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[L.O.G.S. SERIES REPORT NO. 3]

LEVELS OF GROWING STOCK COOPERATIVE STUDY IN DOUGLAS FIR IN BRITISH COLUMBIA

P.K. DIGGLE

PACIFIC FOREST RESEARCH CENTRE VICTORIA, B.C.
ENVIRONMENT CANADA FORESTRY SERVICE

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BY

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INFORMATION REPORT BC-X-66

(Report No. 3, Cooperative L.O.G.S. Study Series)

Department of the Environment

May, 1972

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

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

Abstract of Report No. 1, Cooperative L.O.G.S. Study Series

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

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

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

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

LEVELS-OF-GROWING-STOCK

COOPERATIVE STUDY

ON DOUGLAS-FIR

Report No. 3 -- The Levels-of-Growing-Stock Cooperative Study in Douglas-fir in British Columbia.

by
P. K. Diggle, Silviculturist,
Pacific Forest Research Centre,
Canadian Forestry Service,
Department of the Environment.

In 1969, the Canadian Forestry Service (C.F.S.) joined the levels-of-growing stock (L.O.G.S.) cooperative study in Douglas-fir, coordinated by the Pacific Northwest Forest and Range Experiment Station, U.S. Forest Service, Portland, Oregon. While following the cooperative study publication format, the C.F.S. is publishing its own reports on work done under the L.O.G.S. program. Thus this report is both Report No. 3 in the L.O.G.S. series and C.F.S. Information Report BC-X-66.

Study area	*Cooperator*
Skykomish	Forestry Research Centre Weyerhaeuser Company Centralia, Washington
Hoskins	School of Forestry Oregon State University Corvallis, Oregon
Rocky Brook	U.S. Forest Service Region 6 and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Clemons	Forestry Research Centre Weyerhaeuser Company Centralia, Washington
Francis	Washington State Department of Natural Resources Olympia, Washington
Iron Creek	U.S. Forest Service Region 6 and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Stampede Creek	U.S. Forest Service Region 6 and Pacific Northwest Forest and Range Experiment Station Portland, Oregon
Sayward Forest (Listed as Campbell River in L.O.G.S. Reports 1 and 2)	Canadian Forestry Service Pacific Forest Research Centre Victoria, British Columbia
Shawnigan Lake	Canadian Forestry Service Pacific Forest Research Centre Victoria, British Columbia

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THE LEVELS-OF-GROWING-STOCK COOPERATIVE STUDY IN DOUGLAS-FIR IN BRITISH COLUMBIA

by

P. K. Diggle

ABSTRACT

Since the Canadian Forestry Service joined the levels-of-growing-stock (L.O.G.S.) cooperative study in Douglas-fir in 1969, two installations have been established. Both are in plantations, one 22 years old with site index 140, the other 25 years old with site index 110. The study plan and the work done to date are described; information on climate, soils and basic plot data are given. Additions made to the basic L.O.G.S. study are described.

INTRODUCTION

In 1967, the British Columbia Regional Advisory Committee[1/] reached agreement on the need for studies on the growth and yield of managed forest stands in British Columbia. Because of the magnitude and complexity of the problem area, a subcommittee was delegated to define objectives and outline a program. Among the subcommittee's recommendations was the suggestion to join the Douglas-fir levels-of-growing-stock cooperative study (L.O.G.S. study), coordinated by the Pacific Northwest Forest and Range Experiment Station of the United States Forest Service at Portland, Oregon. It was decided that the

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1/ Composed of government, industry and university representatives.

Canadian Forestry Service (C.F.S.) would join this cooperative program, thus acquiring the benefits of shared costs and data, and establish two study installations.

The basic elements of the study were developed at the Weyerhaeuser Forestry Research Centre, Centralia, Washington (Staebler, 1959 and 1966). With the development of a cooperative program, responsibility for coordination was assumed by the Pacific Northwest Forest and Range Experiment Station of the United States Forest Service. A comprehensive work plan was drawn up (Staebler and Williamson, 1962) to ensure standardized procedures among cooperators, and an information pamphlet describing the program was published (Williamson and Staebler, 1965). This pamphlet was extensively revised in 1971 (Williamson and Staebler, 1971), and was published as Report No. 1 in the cooperative program series. In total, nine study areas (see cooperators list) represent lands from site index 100 to 180.

The study in B.C. was initiated with the establishment in 1969/70 of an installation in a 20-year-old Douglas-fir plantation of site index 140 (McArdle, 1961). A second installation in a 22-year-old Douglas-fir plantation of site index 110 was established in 1970/71.

This report records work done to date in Canada under the cooperative program. It also describes additions made to the basic L.O.G.S. study plan by the C.F.S.

OBJECTIVES

The objectives are to determine how the amount of growing stock retained in repeatedly thinned stands of Douglas-fir affects (i) cumulative volume production, (ii) tree-size development, and (iii)

growth/growing stock ratios. The data obtained will provide forest managers with a basis upon which to manipulate stand spacing to meet a wide range of management objectives.

STUDY PLAN

Experiment Description

The study commences with young Douglas-fir stands, 20 to 40 feet in height. It will be continued until the trees reach a height of 80 to 100 feet (six thinning intervals), and the critical developmental stage of the stand has passed.

Each experiment consists of eight thinning regimes, plus unthinned controls, applied to 27 0.2-acre square plots, with three plots per regime in a completely randomized design. The 24 treatment plots are thinned initially to a common density or basal area level to obtain a high degree of stand uniformity. Plot density or basal area level at this calibration thinning is determined by a formula expressing a density/diameter breast height (d.b.h.) relationship.

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

Following a calibration period which permits trees to adjust to changed growing space, the treatment plots will be thinned periodically to several different levels of growing stock. Levels of growing stock to be tested are based on gross basal area increment of unthinned control plots, and thinning interval is the time required for ten feet in height growth, averaged for all crop trees. In this way, the tested levels and thinning interval are correlated with actual local growth conditions, rather than governed by arbitrary artificial criteria.

The thinning regimes tested differ in the amount of basal

area allowed to accumulate in the growing stock (Table 1). The basal area increment retained at time of thinning, over the amount left after the previous thinning, is a predetermined percentage of the average gross increment on the unthinned control plots for the same period. Thus a wide range in stand densities, with varying degrees and rates of release, will be obtained, permitting a comprehensive evaluation of the response of Douglas-fir to changes in growing space.

Table 1. *(From Williamson and Staebler, 1965). L.O.G.S. study treatment schedule, showing percentage of gross basal area increment to be retained in growing stock.*

Thinning Number	Treatment 1	2	3	4	5	6	7	8
	Percentage of gross basal area increment retained							
Calibration	--	--	--	--	--	--	--	--
1st	10	10	30	30	50	50	70	70
2nd	10	20	30	40	50	40	70	60
3rd	10	30	30	50	50	30	70	50
4th	10	40	30	60	50	20	70	40
5th	10	50	30	70	50	10	70	30
6th[1/]								

[1/] Evaluate results for possible further treatments.

Measurements

Minimum leave tree d.b.h. in treatment plots is half the quadratic mean d.b.h. of all crop trees. while in control plots all trees 1.6 inches d.b.h. and greater are included. A minimum of eight trees per plot are selected for height measurements; they are preferably crop trees, but cover the d.b.h. range of the leave trees.

At each subsequent thinning, remeasurement of d.b.h. and height is carried out to provide volume-growth data and the basis for calculating basal area accrual.

Analysis

The response of the various treatments to growing space change will be measured in terms of five variables:

(i) change in basal area from the start of one thinning interval to the end of that interval.

(ii) change in cubic-foot volume during any thinning interval.

(iii) diameter corresponding to tree of average basal area at the end of any thinning interval.

(iv) basal area growth percent.

(v) volume growth percent.

Data from each installation will be subjected to ten analyses of variance, two for each of the five variables. One analysis in each set of two will be for crop trees only, the other for all trees. The main plot portion of the analysis will not be disturbed by loss of some plots, provided two plots survive for each treatment.

When data for an equal number of thinning intervals are available from several installations, a combined analysis will be made,

enabling examination of site quality/growth response interactions and generally strengthening the results of the program.

C.F.S. Additions to the Basic L.O.G.S. Study Plan

Any thinning study that attempted to answer all or even most of the questions relevant to the growth and yield of a species would be of dismaying size and complexity. The cooperative L.O.G.S. program was not designed to try the impossible, but was restricted to examining the three stated objectives. It was decided, however, that some additions to the basic plan would enhance the study by permitting a more flexible and comprehensive analysis and extrapolation of results.

Climate and Soils. When the C.F.S. joined the cooperative program in 1969, no detailed climatic or soils information had been obtained for existing installations. A basic facet of the program is the combined analysis of results for installations of similar site quality. Climate and soils are major determinants of site quality. It was already apparent that some existing installations, although of similar site quality, had markedly differing contributing factors that could conceivably produce dissimilar growth responses and confuse a combined analysis. It seemed expedient to install meteorological stations at the C.F.S. study sites to record the local climate. Soil profiles and characteristics at both study sites have been described in detail and the soils classified.

Density Variations. The basic L.O.G.S. plan required all 24 treatment plots to be brought to a uniform density or basal area level at time of calibration thinning. The basis for this initial level is the

assumption of a reduction in stand density from 680 trees per acre (8 x 8 ft), 4.5 feet tall, to 100 per acre with average d.b.h. of 20.9 inches, with a linear relationship between average d.b.h. and spacing.

This relationship is expressed in the formula:

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

A sample solution of the equation is: with average d.b.h. of 5 inches, trees per acre = 355, basal area = 48.2 square feet.

While an initial spacing of 8 x 8 feet was a rational, middle-of-the-road choice, a test of the effect of differing initial densities on subsequent growth response was desirable. Two other widely used planting densities, 6 x 6 feet and 10 x 10 feet, were therefore chosen. These densities were assumed to proceed similarly to the original end point of 100 trees/acre at 20.9 inches d.b.h., and appropriate equations were derived.

(a) Dense variation (from 6 x 6 ft).

Average spacing in feet = 0.7117 (avg d.b.h.) + 6.

A sample solution is: with average d.b.h. of 5 inches, trees per acre = 477, basal area = 64.9 square feet.

(b) Open variation (from 10 x 10 ft).

Average spacing in feet = 0.5202 (avg d.b.h.) + 10.

A sample solution is: with average d.b.h. of 5 inches, trees per acre = 274, basal area = 37.3 square feet.

At the Sayward Forest study area, four plots were established according to the dense variation equation (data summary Table 2). These plots will be used to test two basic plan treatment schedules, replicated twice, the particular schedules to be selected at the end

of the calibration period on the basis of the most recent information from other installations in the program.

At the Shawnigan Lake installation, five plots were established for each of the dense and open variation equations (data summary Table 2). Each group of five plots represents two treatment schedules, replicated twice, with one spare plot; treatment schedules will be assigned at the end of the calibration period.

Aerial Photography. Since simulation modelling developments indicate the possibility of a more comprehensive and flexible analysis of data than the basic L.O.G.S. study analyses of variance, it was decided to collect such extra data from the C.F.S. installations as would be needed for simulation testing and interpretation, including tree heights, live crown length and width, and stem maps.

The best approach available was by use of low-level aerial photography that would permit photogrammetric measurement of data at any convenient time, the photographs providing a permanent record and data source. The 70 mm photographic system developed by the B.C. Forest Service using two Linhof aero-electric cameras mounted on a 15-foot boom suspended beneath a helicopter was used. Stereo-pair photographs were obtained for interpretation on a Wilde A40 autograph with plotting table. Measured data are recorded by an interfaced IBM card punch machine. A high degree of accuracy of measurement is obtainable with this system.

The decision to collect additional data using this technique was not made until after the calibration thinning at the Sayward Forest installation, thus there is no unthinned photographic record. However,

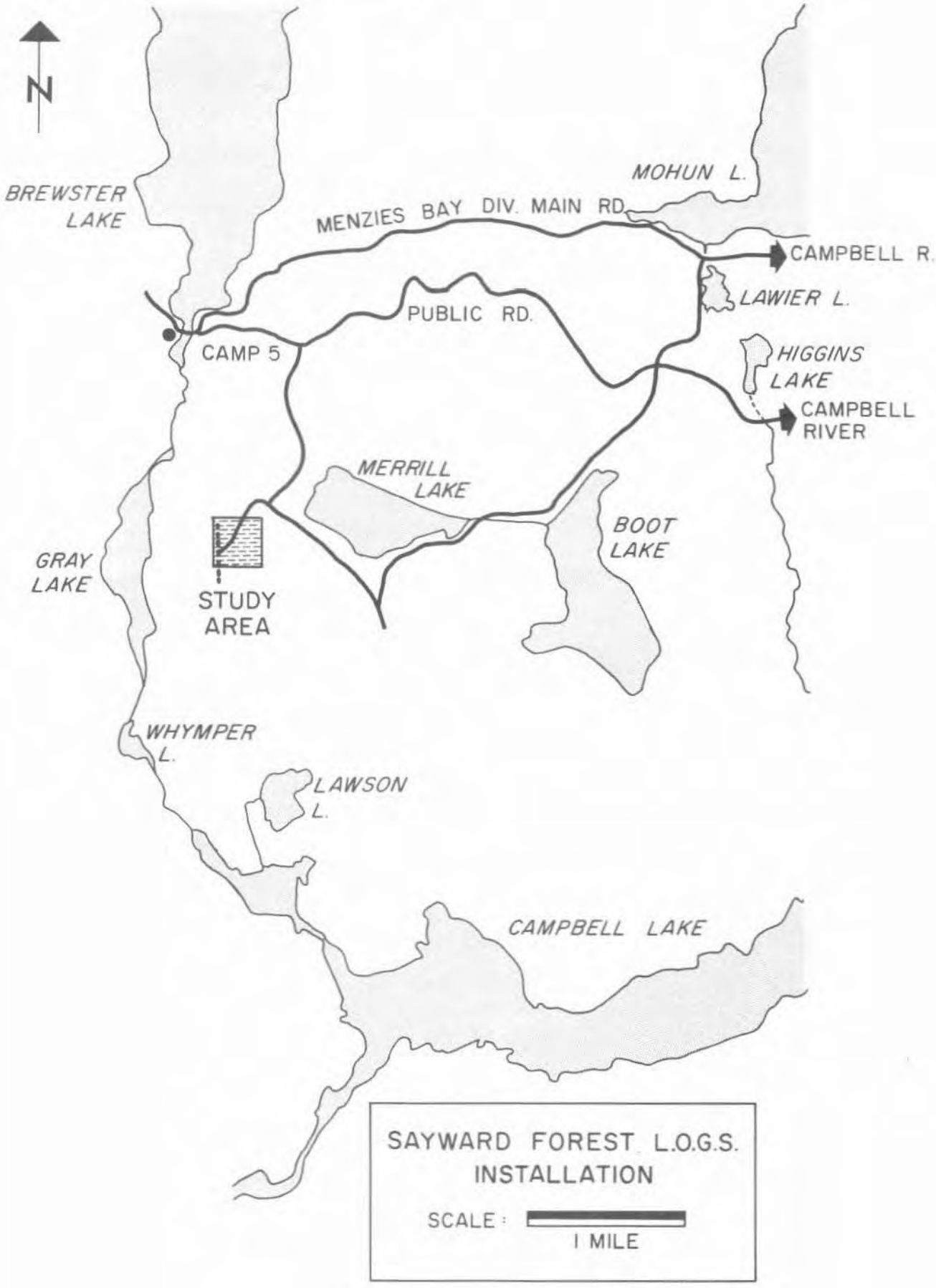
stand photographs were obtained for the Shawnigan Lake installation before and after thinning.

Both black and white and colour film were used at the Sayward Forest and for the pre-thinning photography at Shawnigan Lake. At the time of flying, November 1970, the low sun angle reduced exposure quality of the only colour film then readily available. That film, Kodak aerocolour 2448, rated 64 ASA, gave marked exposure contrast between light and shade. To supplement the colour, both studies were also flown with Kodak Tri-X 400 ASA black and white film which had a much better shadow penetration. For the post-thinning photography of the Shawnigan Lake installation, in April 1971, Kodak colour film only was used, as the sun angle was high, and the light crowns and thinned stand permitted good ground illumination.

A subsequent testing of GAF (formerly Ansco) D200 colour film, rated 200 ASA, indicates this film to be preferable for this type of study as it is very sensitive to green colour variations and has good shade penetrating qualities, giving good interpretive detail from tree crown to forest floor.

Buffer Strips. The C.F.S. was fortunate in finding study stands sufficiently large and uniform to permit the use of one chain-wide buffer strips between plots to eliminate plot density interactions.

Stem Analysis. Currently available volume tables are based on data from natural, unmanaged stands. As tree form, and thus tree volume, is a function of stand density, current tables will probably be inaccurate for use with the L.O.G.S. study. Stem analyses, therefore,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CAMPBELL RIVER
MERRILL LAKE
BOOT LAKE
GRAY LAKE
STUDY AREA
WHYMPER L.
LAWSON L.
CAMPBELL LAKE
SAYWARD FOREST L.O.G.S. INSTALLATION
SCALE :
1 MILE

were carried out at both study areas at the time of calibration thinning to provide initial data on local tree form and volume. Further analyses will be carried out during future thinnings to monitor form and volume changes associated with different levels of growing stock and to permit compilation of and comparison between individual treatment regime tree volume tables.

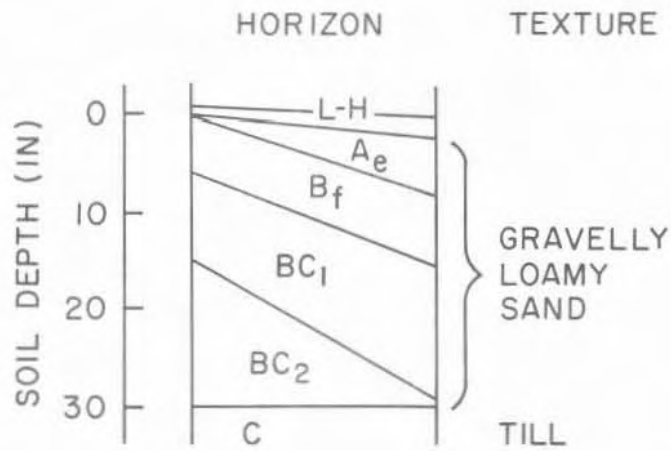
WORK ACCOMPLISHED TO DATE

Sayward Forest

(a) Description of Study Area. The first C.F.S. installation was established in a 20-year-old Douglas-fir plantation on the Sayward Forest, about 15 miles west of Campbell River, Vancouver Island (Fig. 1). The plantation was established in the spring of 1950, with 2-year-old seedlings that originated from a Merville, Vancouver Island, seed source (pers. comm. Reforestation Divn., B.C.F.S.). Following the standardized L.O.G.S. program procedure, site quality was evaluated according to U.S.D.A. Technical Bulletin 201 (McArdle, 1961) and approximated site index 140 (S.I. 111, King, 1966). Average crop tree height was 38.5 feet.

The stand, situated about 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 sandy, gravelly glacial till and is classified as a mini humo-ferric podzol (Canada Dept. Agric., 1970). Soil profiles show little variation throughout the study area, with an average depth of 30 inches to the under-

PIT #1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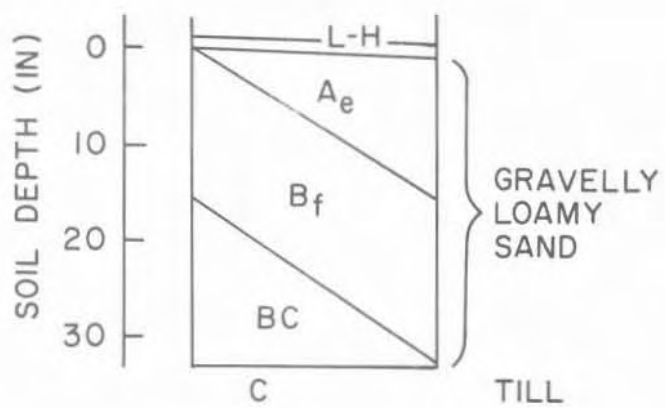
SOIL DEPTH (IN)
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SAND
TILL

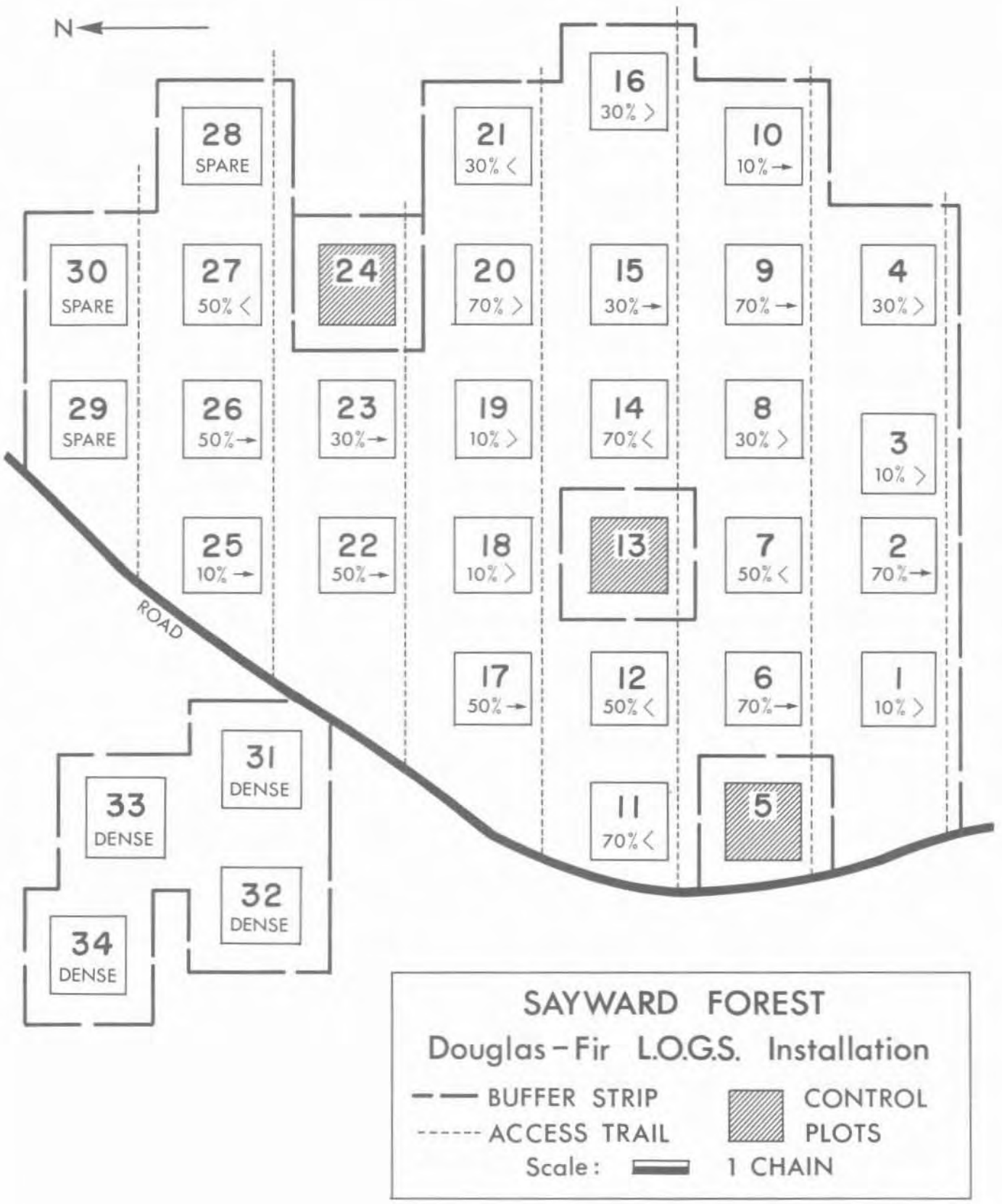
lying till (Fig. 2).

The climate is marine west coast, a division of the humid mesothermal zone (Canada Dept. Transport, 1957). Local average annual precipitation is 58.5 inches per annum, with 10 inches falling during a 149-day frost-free period (pers. comm. J. R. Marshall). Temperatures are mild; the growing season average temperature is 58.4 F.

Initial stand density was approximately 1000 trees per acre and although planted to Douglas-fir, minor fill-in of western hemlock, western red cedar, western white pine and lodgepole pine occurred. Stocking uniformity varied slightly due to a combination of planting irregularities and natural regeneration. As the live crown base averaged about 6 feet above ground level, no serious loss of crown mass had occurred. Ground vegetation was predominantly salal with lesser amounts of Oregon grape, bracken, red huckleberry and willow.

(b) Study Establishment. Thirty 0.2-acre square plots, separated by one chain-wide buffer strips, were established during the summer of 1969 (Fig. 3). These comprised 27 plots of the basic study plus three spare treatment plots. Crop trees and non-crop leave trees were selected and measured according to the standardized work plan. Residual stand density at time of calibration thinning was determined by the number of trees per acre. Tree numbers were held constant (control plots remaining unthinned), while basal area was allowed to vary within $\pm$ 15% of the average, in each treatment plot.

Future treatment regimes were randomly assigned among the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10 10% →
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14 70% <
8 30% >
3 10% >
25 10% →
22 50% →
18 10% >
13
7 50% <
2 70% →
ROAD
17 50% →
12 50% <
6 70% →
1 10% >
31 DENSE
33 DENSE
11 70% <
5
32 DENSE
34 DENSE
SAYWARD FOREST
Douglas-Fir L.O.G.S. Installation
BUFFER STRIP
ACCESS TRAIL
CONTROL PLOTS
Scale: 1 CHAIN

basic 27 plots (Fig. 3). Excepting the three unthinned control plots, this assignment is tentative, subject to evaluation of plot growth response at the end of the calibration period. At that time, it may be preferable to change assigned treatments to currently spare plots.

All leave trees were pruned to a height of eight feet for ease of measurement and access, also to reduce fire risk. Crop trees were pruned up to 12 feet to provide a basis for possible future pruning/grade recovery studies and to distinguish them from other leave trees. All leave trees were marked at breast height by a permanent numbered metal tag and by a band of white paint. Crop trees were further distinguished by two white bands.

During plot establishment, all plots were inspected for occurrence of the root rot fungi Armillaria mellea and Poria weirii. One infection centre of P. weirii and several of A. mellea were found. The poria-infected trees and some armillaria-infected trees were felled; the stumps were pulled out and removed from the study site.

In early summer 1969, a meteorological station was established on the study area to record local climatic conditions. This station has been continually maintained and will provide useful data to supplement growth analyses.

In autumn 1969, the treatment plots (24 basic plus 3 spares) were thinned. Twenty-seven trees covering the d.b.h. range available were sectioned for stem-volume analysis. A copy of this data was sent to the U.S.F.S. Pacific Northwest Forest and Range

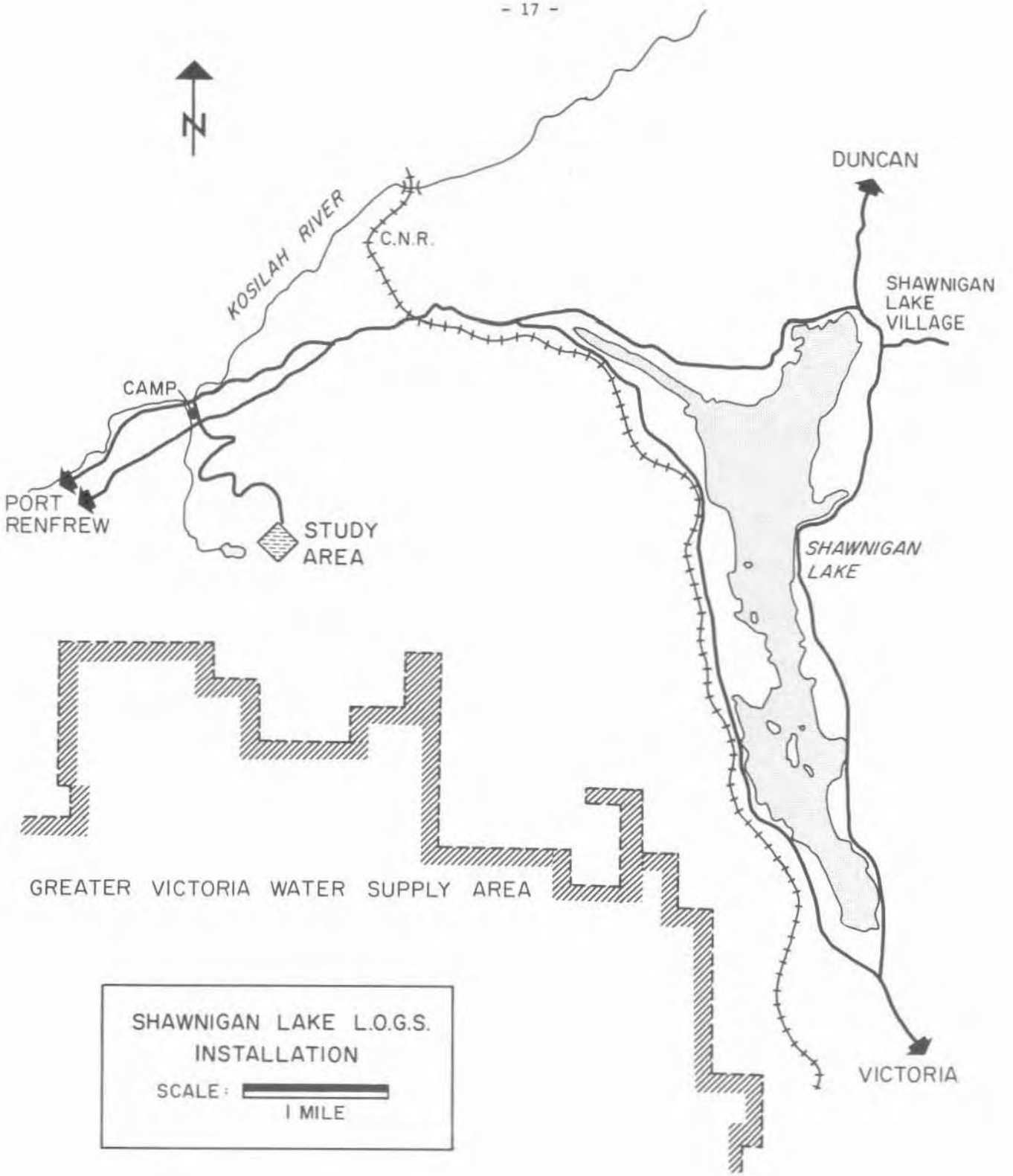
Experiment Station where similar data from other cooperators are being pooled for development of small tree volume tables appropriate to the L.O.G.S. program.

Buffer strips were marked and thinned on an average spacing basis during the winter of 1969/70. During summer 1971, the buffer strips were subdivided into four ½-chain-wide sectors per plot and the number of residual trees reduced to a density equalling that of the adjacent plot.

In spring 1970, five soil pits were dug in the study area and soil profiles and characteristics were described, permitting classification of the soil type. Soil profiles and depths varied little throughout the study area.

A critical evaluation of the L.O.G.S. program resulted in a decision to establish additional plots at the study site. Consequently, in late spring 1970, four extra plots (the number restricted by available time and area) were laid out, measured and thinned to a higher residual density (see section "Density Variation") than in the basic study. The buffer strips for these plots were marked and thinned in late summer.

In autumn 1970, low-level 70 mm stereo black and white and colour aerial photography was taken of the study area. All plot corners were marked with 2-foot square orange cards as ground reference points, while colour-coded cotton flagging was tied in the top of one tree near plot centre in the first, middle (where appropriate) and last plots of each row to provide flying control. This stereo-photography was designed to provide a permanent source of data for stem map compilation and for other information,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C.N.R.
SHAWNIGAN LAKE VILLAGE
CAMP
PORT RENFREW
STUDY AREA
SHAWNIGAN LAKE
GREATER VICTORIA WATER SUPPLY AREA
VICTORIA
SHAWNIGAN LAKE L.O.G.S. INSTALLATION
SCALE:
1 MILE

such as analysis of growth responses by simulation model techniques.

Shawnigan Lake

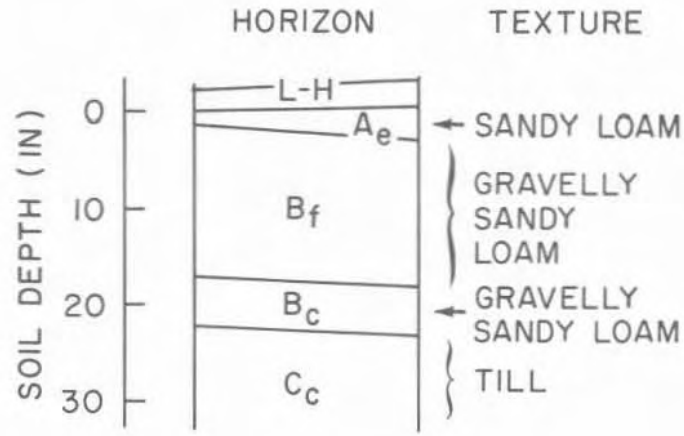
(a) Description of Study Area. This second installation is situated in a site index 110 (S.I. 94, King, 1966) Douglas-fir plantation established in 1948, about 5 miles southwest of Shawnigan Lake, Vancouver Island (Fig. 4). Average height of crop trees was 38 feet. The seed source for this plantation was the same east coast island locality, Merville, as that of the Sayward Forest plantation (pers. comm. Reforestation Divn., B.C.F.S.)

The stand is located on a low ridge, 1,100 feet above sea level. Topography is from flat to very gently rolling 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 Dept. of Agric., 1970). Soil profiles vary little throughout the stand, and depth to the till averages 24 inches (Fig. 5).

Climatically, the study area falls within the Mediterranean division of the humid mesothermal zone. Local annual precipitation is 46.2 inches, with 7 inches falling during a 146-day frost-free period (pers. comm. J. R. Marshall).

Initial stand density averaged 1,200 trees per acre. Crowns were of a noticeably lighter density than in the Sayward Forest installation, though with live crown bases averaging 4 feet above ground level, little loss of green crown had occurred. Natural fill-in was light, with scattered western white pine, lodgepole pine and isolated western hemlock and western red cedar. Ground

PIT #1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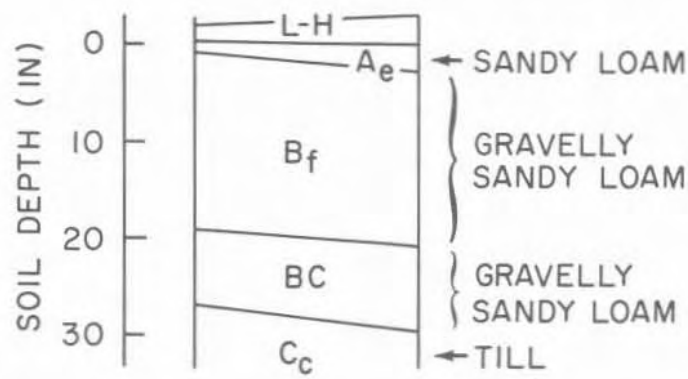
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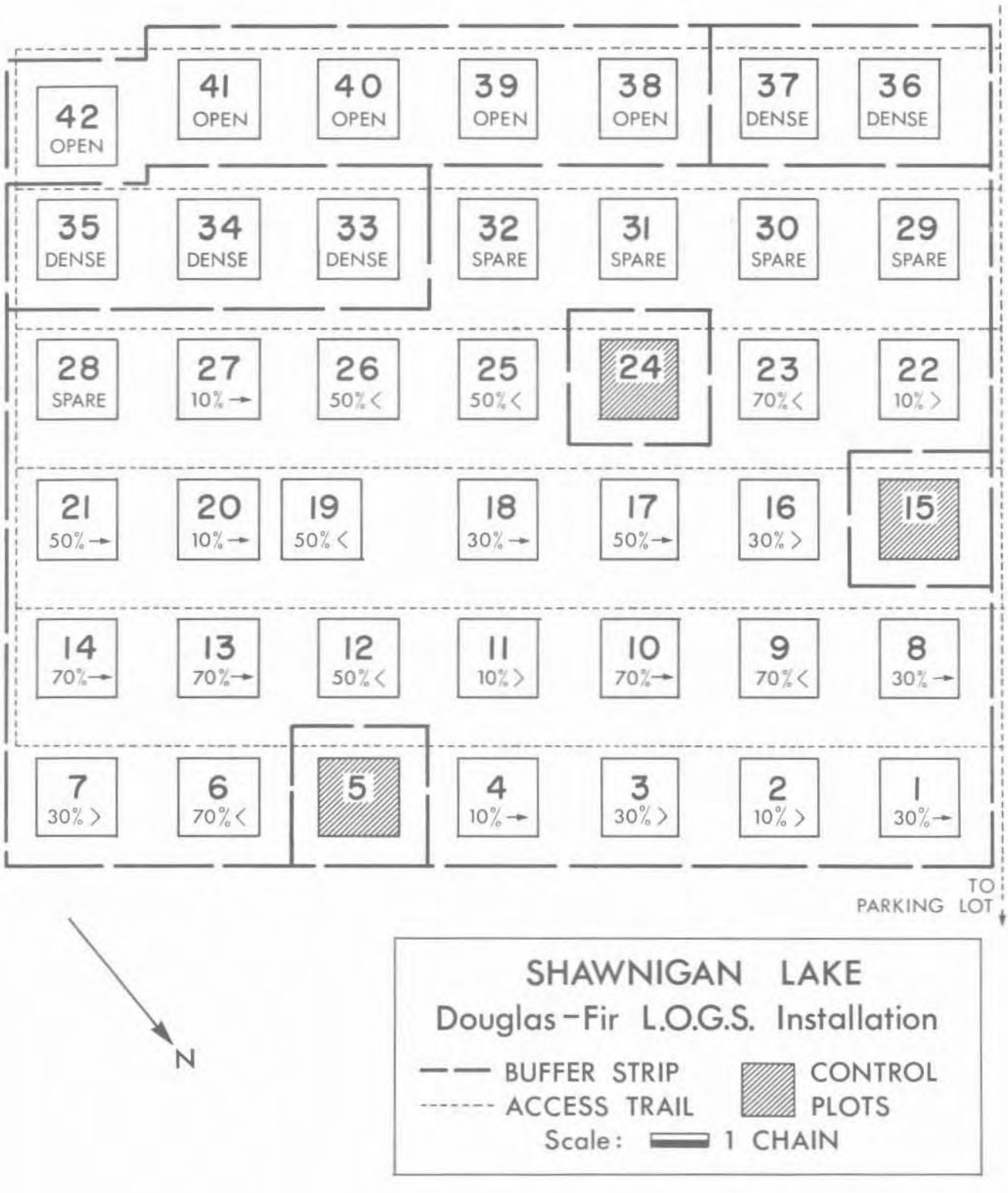
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28 SPARE
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21 50% →
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8 30% →
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6 70% <
5
4 10% →
3 30% >
2 10% >
1 30% →
TO PARKING LOT
N
SHAWNIGAN LAKE
Douglas-Fir L.O.G.S. Installation
BUFFER STRIP
ACCESS TRAIL
CONTROL PLOTS
Scale: 1 CHAIN

vegetation was predominantly salal, with some Oregon grape, bracken and willow.

(b) Study Establishment. In spring 1970, after selection of the study stand, a meteorological station was established jointly with another C.F.S. project in the area.

With an establishment procedure identical to that used at the Sayward Forest, a complete 27-plot basic installation, plus five spare plots, was laid out, measured and marked for calibration thinning (Fig. 7), and treatment regimes were provisionally assigned during the summer of 1970 (Fig. 6). In addition, ten more plots were established to strengthen information to be derived from the basic study. Five of these plots were marked to a higher residual density and five to a lower residual density than that of the basic study. Buffer strips for all plots were marked for thinning on an average spacing basis.

In late autumn 1970, pre-thinning low-level 70 mm black and white and colour aerial photographs were taken (Fig. 9). All plot corners were marked as at the Sayward Forest study. Due to the difficulty of identifying plot corner markers through the dense canopy of the unthinned stand, colour-coded cotton flagging was erected in the top of a centrally located tree in every plot. This provided extra ground control as well as flight line control. All measured trees, many to be cut in thinning, were identified on 8- x 10-inch black and white enlargements to aid in construction of original stand stem maps from the 70 mm film.

Fig. 7. Plot 3, Shawnigan Lake, before thinning.

Fig. 8. Plot 3, Shawnigan Lake, after calibration thinning.

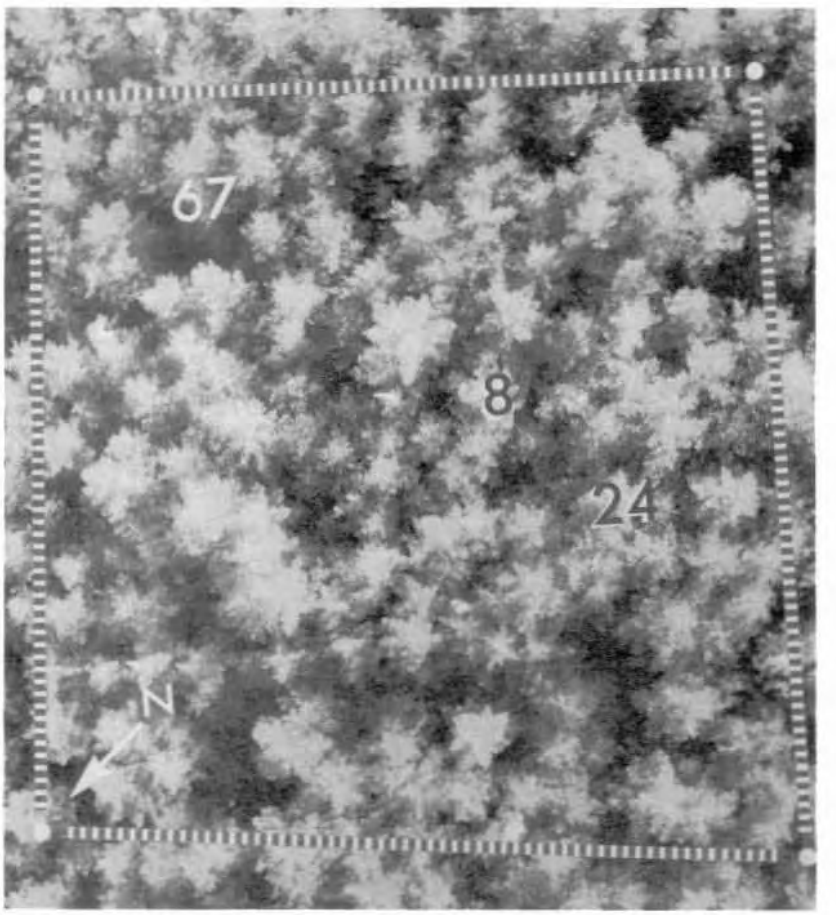

Fig. 9. Plot 20, Shawnigan Lake, before thinning. Apparent trapezoidal shape of plot due to photographic distortion.

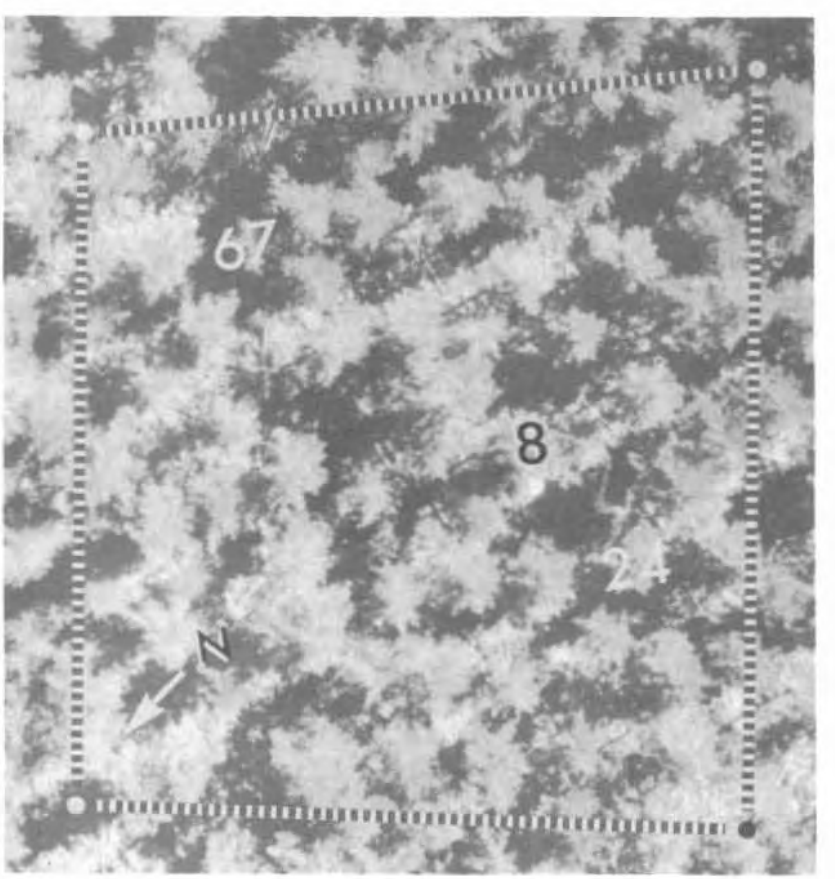

Fig. 10. Plot 20, Shawnigan Lake, after thinning. Three trees (Nos. 8, 24, 67) are identified both before and after thinning.

A survey of the plots for root rot infections revealed nine Poria weirii centres and two Armillaria mellea centres either in or on the edge of plots. All affected trees were felled and the stumps were pulled out and removed from the study area.

Thinning of all treatment plots and associated buffer strips was carried out during the winter of 1970/71 (Fig. 8). All stumps were dusted with borax powder immediately after felling to prevent infection and spread of Fomes annosus root rot. During the plot thinning phase, stem analysis data from 48 trees were collected for uses as at Sayward Forest.

In winter 1970/71, four soil pits were dug in the study area and soil profiles and characteristics were described. Soil profiles and depths to the underlying till showed less variation than at Sayward Forest.

Post-thinning 70 mm aerial photographs of the study area were taken in April, 1971 (Fig. 10), using colour film only. In addition to marking all plot corners, large cards showing the plot numbers were placed on open ground near each plot centre, facilitating rapid photographic plot identification.

During summer and autumn of 1971, the buffer strips were sub-divided into four ½-chain-wide sectors per plot, and the number of leave trees were reduced, where necessary, to conform with adjacent plot densities.

Stand data summaries for both installations are given in Table 2, while plot data pertaining to before and after cali-

bration thinning basal areas, volumes, stand tables and species composition are contained in Tables 3 -12. Volumes were derived using B.C.F.S. standard cubic-foot volume tables.

FUTURE WORK

Treatment thinnings will be carried out every increase of ten feet in height growth of crop trees, according to work plan specifications. Growth data derived from measurements taken will be subjected to the standard L.O.G.S. study analysis and will be available to other cooperators in the program.

Stem analysis of sample trees will be undertaken at each treatment thinning, for each treatment category, to permit analysis of tree volume and form changes associated with the diverse changes in growing space.

To obtain continuing data for simulation testing and interpretation of growth responses and a permanent visual record of stand development, low-level aerial photography will be carried out before each treatment thinning.

The two meteorological stations will be maintained until local climatic parameters are adequately described and defined.

At the time of first treatment thinning, one spare plot of the basic density at each installation will be selected to illustrate the consequences of no further thinning and thus demonstrating the onset, progress and effect on growth of stand competition. Other spare plots, after permanent assignment of basic treatments, will be used to test a variation of thinning interval on growth response and will be thinned at time intervals equalling 20 feet of crop tree

height growth. The treatment or treatments to be tested will be selected at the time of first thinning.

The feasibility of conducting wood yield and quality studies in conjunction with the Western Forest Products Laboratory, Vancouver, will be investigated.

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Dr. G. W. Wallis, C.F.S., Victoria - for conducting root rot disease surveys of the study areas and recommending preventive treatment.

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List of Botanical Names of Species Cited in Text.

(a) Trees

Pinus contorta Dougl.	Lodgepole pine
Pinus monticola Dougl.	Western white pine
Pseudotsuga menziesii (Mirb.) Franco	Douglas-fir
Thuja plicata Donn	Western red cedar
Tsuga heterophylla (Raf.) Sarg.	Western hemlock

(b) Shrubs

Gaultheria shallon Pursh.	Salal
Mahonia nervosa (Pursh.) Nutt.	Oregon grape
Pteridium aquilinum pubescens Underw.	Bracken
Salix spp.	Willow
Vaccinium parvifolium Smith	Red huckleberry

TABLE 2. *STAND DATA SUMMARY*

	SAYWARD FOREST	SHAWNIGAN LAKE
MEAN HEIGHT, CROP TREES	38.5 FEET	38.0 FEET
MEAN DBH, CROP TREES	5.7 INCHES	5.2 INCHES
MEAN DBH, ALL LEAVE TREES:		
(A) BASIC STUDY	5.0 INCHES	4.5 INCHES
(B) OPEN VARIATION	-------	4.5 INCHES
(C) DENSE VARIATION	4.7 INCHES	4.3 INCHES
AVERAGE BASAL AREA PER ACRE:		
(A) BASIC STUDY	48.1 SQ FT	40.6 SQ FT
(B) OPEN VARIATION	-------	32.2 SQ FT
(C) DENSE VARIATION	60.1 SQ FT	53.5 SQ FT
(D) CONTROLS	87.6 SQ FT	90.9 SQ FT
NUMBER OF TREES PER ACRE:		
(A) BASIC STUDY	355 STEMS	375 STEMS
(B) OPEN VARIATION	-------	285 STEMS
(C) DENSE VARIATION	495 STEMS	535 STEMS
(D) CONTROLS	1061 STEMS	1193 STEMS
TOTAL AGE	22 YEARS	25 YEARS
BREAST HEIGHT AGE	14 YEARS	16 YEARS

TABLE 3. *SAYWARD FOREST - BASIC DATA AT ESTABLISHMENT - ALL TREES (PER ACRE)*

TREATMENT	PLOT NO.	NUMBER OF TREES	AVG DBH (in.)	BASAL AREA (ft^2) BEFORE THINNING	BASAL AREA (ft^2) AFTER THINNING	RESIDUAL VOLUME (ft^3)	VOLUME REMOVED (ft^3)
	10	355	4.7	60.3	42.8	633	241
1	19	355	4.7	63.5	42.5	626	250
	25	355	5.1	76.6	50.4	751	339
	1	355	5.3	83.8	55.0	862	390
2	3	355	5.4	98.9	55.5	852	880
	18	355	4.8	70.8	45.5	692	320
	15	355	4.7	83.1	42.4	638	534
3	21	355	5.2	84.8	52.8	818	427
	23	355	5.0	89.0	49.1	749	535
	4	355	4.8	91.0	44.4	671	627
4	8	355	5.0	102.6	48.1	726	722
	16	355	4.6	80.8	41.1	604	551
	17	355	5.0	78.1	47.9	749	403
5	22	355	5.2	102.7	51.7	808	693
	26	355	5.0	87.9	48.7	744	520
	7	355	5.1	112.1	50.4	771	885
6	12	355	4.7	97.3	42.6	618	705
	27	355	5.2	74.8	52.2	819	310
	2	355	5.1	102.9	50.3	770	729
7	6	355	5.2	100.3	52.9	771	693
	9	355	4.9	80.3	46.0	683	492
	11	355	4.9	81.8	44.6	616	512
8	14	355	4.8	102.4	44.6	654	780
	20	355	5.1	64.4	49.7	758	212

TABLE 3. *SAVWARD FOREST - BASIC DATA AT ESTABLISHMENT - ALL TREES (PER ACRE) (CON'T)*

TREATMENT	PLOT NO.	NUMBER OF TREES	AVG DBH (in.)	BASAL AREA (ft^2) BEFORE THINNING	BASAL AREA (ft^2) AFTER THINNING	RESIDUAL VOLUME (ft^3)	VOLUME REMOVED (ft^3)
	5	1495	3.5	101.4	101.4	1304	-
Control	13	1005	4.0	85.9	85.9	1329	-
	24	685	4.5	75.5	75.5	1144	-
	28	355	4.9	88.8	45.7	714	579
Spare	29	355	5.1	78.7	49.7	754	368
	30	355	5.2	84.5	52.3	791	468
	31	495	4.9	106.5	66.2	985	622
Dense	32	495	4.8	91.0	61.6	915	413
	33	495	4.5	86.9	55.7	825	396
	34	495	4.6	75.2	56.8	819	757

TABLE 4. *SAYWARD FOREST - BASIC DATA - CROP TREES (PER ACRE)*

TREATMENT	PLOT #	# TREES	AVG DBH	BASAL AREA (ft^2)	VOLUME (ft^3)
	10	80	5.3	12.5	202
1	19	80	5.5	13.0	205
	25	80	6.0	15.6	236
	1	80	6.0	15.5	246
2	3	80	6.1	16.4	248
	18	80	5.6	13.7	222
	15	80	5.4	12.8	237
3	21	80	6.2	16.7	269
	23	80	5.8	14.5	237
	4	80	5.3	12.2	187
4	8	80	5.4	12.6	161
	16	80	5.4	12.6	191
	17	80	5.9	15.3	254
5	22	80	6.0	15.6	260
	26	80	5.7	13.9	215
	7	80	5.8	14.7	229
6	12	80	5.4	12.7	192
	27	80	5.9	15.2	253
	2	80	5.7	14.3	218
7	6	80	5.8	14.5	224
	9	80	5.6	13.8	218
	11	80	5.7	14.1	222
8	14	80	5.3	12.3	176
	20	80	6.0	15.5	252

TABLE 4. *SAYWARD FOREST - BASIC DATA - CROP TREES (PER ACRE) (CON'T)*

TREATMENT	PLOT #	# TREES	AVG DBH	BASAL AREA (ft^2)	VOLUME (ft^3)
	5	80	5.2	11.8	174
Control	13	80	5.4	12.7	196
	24	80	6.0	15.7	254
	28	80	5.7	14.0	225
Spare	29	80	6.1	16.4	266
	30	80	5.8	14.6	226
	31	80	6.1	16.0	258
Dense	32	80	6.1	16.3	257
	33	80	5.0	11.0	183
	34	80	6.1	16.4	262

TABLE 5. *SAYWARD FOREST STAND TABLE - BEFORE THINNING (STEMS PER ACRE)*

DBH CLASS	PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2	–	–	–	–	375	–	–	–	–	–	–	–	100	–	–	–	–
3	95	175	230	245	485	150	195	195	165	110	275	310	240	345	240	295	170
4	185	305	425	435	410	320	345	420	285	240	355	490	320	415	385	380	240
5	190	280	270	220	215	280	330	310	255	185	190	205	285	250	175	195	185
6	110	110	120	45	10	105	135	55	55	40	20	30	60	50	55	35	80
7	45	20	30	5	–	15	–	–	5	–	10	5	–	10	5	–	20
8	5	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	5
TOTAL	630	890	1075	950	1495	870	1005	980	765	575	850	1040	1005	1070	860	905	700

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2	–	–	–	–	–	–	40	–	–	–	–	–	–	–	–	–	–
3	150	195	110	150	185	175	140	145	165	85	260	205	120	145	195	300	320
4	260	300	160	260	335	320	145	250	325	165	325	225	205	250	285	410	250
5	185	115	135	195	265	210	215	210	215	230	225	165	215	255	225	205	110
6	50	40	120	90	95	90	80	75	85	110	65	60	130	150	85	30	25
7	15	–	10	25	20	15	30	5	5	5	15	30	10	40	15	5	20
8	–	5	–	10	5	–	–	–	5	5	–	10	5	5	10	–	25
TOTAL	660	655	535	735	905	810	650	685	800	600	890	695	685	845	815	950	750

TABLE 6. *SAYWARD FOREST STAND TABLE - AFTER THINNING (STEMS PER ACRE)*

DBH CLASS	PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
2	–	–	–	–	375	–	–	–	–	–	–	–	100	–	–	–	–
3	15	25	15	–	485	10	–	5	15	35	25	15	240	5	35	40	35
4	90	85	70	145	410	65	100	100	125	140	145	160	320	155	135	140	95
5	105	130	145	165	215	180	150	190	155	120	145	150	285	150	130	135	130
6	95	105	80	40	10	85	105	50	55	60	20	25	60	40	50	40	70
7	50	10	45	5	–	15	–	10	5	–	10	5	–	5	5	–	20
8	–	–	–	–	–	–	–	–	–	–	10	–	–	–	–	–	5
TOTAL	355	355	355	355	1495	355	355	355	355	355	355	355	1005	355	355	355	355

	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
2	–	–	–	–	–	–	40	–	–	–	–	–	–	–	–	–	–
3	25	15	30	5	15	25	140	15	10	10	10	50	20	45	70	35	125
4	130	190	90	90	100	110	145	105	110	70	130	105	85	170	175	230	200
5	125	95	120	165	120	120	215	140	150	155	140	95	140	145	165	195	105
6	60	50	105	60	90	75	80	80	75	110	60	65	90	120	60	30	25
7	15	–	10	25	25	25	30	15	5	5	15	30	15	15	15	5	20
8	–	5	–	10	5	–	–	–	5	5	–	10	5	–	10	–	20
TOTAL	355	355	355	355	355	355	650	355	355	355	355	355	355	495	495	495	495

TABLE 7. SAYWARD FOREST SPECIES COMPOSITION BY BASAL AREA BEFORE AND AFTER CALIBRATION CUT

TREATMENT	PLOT NO.	% OF TOTAL BASAL AREA									
		DOUGLAS FIR		HEMLOCK		CEDAR		WHITE PINE		LODGEPOLE PINE	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
	10	99.4	99.1	-	-	-	-	0.6	0.9	-	-
1	19	91.8	95.9	6.9	4.1	1.3	-	-	-	-	-
	25	96.3	98.6	2.0	-	0.8	-	-	-	0.9	1.4
	1	99.1	100	0.3	-	0.6	-	-	-	-	-
2	3	100	100	-	-	-	-	-	-	-	-
	18	95.6	99.1	2.6	0.9	1.3	-	0.5	-	-	-
	15	99.7	100	-	-	0.3	-	-	-	-	-
3	21	98.6	98.6	1.4	1.4	-	-	-	-	-	-
	23	99.6	100	-	-	-	-	0.4	-	-	-
	4	99.7	100	-	-	0.3	-	-	-	-	-
4	8	99.6	100	0.4	-	-	-	-	-	-	-
	16	99.8	100	0.2	-	-	-	-	-	-	-
	17	98.3	100	0.3	-	1.4	-	-	-	-	-
5	22	96.9	98	0.3	-	2.8	2.0	-	-	-	-
	26	97.8	97.5	1.7	2.5	0.5	-	-	-	-	-
	7	99.5	98.8	-	-	-	-	-	-	0.5	1.2
6	12	97.7	100	-	-	2.3	-	-	-	-	-
	27	100	100	-	-	-	-	-	-	-	-
	2	98.9	100	-	-	0.8	-	0.3	-	-	-
7	6	99.6	100	0.2	-	0.2	-	-	-	-	-
	9	96.8	100	2.9	-	0.3	-	-	-	-	-
	11	94.9	97.9	3.0	2.3	2.1	-	-	-	-	-
8	14	99.1	100	0.2	-	0.7	-	-	-	-	-
	20	97.4	97.8	0.9	2.2	1.7	-	-	-	-	-

TABLE 7. *SAYWARD FOREST SPECIES COMPOSITION BY BASAL AREA BEFORE AND AFTER CALIBRATION CUT (CON'T)*

TREATMENT	PLOT NO.	% OF TOTAL BASAL AREA									
		DOUGLAS FIR		HEMLOCK		CEDAR		WHITE PINE		LODGEPOLE PINE	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
	5	92.4	92.4	2.5	2.5	5.0	5.0	0.1	0.1	-	-
Control	13	98.7	98.7	0.7	0.7	0.6	0.6	-	-	-	-
	24	96.9	96.9	3.1	3.1	-	-	-	-	-	-
	28	99.7	100	0.3	-	-	-	-	-	-	-
Spare	29	86.5	91.2	8.9	5.9	3.9	2.9	0.7	-	-	-
	30	99.6	100	0.4	-	-	-	-	-	-	-
	31	98.5	100	-	-	1.5	-	-	-	-	-
Dense	32	96.8	98.4	0.3	0.5	2.9	1.1	-	-	-	-
	33	96.8	97.6	0.3	-	2.4	1.9	-	-	0.5	-
	34	80.4	88.9	12.8	10.1	6.5	1.0	0.3	-	-	-

TABLE 8. *SHAWNIGAN LAKE - BASIC DATA AT ESTABLISHMENT - ALL TREES (PER ACRE)*

TREATMENT	PLOT NO.	NUMBER OF TREES	AVG DBH (in.)	BASAL AREA (ft^2) BEFORE THINNING	BASAL AREA (ft^2) AFTER THINNING	RESIDUAL VOLUME (ft^3)	VOLUME REMOVED (ft^3)
	4	375	4.3	83.7	37.9	548	640
1	20	375	4.6	95.0	44.3	672	726
	27	375	4.8	100.2	46.5	715	788
	2	375	4.2	65.2	36.4	537	387
2	11	375	4.6	106.6	42.9	657	863
	22	375	4.4	84.3	39.6	600	624
	1	375	4.3	69.5	37.4	564	425
3	8	375	4.3	73.4	37.9	564	479
	18	375	4.5	87.6	41.2	627	699
	3	375	4.3	87.7	37.4	552	684
4	7	375	4.4	96.8	39.5	576	890
	16	375	4.2	79.9	36.6	554	620
	17	375	4.5	81.9	40.8	605	637
5	21	375	4.5	90.2	40.6	581	640
	26	375	4.8	96.7	46.9	709	760
	12	375	4.6	87.3	43.6	659	644
6	19	375	4.6	98.4	43.7	668	825
	25	375	4.3	73.0	37.5	583	489
	10	375	4.6	98.2	42.8	667	830
7	13	375	4.6	81.7	40.7	628	601
	14	375	4.6	94.7	40.8	619	735
	6	375	4.6	85.8	42.3	661	587
8	9	375	4.3	76.4	38.2	582	522
	23	375	4.4	71.3	40.2	595	417

TABLE 8. *SHAWNIGAN LAKE - BASIC DATA AT ESTABLISHMENT - ALL TREES (PER ACRE) (CON'T)*

TREATMENT	PLOT NO.	NUMBER OF TREES	AVG DBH (in.)	BASAL AREA (ft^2) BEFORE THINNING	BASAL AREA (ft^2) AFTER THINNING	RESIDUAL VOLUME (ft^3)	VOLUME REMOVED (ft^3)
	5	1070	3.8	86.9	86.9	1245	-
Control	15	1185	3.7	90.0	90.0	1296	-
	24	1325	3.6	95.8	95.8	1362	-
	28	375	4.5	107.9	42.1	594	985
Spare	29	375	4.5	72.7	41.2	660	439
	30	375	4.5	66.5	41.2	616	368
	31	375	4.4	67.5	39.5	598	372
	32	375	4.3	76.0	38.1	566	512
	33	535	4.5	96.6	59.6	913	548
Dense	34	535	4.3	101.8	55.0	828	615
	35	535	4.1	88.3	49.8	716	548
	36	535	4.2	57.9	52.1	784	30
	37	535	4.3	71.2	51.2	755	277
	38	285	4.7	68.4	34.6	532	232
Open	39	285	4.5	77.0	30.7	468	628
	40	285	4.8	86.6	36.7	575	737
	41	285	4.4	85.1	29.8	454	741
	42	285	4.3	71.4	29.4	436	567

TABLE 9. *SHAWNIGAN LAKE - BASIC DATA - CROP TREES*

(PER ACRE)

TREATMENT	PLOT #	# TREES	AVG DBH	BASAL AREA (ft^2)	VOLUME (ft^3)
	4	80	5.1	11.6	176
1	20	80	5.3	12.4	204
	27	80	5.5	13.0	201
	2	80	4.9	10.5	163
2	11	80	5.3	12.3	192
	22	80	5.0	11.1	173
	1	80	5.0	11.1	175
3	8	80	4.9	10.5	164
	18	80	5.2	12.0	197
	3	80	5.0	11.1	170
4	7	80	5.1	11.3	182
	16	80	4.9	10.6	173
	17	80	5.1	11.0	202
5	21	80	5.4	12.5	195
	26	80	5.6	13.8	214
	12	80	5.6	14.0	219
6	19	80	5.1	11.4	177
	25	80	4.9	10.4	168
	10	80	5.5	13.2	216
7	13	80	5.1	11.5	185
	14	80	5.1	11.2	178
	6	80	5.5	13.4	223
8	9	80	5.0	10.8	174
	23	80	5.1	11.3	174

TABLE 9. *SHAWNIGAN LAKE - BASIC DATA - CROP TREES (PER ACRE) (CON'T)*

TREATMENT	PLOT #	# TREES	AVG DBH	BASAL AREA (ft^2)	VOLUME (ft^3)
	5	80	5.6	13.6	223
Control	15	80	5.2	11.9	201
	24	80	5.1	11.5	187
	28	80	5.1	11.5	187
Spare	29	80	5.3	12.4	206
	30	80	5.4	12.5	199
	31	80	5.1	11.3	176
	32	80	4.9	10.7	163
	33	80	5.6	13.5	214
Dense	34	80	5.4	12.9	204
	35	80	5.1	11.3	178
	36	80	5.2	11.7	219
	37	80	5.3	12.5	192
	38	80	5.5	13.3	217
Open	39	80	5.2	11.9	188
	40	80	5.4	12.6	204
	41	80	4.9	10.5	168
	42	80	4.8	10.2	173

TABLE 10. *SHAWNIGAN LAKE STAND TABLE - BEFORE THINNING (STEMS PER ACRE)*

DBH CLASS	PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2	-	-	-	-	240	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	530	430	435	505	310	320	380	430	360	360	300	265	320	355	210	420	475	370	170	365	465
4	300	360	400	405	295	380	345	355	405	350	405	365	285	430	395	360	350	315	265	350	365
5	95	75	175	130	150	155	205	125	135	285	275	150	235	180	345	170	170	225	260	235	90
6	15	10	-	15	45	40	60	15	20	55	65	70	30	25	180	25	40	55	110	50	50
7	5	-	15	5	20	20	10	-	-	5	10	25	5	10	55	-	-	5	20	10	15
8	-	-	-	-	10	-	10	-	-	-	5	-	5	-	-	-	-	-	5	-	15
TOTAL	945	875	1025	1060	1070	915	1/ 1015	925	920	1055	1066	875	880	2/ 1010	1185	975	1035	970	830	1010	1/ 1005

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
2	-	-	245	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3	405	410	485	455	230	290	520	285	310	380	520	275	475	530	275	330	265	545	295	625	590
4	350	265	375	320	290	295	510	225	220	315	275	350	360	390	250	315	260	300	285	360	310
5	195	155	170	145	200	240	160	180	165	100	170	245	230	120	165	125	125	120	225	145	80
6	30	25	50	20	120	80	50	45	25	30	5	65	65	30	60	35	55	30	60	10	5
7	-	-	-	-	15	35	20	15	15	5	5	5	5	10	10	5	5	5	10	-	-
8	-	-	-	-	10	-	-	-	-	-	-	5	-	-	-	5	5	-	5	-	-
TOTAL	980	855	1325	940	865	940	1260	3/ 755	735	830	975	1/ 950	1135	1/ 1085	760	815	715	1000	880	1140	985

1/ 5 9" CLASS TREES INCLUDED
2/ 5 9" CLASS TREES & 5 10" CLASS TREES
3/ 5 10" CLASS TREES INCLUDED

TABLE 11. *SHAWNIGAN LAKE STAND TABLE - AFTER THINNING (STEMS PER ACRE)*

DBH CLASS	PLOT 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
2	–	–	–	–	240	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3	75	60	80	80	310	45	70	60	55	55	40	50	50	35	210	80	55	55	70	35	70
4	195	225	175	190	295	165	180	195	200	130	160	165	140	195	395	170	180	160	100	155	185
5	85	80	115	90	150	130	100	110	95	150	135	105	160	120	345	115	110	120	160	150	70
6	10	10	–	10	45	20	25	10	25	35	40	50	20	25	180	10	30	40	45	30	45
7	10	–	5	5	20	15	–	–	–	5	–	5	5	–	55	–	–	–	–	5	5
8	–	–	–	–	10	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
TOTAL	375	375	375	375	1070	375	375	375	375	375	375	375	375	375	1185	375	375	375	375	375	375

	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42
2	–	–	245	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
3	55	55	485	65	50	25	45	45	80	70	75	100	130	155	160	160	45	50	15	30	30
4	175	180	375	170	120	150	180	155	130	175	160	210	215	270	210	225	95	135	95	145	170
5	125	120	170	125	140	135	115	150	140	95	135	180	145	80	120	120	90	65	125	105	75
6	20	20	50	15	60	65	25	10	15	30	5	35	40	30	40	25	50	30	45	5	10
7	–	–	–	–	5	–	10	15	10	5	–	5	5	–	5	5	5	5	5	–	–
8	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
9	–	–	–	–	–	–	–	–	–	–	–	5	–	–	–	–	–	–	–	–	–
TOTAL	375	375	1325	375	375	375	375	375	375	375	375	535	535	535	535	535	285	285	285	285	285

TABLE 12. *SHAWNIGAN LAKE-SPECIES COMPOSITION BY BASAL AREA BEFORE AND AFTER CALIBRATION CUT*

TREATMENT	PLOT NO.	% OF TOTAL BASAL AREA									
		DOUGLAS FIR		HEMLOCK		CEDAR		WHITE PINE		LODGEPOLE PINE	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
	4	95.3	100	0.2	-	-	-	4.5	-	-	-
1	20	99.8	100	0.2	-	-	-	-	-	-	-
	27	98.9	100	-	-	0.4	-	-	-	0.7	-
	2	97.0	100	-	-	-	-	2.3	-	0.7	-
2	11	100	100	-	-	-	-	-	-	-	-
	22	98.7	100	-	-	-	-	1.3	-	-	-
	1	99.4	100	-	-	-	-	0.6	-	-	-
3	8	100	100	-	-	-	-	-	-	-	-
	18	97.9	98.5	-	-	-	-	2.1	1.5	-	-
	3	99.3	100	-	-	-	-	0.7	-	-	-
4	7	96.8	100	2.9	-	-	-	0.3	-	-	-
	16	98.0	100	-	-	-	-	1 .3	-	0.7	-
	17	99.1	100	-	-	-	-	0.9	-	-	-
5	21	97.1	100	-	-	-	-	2.9	-	-	-
	26	97.0	99.3	1.8	0.7	0.5	-	0.7	-	-	-
	12	98.1	100	0.1	-	-	-	1.4	-	0.3	-
6	19	96.8	100	2.4	-	-	-	0.8	-	-	-
	25	100	100	-	-	-	-	-	-	-	-
	10	98.9	100	-	-	-	-	1.1	-	-	-
7	13	98.2	100	-	-	0.2	-	1.6	-	-	-
	14	99.6	100	-	-	0.2	-	0.2	-	-	-
	6	96.2	100	1.4	-	0.3	-	2.1	-	-	-
8	9	99.2	100	-	-	-	-	0.8	-	-	-
	23	98.2	100	-	-	-	-	1.8	-	-	-

TABLE 12. *SHAWNIGAN LAKE-SPECIES COMPOSITION BY BASAL AREA BEFORE AND AFTER CALIBRATION CUT (CON'T)*

		% OF TOTAL BASAL AREA									
TREAT-MENT	PLOT NO.	DOUGLAS FIR		HEMLOCK		CEDAR		WHITE PINE		LODGEPOLE PINE	
		BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER	BEFORE	AFTER
	5	99.8	99.8	-	-	-	-	-	-	0.2	0.2
Control	15	98.8	98.8	-	-	-	-	1.2	1.2	-	-
	24	100	100	-	-	-	-	-	-	-	-
	28	99.5	100	-	-	-	-	0.5	-	-	-
Spare	29	85.3	95.1	-	-	-	-	0.7	1.3	14.0	3.6
	30	99.6	100	-	-	-	-	0.4	-	-	-
	31	100	100	-	-	-	-	-	-	-	-
	32	98.3	100	-	-	-	-	1.7	-	-	-
	33	99.4	100	-	-	-	-	0.6	-	-	-
Dense	34	96.7	100	-	-	0.6	-	2.5	-	0.2	-
	35	99.5	100	-	-	0.5	-	-	-	-	-
	36	99.5	100	-	-	-	-	0.5	-	-	-
	37	99.2	99.6	-	-	-	-	0.8	0.4	-	-
	38	98.8	100	-	-	-	-	1.2	-	-	-
Open	39	99.7	100	-	-	-	-	0.3	-	-	-
	40	95.7	100	4.0	-	-	-	0.2	-	-	-
	41	99.5	100	-	-	-	-	0.5	-	-	-
	42	100	100	-	-	-	-	-	-	-	-

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

Williamson, R.L. and G.R. Staebler. 1965. A cooperative level-of-growing-stock study in Douglas-fir. U.S.D.A. For. Serv. Pacific Northwest For. Range Expt. Sta.

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

Williamson, R.L. and G.R. Staebler. 1971. Levels of Growing Stock Cooperative Study on Douglas-fir. Report No. 1-- Description of study and existing study areas. U.S.D.A. For. Serv. Res. Pap. PNW-111. Pacific Northwest For. Range Expt. Sta.

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

Bell, J.F. and A.B. Berg. 1972. Levels of Growing Stock Cooperative Study on Douglas-fir. Report No. 2 -- The Hoskins Study, 1963-70. U.S.D.A. For. Serv. Res. Pap. PNW-130. Pacific Northwest For. Range Expt. Sta.

Thinning regimes in a young Douglas-fir stand near Hoskins, Oregon are described. Data are tabulated for the first seven years of management.