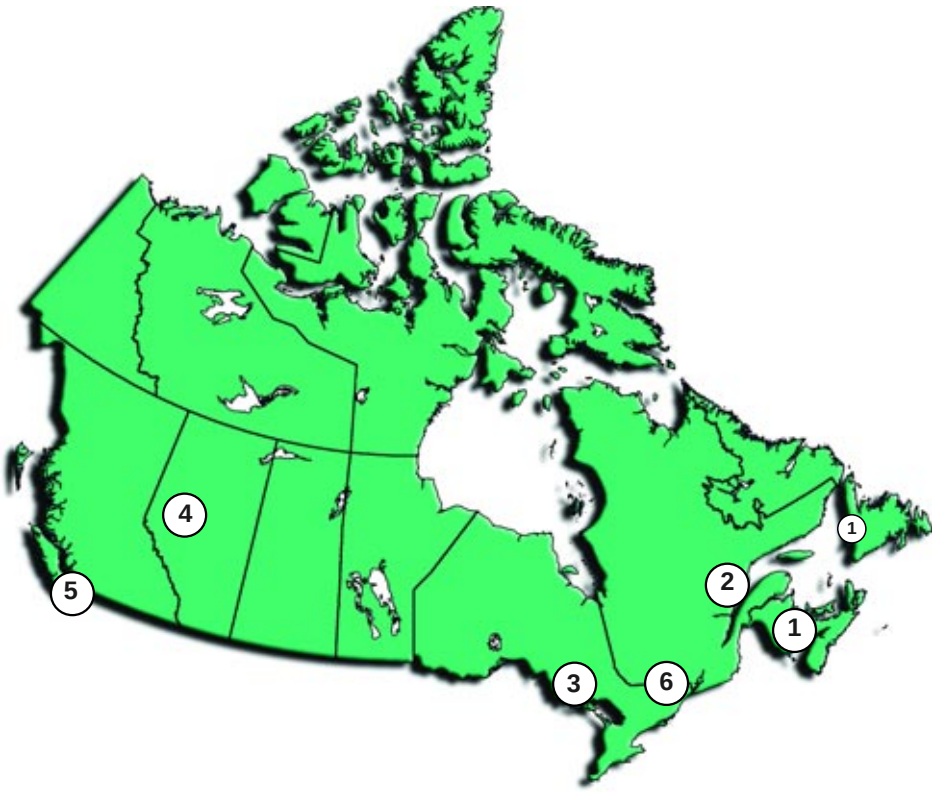

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