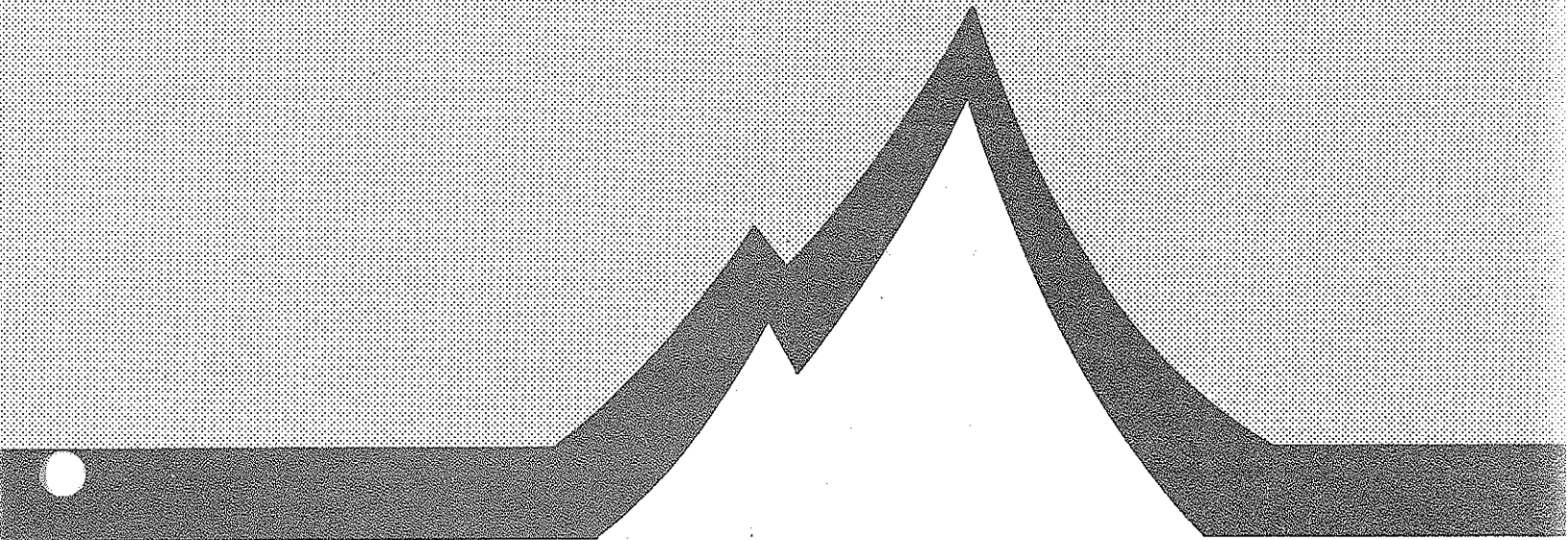


HIGH ELEVATION REFORESTATION PROBLEMS

IN THE VANCOUVER FOREST DISTRICT



INTERIM RESEARCH RESULTS NO. 2

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FOREWORD

In November 1973, a task force was organized by the Reforestation Board of the Tree Farm Forestry Committee to identify research needs associated with high elevation reforestation problems in the Vancouver Forest District. This task force prepared recommendations that were then acted upon by a working group consisting of the chairman of the Reforestation Board and members of the Canadian Forestry Service (PFRC) and the Research Division (BCFS). Last year, the working group prepared the first progress report entitled "Interim Research Results No. 1". Since then a considerable amount of research has been initiated and it was felt that a sequel was required to:

- 1) inform potential users of the progress that has been attained in the past year;
- 2) further explore ways and means of improving bilateral communication between researchers and users in the field.

With particular regard to the second point, the

working group would appreciate any comments related to the projects reported herein. There are many individuals in government and industry who are presently encountering everyday reforestation problems at high elevations and who have their own relevant field experience to call upon. Furthermore, several member companies of the (former) Tree Farm Forestry Committee now have their own high elevation reforestation research programs and may be able to further contribute to some of the research projects covered in this report. Such communications are earnestly solicited and should be addressed to D. McMullan, Chairman of the Reforestation Board, B.C. Forest Products, Box 130, Crofton, B.C.

Some of the progress statements presented here arise from closely associated projects being conducted in other Forest Districts. They are included here because the approach to the problem and the methodology are pertinent to Vancouver District problems. Some of the projects were initiated before the task force was formed.

SECTION I

AMABILIS FIR ADVANCE REGENERATION

L. Herring, Research Division, B.C.F.S., and H. Craig, C.F.S., completed the study of decay status and post-logging growth responses of advance amabilis fir regeneration. Research results, together with other observations concerning the potential use of amabilis fir as a restocking component will shortly be presented in a final report.^{1/}

Amabilis fir advance regeneration growth data were obtained and analyzed from seven coastal sites which were logged between 1944 and 1967. Results indicated the following:

1. After logging, stocking is often patchy.
2. Minor stem deformities relating to the previous restricted environment are quickly outgrown. Severe deformities are usually the result of

logging damage.

3. Diameter growth response occurs 1 or 2 years after logging; noticeable height growth takes longer.
4. The level of growth response was considerably influenced by site quality, especially moisture status, and by stem competition.
5. Larger diameter trees (basal diameter > 2.4 cm (i.b.)) are more susceptible to logging damage and sustain more serious injury than smaller trees.
6. Although up to 20 percent of post-logging advance growth showed some form of logging injury, less than 2 percent was found to harbor active decay (mostly *Haematostereum sanguinolentum*); decay due to the Indian paint fungus (*Echinodontium tinctorium*) was considered low to non-existent. Heartrot incidence increased in regeneration greater than 60 years at the time of logging.

^{1/} The same researchers are conducting a parallel study on sub-alpine fir (*Abies lasiocarpa*) advance regeneration in the Nelson, Kamloops and Cariboo Districts. Research Division, B.C.F.S. E.P. 754.

LOGEPOLE PINE PROVENANCE TESTS AT HIGH ELEVATIONS

Analyses of growth data which were collected in 1972 and 1974 from the high elevation Lodgepole Pine provenance trials at Boston Bar were continued this year under the direction of K. Illingworth, Research Division, B.C.F.S.

Overall survival of the 6-year-old trees averaged 94 percent; mean plantation height was 47.5 cm. Early analyses indicated highly significant differences among the 45 inland provenances in survival, height and height increment. B.C. interior provenances varied markedly with latitude, elevation and region. **Noteworthy in terms of survival and height were the middle-elevation provenances in or fringing the Columbia Forest Zone.** Provenances from the Alberta foot-hills, Montana and Utah showed poorer growth response.

Analyses are being continued and the next assessment is scheduled for 1977.

Research Division, B.C.F.S. E.P. 657

DOUGLAS-FIR PROVENANCE TESTS AT HIGH ELEVATIONS

Six years after planting, survival of Douglas-fir in the high elevation (1,000 m) trial at Lookout Mountain (Vancouver Island) averaged 94.4 percent survival. **Differences among provenances were significant and ranged from 59.2 percent to 99.8 percent.** Plantation mean height was 106 cm. None of the eleven interior provenances grew faster than the lowest quartile of coastal provenances, but those from the Columbia Forest Zone were most promising.

Four of these were included in additional trials by K. Illingworth, Research Division, B.C.F.S. at three other high elevation sites on Vancouver Island. First-year height and survival data were collected in 1975 and await analysis.

Research Division, B.C.F.S. E.P. 599

SEED PRODUCTION CAPABILITIES OF HIGH ELEVATION CONIFERS

Dr. J. Owens, under contract with the Research Division, B.C.F.S. continued research on two projects, as well as initiating a new one in 1975.

In the first project, seeds were collected in the fall of 1975 from cones obtained from the 15 yellow cedar seedlings which had been induced by gibberellin in the summer of 1973. Anatomical development of the seed was normal, although there were many empty seeds which appeared to be characteristic for the species. These seeds are now being stratified and germination tests will be made in the spring of 1976.

In the second project, yellow cedar cones induced in 1974, were allowed to pollinate in 1975. During the year, there was some abortion and loss of seed cones. The remaining cones will be allowed to develop until seeds are mature in 1976. Mountain hemlock trees, which failed to initiate cones in 1974, were checked in case there was a carry-over effect inducing cones in 1976. This did not occur.

A research paper has been published on the results of the third project dealing with the time of pollination and fertilization of mountain hemlock, as well as the phenology of embryo and seed development of this species:

Owens, J.N. and M. Molder. 1975. Sexual reproduction in mountain hemlock (*Tsuga mertensiana* (Bong.) Carr.). Can. J. Bot. 53: 1811-1826.

Seed cone collections, made at Green Mountain in 1975, were once again found to contain no developing pollen cones. This was attributed to the cool wet weather that occurred in the early part of the past two growing seasons. Collections will be made again in 1976 to try to determine the time of pollen cone initiation.

A fourth project was initiated this year to investigate cone initiation and seed development in amabilis fir. Collections from near Ladysmith and Duncan demonstrated the phenology and all stages of vegetative bud development, as well as the time and method of cone initiation. Vegetative growth began in early April and ended in November. Both pollen- and seed-cone buds differentiated in mid-July from axillary buds which were initiated in mid-April. New pollen- and seed-cone buds became dormant in October and November, respectively. A manuscript describing this is nearly completed. Pollen and seed cone development were anatomically studied until fertilization occurred early in July. Later stages of embryo development were studied

only to a limited extent due to the scarcity of pollen cones in 1975. As a result, stages of fertilization and early embryo development that occurred in July were not present in the collection. Collections of pollinated seed cones will be made again during July of 1976, in order to complete this study.

Research Division, B.C.F.S. E.P.'s 738,739,751

PROPAGATION OF YELLOW CEDAR

Dr. D.G.W. Edwards, C.F.S., reported that the 1974 yellow cedar germination trials showed the best germination followed 1 month warm (room temperature) stratification plus 6 months cold (10-40°C) stratification. An attempt to produce seedlings for a planting trial using this pretreatment prescription was a complete failure. The same seedlot was used as in the 1974 trials and it was suspected that the seeds had deteriorated in storage. An experiment has begun to test seed storage life for this species.

Some 400 seedlings, raised at PFRC, were outplanted at the Mission Tree Farm. Approximately half the plants have had two full growing seasons in the ground and most average 30-40 cm in height. **Many of these seedlings are over 50 cm high and mortality is less than 2%.** The Mission Tree Farm has raised and outplanted over 10,000 yellow cedar seedlings. Mortality has been low and growth has been resumed following first season planting check.

Several hundred cuttings, which were also raised at PFRC and outplanted at Mission, show vigorous growth and 100% survival after one growing season. Many of the cuttings still display a lack of apical dominance.

The results of the Cowichan Lake rooting trials, mentioned in the first report, have now been published: Karlsson, I. 1974. Rooted cuttings of yellow cedar. B.C.F.S. Res. Note No. 66.

Research Division, B.C.F.S. E.P. 750

P.F.R.C. Project 28-247

ASSESSMENT OF LOGGING DISTURBANCE

Surveys of soil disturbance and vegetation recovery on steep clear-cuts in the Nelson Forest District were continued by Dr. R. Smith, C.F.S. Additional logging

methods examined in 1975 were grapple, jammer and skyline. Transects were also run in unburned summer and winter highlead, combinations not encountered in 1974.

Combining the 1974 and 1975 surveys, disturbance over 25 cm deep caused by roads and skidroads was highest for summer ground skidding (28% of clear-cut) and ranged downward through summer grapple (19%), winter ground skidding (13%), winter grapple (11%), summer highlead (9%), summer jammer (7%), winter highlead (6%) and skyline (0%).

Non-road disturbance consisted of gouges and deposits mainly attributed to erosion, butt gouging and stump and tree overturns, and on burned sites, litter burned to mineral soil. Gouges and deposits were generally highest in burned, summer cable-logged clear-cuts, but were generally much less extensive and much shallower than disturbance related to roads. The amount of litter burned to mineral soil varied from none to 67 percent of clear-cuts, reflecting a great variation in the intensity of the burns.

Thirteen of the 1974 transects were re-surveyed to assess changes in vegetation cover over the 1-year period.

Work in 1976 will be directed toward determining what effect, if any, the various types and degrees of disturbance have on site productivity.

P.F.R.C. Project 25-253

ENVIRONMENTAL QUALITY COSTS IN LOGGING ROAD DESIGN AND CONSTRUCTION

A case study was completed that identified a methodology, based on the B.C.F.S. Engineering Division cost accounting system, to compile damage prevention costs:

Ottens, J. 1975. Environmental costs in logging road design and construction. Envir. Can., PFRC, Report BC-X-108, 26 p.

Further work has been carried out in the Carnation Creek study area. The objective is to establish a benchmark set of observations of construction costs, and stream sedimentation by construction tasks resulting from routine, road building practices on the west coast of Vancouver Island. Collection of data was hampered by bad weather conditions and only partial results were obtained.

P.F.R.C. Project 05-189

COSTS AND BENEFITS OF LOGGING GUIDELINES

A report prepared by H. Benskin, under contract with the Research Division, B.C.F.S., described the financial implications and some of the costs and benefits of the Coast Logging Guidelines and the Interim Guides for logging on Severe Sites, with respect to two sample drainages in the Chilliwack Provincial Forest.

A financial analysis showed that the alternate patch-cutting system common to both sets of guidelines was the main contributing factor to increased total logging costs. **The extra initial road development and road maintenance required to implement this system contributed to a 60 percent decline in potential economic rent, without any consideration of increases in physical harvesting costs.** The degree of financial impact was very sensitive to assumptions about interest rates and to length of the leave period between consecutive harvesting passes.

A qualitative analysis of the costs and benefits of the guidelines as they affect other resource values revealed that they may be an inefficient means for obtaining multiple use objectives if applied regardless of site specific needs. The need for land-use zoning was stressed, as well as for clear statements of management objectives for other resource values.

Research Division, B.C.F.S. E.P. 744

NATURAL REGENERATION ASSESSMENT AT HIGH ELEVATIONS

J. Gilmour, L. Herring, C. Johnson, P. Robson, M. Wareing, B.C.F.S. and M. Crown, C.F.S. continued their work on this project during 1975. The results of all three natural regeneration survey methods were tested against a variety of population distributions and stocking levels generated by a computer. **Both statistical theory as well as the computer analyses substantiated the general opinion that the modified survey methods (exploded 4 mil/ac plot and continuous line plot systems) produced more accurate results than the existing 'standard' 4 mil/ac plot system.**

Research findings will be incorporated by D. Wallinger, B.C.F.S. (Reforestation Division) into a handbook now under preparation.

Research Division, B.C.F.S. E.P. 745.03

P.F.R.C. Project 36-256

SOIL AND VEGETATION STUDY IN S.E. BRITISH COLUMBIA

G. Utzig, Research Division, B.C.F.S. and K. Jones, Can. Dept. Agric., have almost completed their analyses of the soil and vegetation data which were collected at Templeton River (Windermere PSYU) and at Garry Creek (Salmo PSYU) in 1974.

Two reports are expected this spring: A Research Note outlining the methodology and data collection, and a Survey Report for the user which contains maps and their interpretations. Additional work is investigating the broader application of such mapping techniques in order to efficiently inventory larger areas.

Research Division, B.C.F.S. E.P. 735-01

IMPROVED ARTIFICIAL REGENERATION METHODS

The preliminary cultural guidelines, prepared by J. Arnott, C.F.S., for producing high elevation tree species in container nurseries were satisfactorily tested at two Forest Service Nurseries on Vancouver Island during 1975. **All species reached outplanting standards within a 26- to 30-week period.**

Field trials using this stock are reported in a new study in Section II entitled "High Elevation Species and Stock Type Trial".

P.F.R.C. Project 36-257

SECTION II

RATE OF HARVESTING FORESTED WATERSHEDS: PROBLEM ANALYSIS

H. Benskin, under contract with the Research Division, B.C.F.S., is in the process of completing a Problem Analysis concerning the economic and environmental implications of the rate of harvesting watersheds in the Vancouver Forest District. Special attention is being given to problems relating to the spatial and temporal distribution of clear-cut units. Field trips were undertaken to a large number of logging operations throughout the District. Discussions were held with foresters and engineers concerning factors which have influenced the historic pattern of development and which are currently taken into account when planning the location and intensity of the annual harvest. An additional field trip was made to Washington and Oregon, and discussions were held with representatives from the U.S. Forest Service; Bureau of Land Management; Washington Departments of Natural Resources and Ecology; Seattle City Water Board; University of Washington and Oregon State University, who have direct dealings with the problem. An analytical comparison will be made of relevant Washington and Oregon forest practices, rules and regulations, with those currently in effect in the Vancouver District. The final report will be completed in March.

Research Division, B.C.F.S. E.P. 772

ALLOCATION OF LIMITED FUNDS FOR REFORESTATION

A short study was undertaken by Y. Dubé (Summer Student, Reforestation Division, B.C.F.S.) to investigate possible methods for improving the basis for allocating limited funds for reforestation. A linear programming model was used to demonstrate how the 1974 reforestation budget for the Nootka PSYU could be optimally allocated among proposed planting projects. The chosen objective was to maximize the benefit/cost ratio of expected increases in allowable cut (discounted to the present) to discounted costs, subject to budgetary and other resource constraints (e.g. manpower and planting stock). The potential use of other techniques such as Dynamic Programming, Simulation and Multiploy were also discussed in the final report.

Research Division, B.C.F.S. E.P. 760

HIGH ELEVATION REFORESTATION: PROBLEM ANALYSIS

K. Klinka, F. Pendl, C. Thompson and G. Utzig, Research Division, B.C.F.S., are currently preparing a problem analysis on high elevation reforestation problems. The primary objectives are to present an overview of problems relating to regeneration - site interactions, to establish research priorities, and to identify research programs which could help to solve these problems.

This project is being conducted in the Vancouver and Nelson Forest Districts by the Research Pedologists and Regional Research Foresters. During the past field season, reconnaissance field tours have been made to various high elevation sites in order to identify some of these problems. The project will be completed in early 1976.

Research Division, B.C.F.S. E.P. 758

HIGH ELEVATION SPECIES AND STOCK TYPE TRIAL

During the 1975 growing season, J. Arnott (C.F.S.) and L. Herring (B.C.F.S.) initiated a planting trial to assess the survival and early growth performance of two sizes of plug stock for each of five high elevation tree species. *Pseudotsuga menziesii*, *Tsuga mertensiana*, *Chamaecyparis nootkatensis*, *Abies amabilis* and *Abies procera* were grown in Styroblock-2 and Styroblock-8 containers under a greenhouse and shelterhouse regime and outplanted in October on three high elevation sites on Vancouver Island. Plot measurement and further trials are planned for 1976.

Research Division, B.C.F.S. E.P. 759

P.F.R.C. Project 36-257

REFORESTATION METHODS FOR AVALANCHE CONTROL

In the Nelson and Vancouver Forest Districts, planning is underway to initiate a project directed at developing reforestation techniques for avalanche control. This is a cooperative project involving the Research Division, B.C.F.S. and the Senior Avalanche Coordinator of the Department of Highways. Two study areas will be located in Allison Pass and Kootenay Pass, respectively, in the Manning and Stagleap Provincial Parks.

Research Division, B.C.F.S. E.P. 781

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