PROGRAM REVIEW

PACIFIC FOREST RESEARCH CENTRE

1981 ~ 1982

Environment Canada
Canadian Forestry Service

Environnement Canada
Service canadien des forêts

The Canadian Forestry Service

The Canadian Forestry Service (CFS) is the principal source of federal expertise in forestry. Its overall objective is to promote sound management and use of Canada's forest resources for the greatest economic, social and environmental benefit of Canadians.

The role of the Canadian Forestry Service is to coordinate federal policies in order to encourage improved resource management and the growth of the forest industry and, through research and development, to provide scientific and technical leadership in forestry. In addition, the CFS acquires and analyses the national and international statistics and information used in policy development. The Service develops and adopts wood product codes and standards, protects Canadian forests by combatting foreign pests and sponsors potential uses of forest resources for energy in keeping with objectives of Environment Canada.

Various federal organizations are involved in forestry programs and a Forest Sector Strategy Committee, chaired by the Canadian Forestry Service, coordinates federal forestry activity.

In addition to six Forest Research Centres and two National Institutes, Canadian Forestry Service headquarters includes three directorates–Forestry Relations, Policy and Economics, Research and Technical Services and Planning, Finance and Administration.

The role of the Forest Research Centres is to respond to regional needs and maintain close contact with the provincial forestry departments. They also participate in national programs and frequently direct them.

The names and locations of the centres are as follows: Pacific Forest Research Centre, Victoria, B.C.; Northern Forest Research Centre, Edmonton, Alberta; Great Lakes Forest Research Centre, Sault Ste. Marie, Ontario; Laurentian Forest Research Centre, Sainte Foy, Quebec; Maritimes Forest Research Centre, Fredericton, N.B.; and Newfoundland Forest Research Centre, St. John's, Nfld.

Programs of national scope are the responsibility of the National Institutes. These are the Petawawa National Forestry Institute, Chalk River, Ontario and the Forest Pest Management Institute at Sault Ste. Marie, Ontario.

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Program Review

Pacific Forest Research Centre

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1982

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Pacific Forest Research Centre

A Word from the Director

Ross Macdonald

The fiscal year **1981-1982** was a time to closely examine the programs and priorities of the Pacific Forest Research Centre (PFRC) to ensure their responsiveness to the needs of the clients of the Canadian Forestry Service (CFS) in the Pacific and Yukon Region.

About one-third of the Centre's projects underwent intensive review by committees representing the management of PFRC, other scientists and members of the research community outside the Centre. Some projects were terminated with a view to placing more emphasis and resources on current CFS priorities such as biological control. The remainder of the projects will be reviewed over the next two years and will continue to be reviewed triennially.

In keeping with the revitalizing efforts of the CFS, we were able during this year to send three of our younger scientists on post-graduate training. Eleanor McMullen, our chemist, is studying for a PhD at the Swedish University of Agricultural Sciences, Umea; Alex Gardner, silviculturist, and Gary Jensen, biologist, are taking MSc programs at the University of Alberta and University of Victoria, respectively.

A number of notable staff changes occurred. We strengthened our computer services by adding three new staff members—Dr. Jack Pannekoek, John Partridge and Arvon Erickson. Other important additions included: William White, Economist; Dr. Hugh Barclay, Forest Mensurationist, and Dr. Allan Auclair, Fire Ecologist. Several of our senior staff members retired during this period, including our Chief Ranger, Lew Fiddick; Jim Kinghorn, Silvi-

culturist, and Al MacEwan, Scientific Editor. We also lost several staff members to the private sector, notably Dr. George Puritch and Bill Nijholt. Dr. Terry Honer, who had been on secondment to CFS Headquarters to develop a national forest statistics program, returned to PFRC to take up responsibilities as a senior research scientist in forest mensuration.

The 30 projects and over 150 studies conducted at the Pacific Forest Research Centre are divided into four major areas:

Forest Environment. *Federal responsibilities in the Forest Insect and Disease Survey and plant quarantine are carried out in cooperation with other federal and provincial agencies. Research includes ways to improve the Canadian Forest Fire Danger Rating System as it relates to British Columbia and the Yukon, as well as investigating meteorological and hydrological influences on forest ecosystems. Environmental impact assessments of major construction projects are carried out.*

Forest Resources. *Research and operations studies involve land classification, improving quality and production of seedlings, and developing improved regeneration methods and silvicultural practices to enhance the productivity of coastal and interior forests. Federal responsibilities in seed certification and testing are carried out.*

Forest Protection. *Research and operations include studies of insect and disease influences and forest depletion, as well as development of pest management strategies and guidelines, and the development of guide-*

lines for the recognition, control and prediction of growth of stem disease.

Forest Economics. *Policy advice on Canada's greatest forest region is provided, as well as the operation of the region's program in energy from forest biomass.*

D. Ross Macdonald
Regional Director, Pacific and Yukon

March 31, 1982

Table of Contents

Forest Environment

C.E. Brown • Program Manager

Forest Insect and Disease Survey

Project Leader:
Dr. G.A. Van Sickle

Professionals:
D. Evans
Dr. J.C. Hopkins

Technicians:
R.J. Andrews
R. Duncan
R.D. Erickson
R. Garbutt
N. Humphreys
H.P. Koot
J. Loranger
D.P. Lowe
E.V. Morris
E. Pass
L.S. Unger
H. Woensdregt
C.S. Wood
R.O. Wood

Tree top samples are collected.

Objectives

To produce part of an annual, national overview of important forest insect and disease conditions and their implications; to conduct quarantine-related surveys and activities; and to support research through maintenance of historical records and collections, monitoring and reporting and, when possible, providing requested collections and observations. To develop methodology to quantify pest-related tree mortality and growth losses and to improve insect and disease sampling techniques.

Achievements

The annual monitoring and assessment of regional forest pest conditions was conducted and results published.

Mountain pine beetle continued to be the most damaging insect in western Canada as current mortality of mature lodgepole pine occurred over more than 158 000 ha and an additional 59 000 ha contained predominantly dead, unsalvageable trees from attacks in recent years. More than 19.5 million mature lodgepole pine trees, with an estimated volume of 6.6 million m^3, were killed by the 1980 beetle attacks and an estimated additional 32 million trees were attacked during 1981. Spruce beetle infestations continued over more than 86 000 ha, killing more than **4** million m^3 of mature white and Engelmann spruce.

Western budworm defoliation of Douglas-fir declined, possibly due to **cool,** wet weather in June and July. Mostly light defoliation occurred over 21 000 ha, down from 81 000 in 1980. Douglas-fir tussock moth defoliated

trees in four areas totalling 1 060 ha in central British Columbia. In one area, a host specific virus was applied.

Root rots, dwarf mistletoes, stem rusts and canker diseases continued as major problems in mature and immature stands, and several needle and leaf diseases were conspicuous and common. The identification of a needle blight which was widespread in natural and planted larch was confirmed for the first time in British Columbia.

Cone and seed pests, usually a major concern in seed orchards and collection areas, were minimal in 1981 because of the generally poor cone crops.

Monitoring and assessment activities are conducted on an annual basis.

Effects of Harvesting and Site Preparation Practices

Project Leader:
Dr. R.B. Smith

Technician:
E.F. Wass

Objectives

To identify, measure and elucidate the effects of harvesting and site preparation practices on forest resources and values as a basis for rationalization of existing practices where appropriate and for development of new practices where appropriate.

Achievements

Detailed field tests and soil samplings were completed on skidroad soils in two additional areas. Bulk density, penetrability, pH and particle-size distribution have now been measured for soils in all five areas. Organic carbon and total nitrogen measurements will be conducted this summer. Significantly higher soil bulk densities and strengths (resistance to penetration) occur on skidroads than in adjacent undisturbed soils. Differences in soil strength across the skidroad surface are also evident.

Two root-disease control (stumped and raked) areas in Interior British Columbia were surveyed for type, degree and area of soil disturbance. Bulk density and penetrability measurements were conducted in the field for each of the major soil disturbance type-depth combinations. Preliminary results were presented during a field tour associated with the 1981 Western International Forest Disease Work Conference held in Vernon. A new study was initiated to determine the pattern of natural vegetative succession on landslides in the Queen Charlotte Islands and on the effects of such slides on tree establishment, composition and growth. This work is being conducted under the aegis of the multi-agency Fish/Forestry Interaction Program.

Advice and services continued and included presentation of papers at a Forest Hydrology Workshop at Selkirk College and at a Slope Stability Seminar in Vancouver.

Fire Research

Project Leader:
B.D. Lawson

Professionals:
Dr. A.N. Auclair
B.C. Hawkes

Technician:
G.R. Lait

Objectives

To develop an understanding of and methods for quantifying and predicting fire effects in forest ecosystems and to develop frameworks and guidelines for incorporating fire effects knowledge into land management plans and practices. To develop fire behavior prediction systems for major fuel types in the region; to incorporate such knowledge within a national framework provided by the CFS Canadian Forest Fire Danger Rating System; and to provide information support systems necessary for implementation. To improve the application of prescribed fire to a variety of land management problems through development of guidelines predicting prescribed fire behavior and impact and development of improved ignition systems.

Achievements

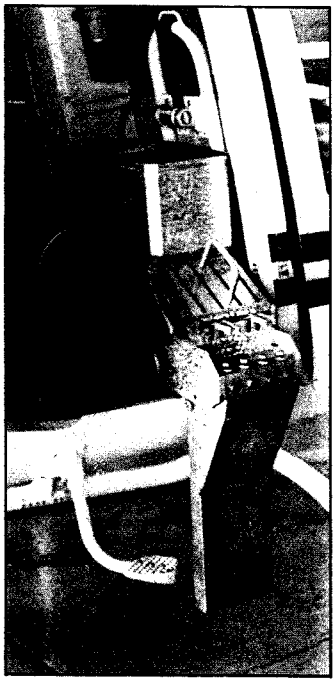
As part of a national Fire Danger Rating System project, the existing wildfire and prescribed fire research data base for B.C. forest types was pooled with similar data from across Canada and preliminary fire spread equations developed. An updated Canadian Forest Fire Danger Rating System will incorporate these "Fire Behavior Indices" to help improve fire management decision-making with regard to predicting the growth and intensity of forest fires.

A study of fire history, fire ecology and fuels classification was completed for Kluane National Park, Yukon. A report is in preparation which will form a significant part of the information base needed to prepare a fire management plan for Kluane.

Work continued on the joint BCMF/CFS Northern Fire Ecology Project in northern B.C., which documents fire's role in the major ecosystems of the Fort Nelson, Cassiar and northern Mackenzie Timber Supply Areas. Reports are in preparation which will be used to guide fire management planning for these northern units.

Training sessions and prescribed burning workshops were conducted or participated in through several parts of B.C. on use and interpretation of the Prescribed Fire Predictor, a decision-aid developed at PFRC to assist land managers in planning and scheduling prescribed burns to meet silvicultural objectives. Trials of the Prescribed Fire Predictor applicability to "brown and burn" site rehabilitation prescription development in coastal high-site Douglas-fir were undertaken in cooperation with BCMF. Preliminary adjustments to the Predictor for this fuel type were reported with further field trials planned. Assistance was provided to BCMF in several regions and the Yukon L&FS with preparation and presentation of training course material on the PFRC Aerial Ignition System for lighting prescribed burns or wildfire control burnout operations from helicopters.

A problem analysis was initiated to determine fire effects research needs in the region. Much of the research of the past five years has been completed, and this analysis will assist in determining the structuring of new research programs to be put in place during the coming year.



Top: Aerial ignition system developed to ignite forest and range fuels from helicopters,

Bottom: Successfully burned Douglas-fir site resulting from correct fire prescription,

Environmental Assessment

Project Leader:
Dr. W.K. Stanek

Technician:
L. Milmine

Exploration must go hand-in-hand with environmental assessment.

Objectives

To fulfill federal responsibilities with regard to the Environmental Assessment and Review Process (EARP) and to provide protection, conservation and wise resources management by ensuring that environmental effects are considered in planning, decision-making and implementation of federal projects.

Achievements

Provided forestry expertise in the environmental assessment and review process; reviewed environmental impact statements in the gas pipelines (Alaska Highway and Dempster Highway), Foothills' final Revegetation Programme for the Alaska Highway, guidelines (Ibex Pass Alternatives), many external and internal papers. Consultations (mining, reserves, logging, pollutants) were provided; confidential reports and reviews (DOE Task Force; Northern Pipeline Agency) were written. Contributed to "Joint DFO/DOE Position Paper on Yukon Placer Mining" and made proposals to DOE Task Force regarding gas pipeline monitoring. Environmental baseline data were collected along the Dempster Highway; and a major report on vegetation types and environmental factors was completed. Major contributions were made toward developing a proposal to study the impact of air emissions on the forest environment from the Hat Creek coal-fired, electricity-generating plant. Contributed to two papers on the utilization of peatlands in different countries; completed a fifth approximation of "A Glossary of Virgin Peat and Peatlands".

Meteorology in Forestry

Project Leader:
Dr. R.H. Silversides

Objectives

To acquire and apply meteorological knowledge to assist in the solution of forestry and environmental problems in the Pacific Region. In the shorter term, to develop guidelines for the optimum siting of weather stations, to develop or adapt meteorological equipment to forestry situations, and to test one or more models which simulate climatic influences.

Achievements

The small-area numerical wind model has undergone further development and is being used *to* investigate budworm dispersal. Two years of data collected from Sayward forest sites will be used to examine changes in stand climate following a thinning operation. Technical support has been provided to the Fertilization on Snow project. A modest level of instrument development is being carried out in order to be aware of current technology and to be able to make recommendations on meteorological instrumentation suitable to forestry needs.

Carnation Creek Experimental Watershed

Project Leader:
Dr. R.B. Smith

Professional:
Dr. E. Hetherington

Technician:
R.J. Roswell

Objectives

To integrate and conduct forestry, hydrology, vegetation and soil studies at Carnation Creek essential to joint interagency formulation of minimum standards for forest harvesting practices in coastal salmonid-producing watersheds.

Achievements

Continuous monitoring of water-table levels and soil moisture was conducted on slopes and in the valley bottom. Regular monitoring was terminated in December 1980, providing two years pre-logging and over *two* years post-logging measurements for the major slope hydrology study area. Shorter term field hydrologic studies were continued. Ground surface transects were rerun on six cutblocks. Revegetation assessments were conducted on 101 plots in five study units and 67 plots were newly established in two units.

The hydrological, vegetation and soil mapping, ground surface disturbance and revegetation studies were presented in five papers by PFRC researchers at the Carnation Creek 10-Year Review and Workshop held in Nanaimo in February 1982. Proceedings of this workshop will be made available.

Damage Appraisal and Remote Sensing

Project Leader:
Dr. **G.A.** Van Sickle

Professionals:
Dr. **R.I.** Alfaro
Dr. **P.** Gimbarzevsky
Dr. **J.W.E.** Harris

Technicians:
R.G. Brown
A. Dawson
E. Wegwitz

Objectives

To determine relationships between the level and duration of pest populations with the loss of growth, form or mortality of trees and stands. To investigate and implement, in close cooperation with the National Forest Insect and Disease Survey, new techniques for the measurement of damage caused by forest pests in such a way that they become an integral part of dynamic forest inventories. This includes work on the use of remote sensing for assessment and quantification of growth reduction and tree mortality caused by forest pests.

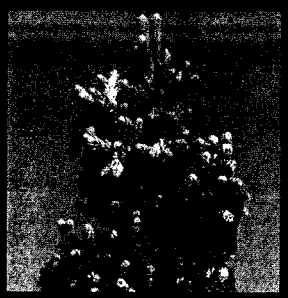
Achievements

A pictorial guide to defoliation levels is being compiled. The numbers of dead and attacked trees in ground and photo plots are being analyzed to develop a multistage sampling scheme. Airborne multispectral scanner data are being analyzed on the laboratory's digital analysis system to enhance and delineate mountain pine, beetle damage.

Western spruce budworm effects on Douglas-fir mortality and radial, height and volume growth were quantified, using intensive dissection techniques, for one stand near Pemberton, and one in the Fraser Canyon. Sampling carried out in 1981, and scheduled for 1982, will permit the extension of those results to representative areas of the province. Measurements in 1981 of 50-year-old Sitka spruce plantations attacked by the Sitka spruce weevil since an early age disclosed that infestations by this insect may drastically reduce the merchantability of the resulting stand.

Forest Resources

Dr. J.A. Dangerfield • A/Program Manager



Coastal Douglas-fir Ecosystems and Stand Tending

Project Leader:
Dr. H. Brix

Professionals:
Dr. J.A. Dangerfield
Dr. V.G. Marshall
Dr. P.C. Pang

Technicians:
M. Clayton
J. Dronzek
C.R. Layton
K. McCullough
A. Mitchell

Objectives

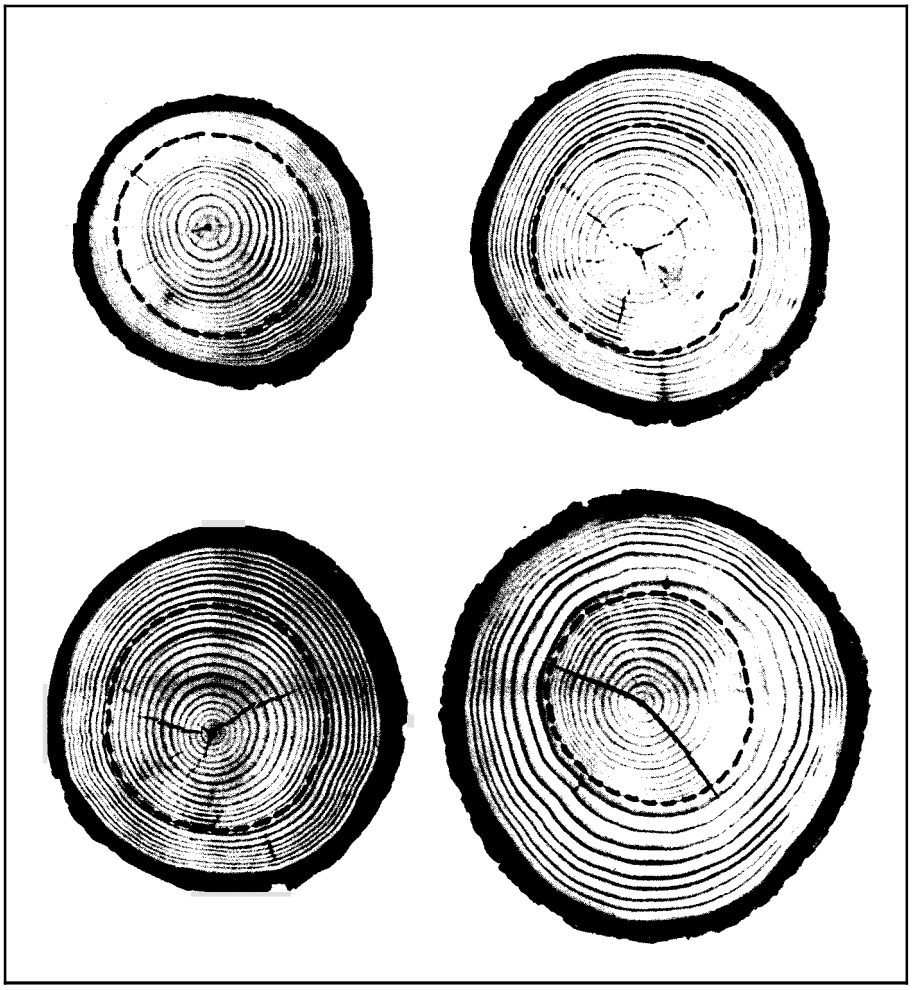
To investigate tree growth and biological processes of soil and trees in response to thinning and fertilization of a coastal Douglas-fir ecosystem and to use the resulting information to develop a comprehensive model for growth prediction.

Achievements

Research continued on thinning and nitrogen fertilization effects on soil chemistry, soil microflora and fauna and their functional interrelationship in nutrient cycling and nutrient availability to trees. This, together with impacts on tree physiology, was the basis for development of a biological model of stand management effects on ecosystem response and stand growth.

Field sampling for a study on tree biomass and nutrient content nine years after thinning and fertilization was completed and biomass data were analyzed. Plots originally fertilized in 1972 were refertilized at the same rate in March 1981. A good first-year growth response to refertilization was obtained. Plots were established for a new study on the role of earthworms in the nutrient cycling.

Reports were published dealing with thinning and fertilization effect on branch and foliage production, photosynthesis in relation to nitrogen source and foliar nitrogen concentration, and nutrient distribution in forest soil. A manuscript on the 9-year growth response is in preparation.



It has been nine years since a 24-year-old Douglas-fir stand, located about 40 km north of Victoria near Shawnigan Lake, underwent initial treatment to determine the effects of nitrogen fertilization and thinning as silviculture treatments. The stand was divided into plots and various levels of thinning and fertilization were applied. The photo above shows nine-year-old stems which were taken from these plots. Top left is a stem from an untreated or control plot. Top right stem is from a plot which had maximum thinning but no fertilization. Bottom left stem had no thinning but maximum fertilization. The stem on the bottom right is from a stand which had both maximum thinning and maximum fertilization and which, in turn, experienced the most growth rate during the test period.

Forestry Resource Data

Project Leader:
Dr. F. Peet

Professional:
Dr. Y.J. Lee

Objectives

To develop and test methodologies for simulating the growth of forest trees and stands; to promote metric conversion and the development of forest standards; and to develop and evaluate remote sensing methodology and relationships with information storage mediums.

Achievements

Remote sensing work continued in cooperation with the Canada Centre for Remote Sensing, the B.C. Ministry of Forests, the B.C. Ministry of the Environment, the Greater Victoria Watershed Forest and the B.C. Research Council. A new version of the OVAAC8 remote sensing software was obtained. The B.C. Forest Inventory Data was manipulated and put in a form suitable for the Canadian Forest Resource Data System in cooperation with the B.C. Systems Corporation and the B.C. Ministry of Forests. The project was terminated March **31,** 1982.

Regeneration and Silviculture Systems

Project Leader:
J.T. Arnott

Professionals:
Dr. S. Eis
A.C. Gardner
Dr. R.G. McMinn

Technicians:
D. Barwise
D. Beddows
D. Craigdallie
J.J. Dennis
G.J. Goodmanson
M.A. Grismer
M.T. Hughes

Objectives

To develop, test and demonstrate new nursery systems and improved methods of stand establishment and tending.

Achievements

High elevation species and stock type trials, run in co-operation with the B.C. Ministry of Forests, continue to be evaluated annually. Progress reports on this work are presented each year in the BCMF Forest Research Review.

Nursery research in the past year concentrated on problems associated with photoperiodism of white and Engelmann spruce when grown at coastal container nurseries. A host mycorrhizal dependency trial was conducted in the laboratory to determine the tree species with the greatest dependency on the mycorrhizal association. The mycorrhizal symbiont characterization continued and the culture collection expanded to 160 individual isolates. Mycorrhizal-inoculated stock trials at Williams Lake were measured and the results summarized.

Measurements of white spruce planted in plots treated by experimental site preparation methods showed that early gains continued to the tenth year following planting. The gap increased between growth on plots prepared by a mixing treatment (surface organic matter mixed into uppermost mineral soil to form a new organic matter enriched surface horizon) or by clipping to remove vegetation (simulating herbicide treatment) compared with no treatment or screefing off surface layers to expose mineral soil. Satisfactory survival and growth

were recorded for large styroplug or transplant white spruce in untreated sites despite dense competing vegetation. Equally satisfactory results were obtained on untreated sites with somewhat smaller stock when planted immediately after logging before vegetation encroachment had begun.

Ecological studies on the rate of vegetative reinvasion on alluvial sites following logging in the Prince George Region have been reported. If white spruce is planted immediately after logging on such sites, the tree seedlings have six to seven years before they are subjected to serious vegetative competition. Companion studies on the comparative growth rates of white spruce and lodgepole pine on such sites were also reported.

Tenth-year results from the bullet, plug and bareroot stock type trials were measured on the Kenneth Creek and Clucultz Lake test sites at Prince George. The second annual replication of the white spruce direct seeding and planting trials in the Yukon was evaluated for fifth-year survival and growth data.

The cooperative Levels-of-Growing-Stock (LOGS) Study is now into the third treatment period at Sayward Forest. The lower-quality site at Shawnigan Lake is still in its first treatment period and will not be thinned until the winter of 1982-1983. Results on this trial have been reported. A report covering results of all studies in this Canada/U.S.A. cooperative is presently in preparation.

Seedlings for regeneration are raised in styroblocks.

Tree and Seed Improvement

Project Leader:
Dr. D.G.W. Edwards

Technicians:
D. Craigdallie
J.F. Dronzek
A. Mitchell
F.T. Portlock
D.W. Taylor

Objectives

To enhance the quality and quantity of forest tree seed supply in British Columbia and the Yukon by improving methods for selection, breeding, production, procurement, processing and utilization and by developing and providing essential services for movement of seed in international trade.

Achievements

Biochemical investigation of seed characterization was continued with comparative analysis of lodgepole pine seedlots through isoelectric focussing of isozymes and terpenoid analysis; large populations of pine were re-examined with newly acquired isoelectric apparatus. This research has been suspended during the pursuit of a postgraduate degree by the study leader.

Certification of source-identified seeds under the Organization for Economic Cooperation and Development (OECD) Scheme accounted for 40 seedlots (168 certificates). These represented 1 **984** kg of seeds for the export market, estimated at $785,000 in overseas earnings. A 5-year report on OECD Certification was published, and a national list of seed orchards has been compiled. The biennial meeting in Paris of Designated Authorities under the OECD Scheme was attended.

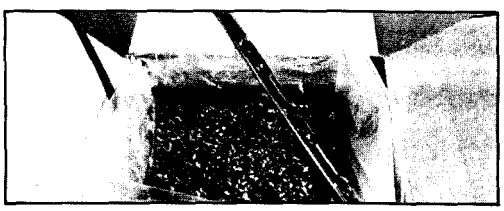
The Official Seed Testing Laboratory issued 150 certificates for export seedlots in accordance with the International Seed Testing Association (ISTA) rules. The PFRC Seed Laboratory participated in an international referee test on ***Pinus sylvestris***. Study leaders continued

to be engaged in development of Forest Tree Seeds Regulations for the Canada Seeds Act. They were also responsible for program development for the 18th Meeting of the Canadian Tree Improvement Association, including a symposium on seed orchards and a special workshop on seed technology in seed orchards. A CFS workshop was organized and held at PFRC to discuss and assign priorities for research and services in cone and seed problems.

Research into seed utilization continued to focus on ***Abies*** species; the feasibility of separating viable from nonviable seeds was tested, and a nursery trial of redried, stratified seeds was established in cooperation with the BCMF. Advice and services on a wide variety of topics, including seed quality assessment and seed and pollen supplies, were maintained.

Cone crop forecasting was terminated with the production of the **1981** Cone Crop Bulletin. A demonstration cone crop forecasting system was developed for major tree species in southern Vancouver Island, and methods for assessing cone resources of the Yukon were examined. Four species guides to identifying reproductive stages in conifers have been completed, and others are in preparation.

Management plans for ***in-situ*** and ***ex-situ*** conservation strategies for remote lodgepole pine stands were devised in response to requests from DIAND Northern Affairs Program.

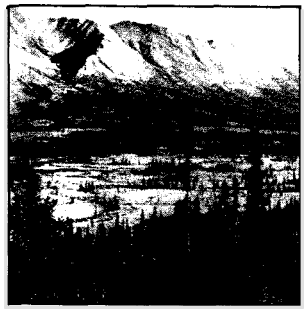


Official sampling of seeds of *Pseudotsuga menziesii*— Douglas-fir.

Forest Land Productivity

Project Leader:
Dr. E.T. Oswald

Technicians:
B.N. Brown
R.K. King



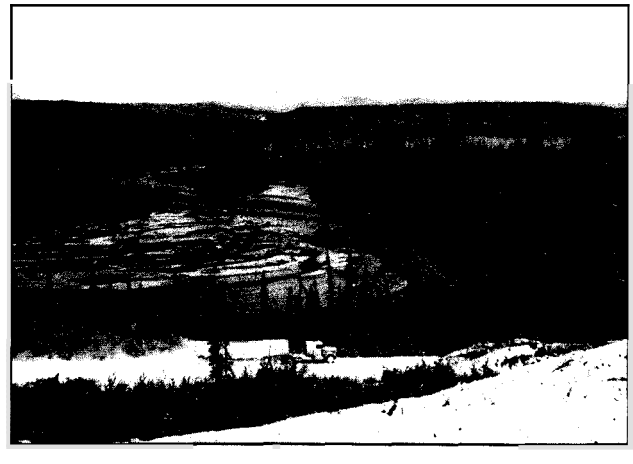
Ecological land surveys are conducted in remote Yukon areas such as these pictured here.

Objectives

To categorize and map the resources of the Yukon Territory into ecologically sound units suitable for integrated resource planning and management and to develop and maintain an information storage and retrieval system that can incorporate all resource data.

Achievements

Ecological assessments were conducted in the Yukon Territory with emphasis in Ecoregions **4,** 6, 7 and 8, using satellite imaging and field observations as the main data sources for present vegetation and forest potential, and in the MacMillan Pass area where an Ecological Land Survey was conducted. Most field data were placed in an information storage and retrieval system.



Management of Resources on Indian Lands

Project Leader:
J.P. Senyk

Objectives

To prepare an assessment of forestry opportunities on Indian lands of southwest Vancouver Island and to develop and put in place a well planned on-the-job training program for native people to cover the fields of forest nurseries, seed production, forest protection and integrated resource inventory.

Achievements

Contacts were maintained with the Nuu-Chah-Nulth Tribal Council and efforts directed to developing a management program tailored to their specific objectives. The project was terminated March 31, 1982.

A training program for native people was conducted at PFRC.

Fate of Nitrogenous Fertilizer Applied on Snow

Project Leader:
Dr. V.G. Marshall

Professionals:
G. Henderson
Dr. P.C. Pang

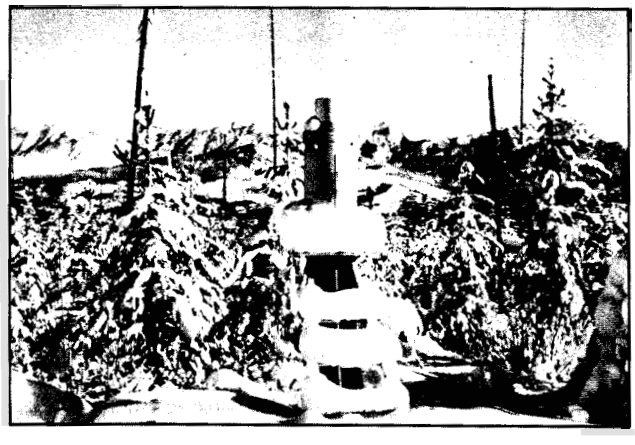
Technicians:
R. Benton
L. Bown
S. Reynolds

Objectives

To conduct field and laboratory experiments for assessing nutrient losses from application of urea and ammonium nitrate and to develop a decision-logic table for applying these fertilizers to forest soils.

Achievements

Samples of air (for ammonia), snow, soil, soil-water and plants were collected from the 15-N single-tree lodgepole pine plots at Spillimacheen (Interior British Columbia) and chemical analysis of these components continued. Douglas-fir plots were established at Green Mountain and at Sooke, Vancouver Island, and were fertilized with urea on snow. Urease activity was measured in one Coastal and two Interior forest types. The first annual report (fiscal **1980-1981)** was submitted to the BCMF and a manuscript on ammonia volatilization was prepared.



Meteorological measurements, as from this rain gauge, are automatically recorded by electronic data loggers.

Supporting Services

Chemistry

Head:
E.E. McMullan
(on sabbatical)

Objectives

To provide efficient, specialized services to the research and other operations of the centre.

Achievements

The analytical chemistry services continued to provide the required support for the research programs.

Computers and Statistics

Head:
Dr. F. Peet

Professionals:
S. Aylers
A. Erickson
Dr. J. Pannekoek
J. Partridge
D. Say
Dr. C.S. Simmons

Technicians:
J.E. Foster
M. Simpson

Objectives

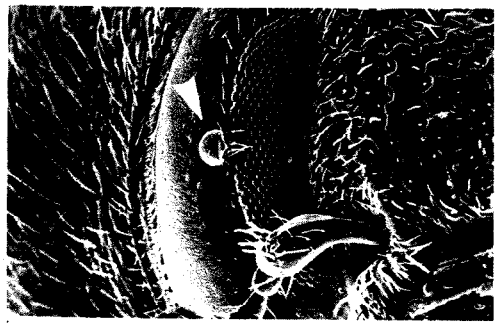
To provide an efficient and comprehensive facility for computation and information processing in order to satisfy the requirements of research and administration at PFRC.

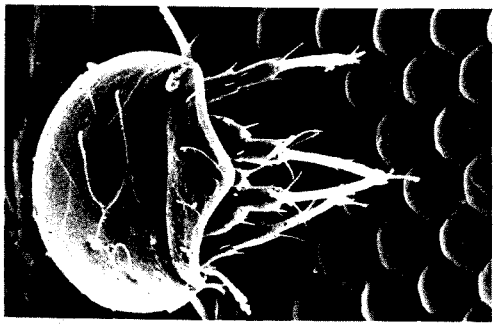
Achievements

The service was utilized by more than 70 research and support staff. The in-house system, a PDP 11/45, supported most of the work. A new operating system, compiler and utility programs were implemented. Improved operating procedures were developed. New terminals were acquired and installed.

Forest Protection

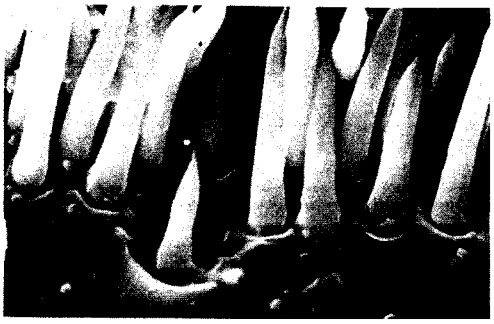
Dr. C.D.F. Miller • Program Manager





A scanning electron microscope (SEM) was purchased and installed during **1981-1982.** A unique feature of an SEM is its ability to scan the surface of a specimen with a beam of electrons and project an image of the specimen onto a fluorescent screen at magnification ranges from as little as 10 times magnification to more than **100** 000 times. The series of photos on the left show a mite on the eye of a bark beetle magnified **54** times in the top photo; magnified 100 times in the middle photo; and magnified **720** times in the bottom photo.

Bottom: The antennal club of a mountain pine beetle is shown here magnified 300 times and the photo of the sensory hairs on the antennal club is magnified 4400 times.



Bark and Wood-Boring Insects

Project Leader:
Dr. L. Safranyik

Professionals:
Dr. L.H. McMullen
Dr. H.A. Moeck
Dr. T.S. Sahota
Dr. D.M. Shrimpton
Dr. S. Whitney

Technicians:
R.E. Betts
A. Ibaraki
C.M. Lawko
D.A. Linton
L.E. Manning
O. Spanier

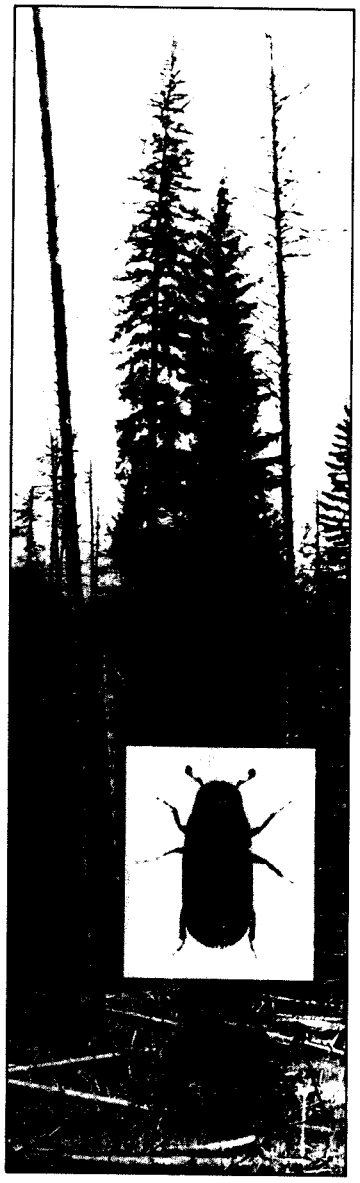
Objectives

To discover, develop and promote management guidelines to reduce losses from major bark and wood-boring insects.

Achievements

Thirteen scientific papers were prepared by project scientists on the biology and management of bark and ambrosia beetles and seven technical papers were presented at workshops, conferences and symposia on bark beetle management. Dr. Safranyik was senior author of a position paper on mountain pine beetle problems in the Rocky Mountain Parks region. Scientists and technical staff undertook a number of information transfer assignments–the highlights of which were: a two-day joint workshop at Fairmont Hot Springs, British Columbia, by scientists and resource managers from Canada and the U.S.A. on mountain pine beetle control and management; development of a sample survey procedure for assessing the need for felling trap trees in cutblocks to reduce attacks on living trees by spruce beetles; evaluation of the tree monkey (a debarking machine) for debarking standing, infested lodgepole pine; and Dr. Safranyik's chairmanship of an interagency technical committee on the mountain pine beetle, involving representatives from the two western provinces, the National Parks and CFS. Culmination of mean annual increment has been shown to be a reliable indicator of susceptibility of lodgepole pine to the mountain pine beetle. Field tests of primary attraction for the mountain pine beetle indicated that bark-free wood from freshly cut lodgepole pine was more attractive than fresh bark (including phloem) and that freshly tapped resin was somewhat attractive. A pine oil,

yarmore, as well as tall oil proved effective in preventing attacks on lodgepole pine by the mountain pine beetle. Yolk deposition rate, used initially in laboratory experiments to evaluate the reproductive potential of bark beetles, was used successfully for evaluating two field populations of the Douglas-fir beetle. An analysis of the spruce beetle population data indicated that, in addition to large beetle numbers, the other necessary condition for development of outbreaks in live trees is the availability of large-diameter, susceptible spruce trees.



Left: mountain pine beetle (insert) damage. Top: beetle galleries are uncovered. Bottom: a parasite of bark beetles—Coeloides sp.

Defoliating Insects

Project Leader:
Dr. R.F. Shepherd

Professional:
Dr. I. Otvos

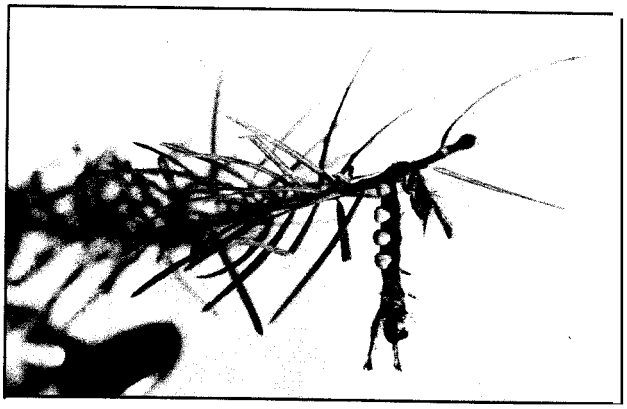
Technicians:
T.G. Gray
M. Talmon de l'Armee

Objectives

To develop pest management systems for the major defoliating forest insects.

Achievements

Early treatment of pre-outbreak populations of Douglas-fir tussock moth with a nucleopolyhedrosis virus proved that outbreaks could be prevented before significant damage occurred using a microbial specific to the pest concerned. Treatment using ground-based application equipment worked as well as the aerially-applied treatment. Detection and appraisal techniques for small, increasing populations are being developed to permit application of this early treatment.



Top: Virus-killed Douglas-fir tussock moth larvae.

Left: Ground application of a virus suspension.

Root and Stem Diseases

Project Leader:
Dr. G.W. Wallis

Professionals:
Dr. A. Funk
Dr. R.S. Hunt
G.D. Jensen
Dr. D.J. Morrison

Technicians:
D. Chu
H.M. Craig
A.L.S. Johnson
G. Reynolds

Objectives

To assess the significance of root and stem diseases as depletion factors in second-growth stands and, through biological and ecological studies of the fungi and hosts, to prescribe sound control procedures.

Achievements

Over 200 microfungi of trees, important to the general public as well as the forest community, are described in the book "Parasitic Microfungi of Western Trees". Three new microfungi were described during the year. A trial to determine if stumping infected sites is an effective method of controlling Armillaria root disease was established at Phoenix. Guides for the recognition of Armillaria and for the management of stands infected with this root disease were published. A study to determine the survival period of the black stain fungus in lodgepole pine stumps was initiated; preliminary results indicate the period is probably less than five years. Workshops and clinics on identification and management of root and stem diseases and identification of wild mushrooms for the general public as well as the forest community were conducted.

An area stumped to control root rot.

Pest Management Systems

Project Leader:
Dr. W.J. Bloomberg

Professionals:
Dr. L.H. McMullen
Dr. A.J. Thomson

Technician:
A.A. Hall

Objectives

To develop computer systems applications to management of four major insect and disease pests of forest stands.

Achievements

A dwarf mistletoe model has been validated for second-growth western hemlock on Southern Vancouver Island. A spruce budworm population dynamics and impact model with applications, as well as a root rot model, have been completed and published. The development of a dwarf mistletoe ballistics model has been completed and applied and control guidelines issued for a computer graphics system for topography display. On-line versions of root rot and dwarf mistletoe models have been developed for forest management and educational purposes. An impact analysis model has been developed for estimating insect and disease losses.

Dwarf Mistletoe

Protection of Seeds, Cones and Seedlings

Project Leader:
Dr. J.R. Sutherland

Professionals:
G. Miller
Dr. T. Sahota

Technicians:
W. Lock
D.S. Ruth
T.A.D. Woods

Objectives

To identify reforestation pest organisms or processes and determine the factors which enhance the pest and prescribe prophylactic measures; to define methods of maintaining reforestation losses to pests within economic tolerances; and to predict incidence resulting from specific conditions, situations or treatments in nurseries, seed production areas and seed orchards and recently reforested areas, i.e., climate or weather, soil types and tree species, sowing or planting, fertilizing and irrigation regimes.

Achievements

In 1981-1982, increased emphasis was placed on the ecology and population dynamics of seed and cone insects and use of pheromones for controlling important pests such as the Douglas-fir cone moth. In the insect diapause study, a new method was developed for dispersing cone scale nuclei for the purpose of digital scanning. It was discovered that the dormant developmental stage of Douglas-fir cone moth is unique among insects. Studies on moulding of container-grown and stored seedlings terminated. Preliminary studies were successfully completed on use of immunoassay techniques for detecting the seed-borne pathogen *Sirococcus*. Inland spruce cone rust studies dealt with disease control. Project personnel prepared 176 reports on nursery and seed orchard pests for user agencies, presented three research and two symposia papers before scientific audiences, and published five research papers and two symposia papers in scientific journals or proceedings.

Top Left: Seed orchard tree killed by root rot.

Left: Insects are reared for future studies.

Right: Cone and seed insect damage.

Host Tree Defense Reaction

Professionals:
Dr. H.A. Moeck
Dr. D.M. Shrimpton
G.D. Jensen

Technicians:
C.M. Lawko
L.E. Manning

Objectives

To describe three host defense processes in the tree and the interaction of these processes with root rot and bark beetles and to identify various stress conditions (biotic and abiotic) that affect these processes, thereby predisposing the tree to disease and insect infestation. To establish the presence, diurnal and seasonal variation in the ethanol content of bark and wood of white spruce and lodgepole pine and to determine its role as a bark beetle attractant.

Achievements

No significant achievements were made. The project was terminated.

Chemicals and the Forest Ecosystem

Project Leader:
Dr. J. Manville

Objectives

To assess the role of chemicals in host-pest interactions and to monitor the impact of certain herbicides on commercial conifers and other components of the forest ecosystem. This program will require extensive analytical chemistry to ascertain if external stimuli cause chemical changes to occur within plant material and to determine their extent and duration.

Achievements

Studies have been carried out on field application of the herbicide Round-Up (glyphosate) in order to ascertain the fate of this chemical applied to cool, moist forest soil and litter. The procurement of and setting up of an organic-analytical chemical facility is nearly complete. Studies in cooperation with other researchers have led to the development of an improved chemical lure for the European Pine Shoot moth, a pest of ornamental pine trees in British Columbia.

Big-lee maple one year a ter treatment with the herbicide glyphosate.

Plant Lipids As Control Agents

Project Leader:
Dr. G.S. Puritch

Technician:
W.J. Nijholt

Objectives

To (a) bioassay the effects of fatty acids and their derivatives alone and in combination with petrochemicals and biological agents on pathogenic fungi (especially *Botrytis, Ceratocystis* and *Fomes*), insects (especially *Lymantria, Operopthtera* and *Adelges*), and moss, algae and liverworts; (b) establish the feasibility of using these compounds operationally; and (c) investigate the role of fatty acid compounds as natural control agents in trees.

Achievements

Objectives (a) and (b) were achieved. A cryptocide called Safers **De-Moss** has been registered and is being marketed. The project was terminated.

Supporting Services
Microtechnique

Project Leader:
S.H. Farris

Objectives

To maintain on a continuing basis a microtechnique service capable of providing the required assistance to the various research programs at PFRC. To develop and refine skills in microtechnique needed in specialized research including ultramicrotomy.

Achievements

Microtechnique services:

Continued the ***Chrysomyxa pirolata*** system study on ***Byrola*** sp.

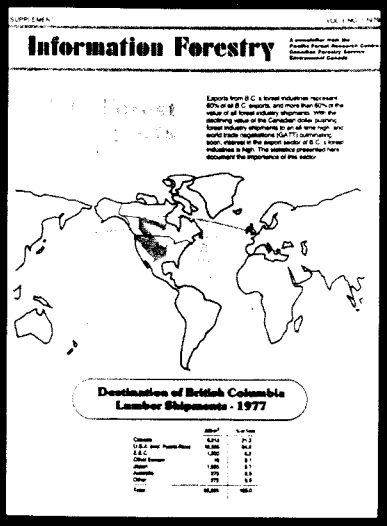
Commenced preparation of cone tissue re RNA synthesis in relation to diapause in sud-feeding insects, using Pectinase to facilitate nuclei separation from other tissues. Initiated preparation of two-year diapause ***Barbara colfaxiana*** fat body for microspectrophotometric scanning. Continued investigation and interpretation of *B.* ***colfaxiana*** pharat adults.

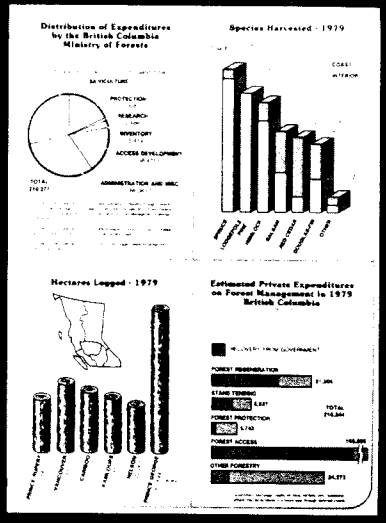
Commenced the histological examination of forest defoliators re RNA-DNA in a study of population quality as related to population dynamics in cooperation with Doctors Shepherd and Sahota.

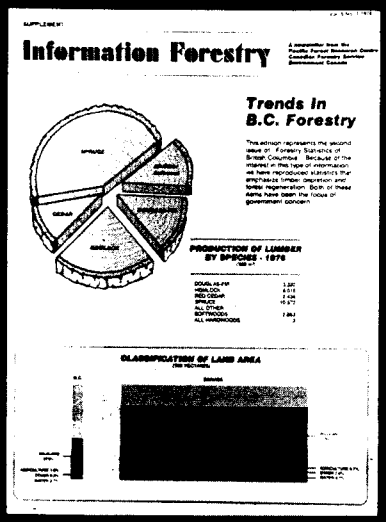
Completed preliminary histopathology of Rickettsia-like bacteria infection of maple petiols.

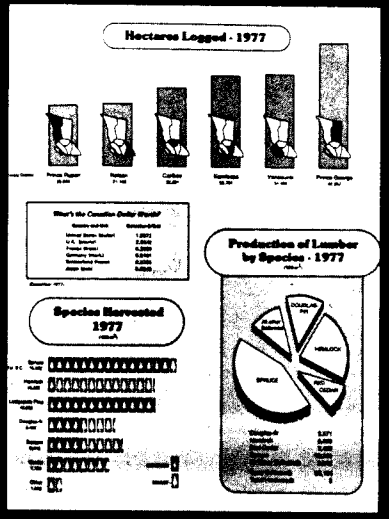
Forest Economics

Dr. G.H. Manning • Program Manager









Development of Economic Guidelines

Project Leader:
Dr. G.H. Manning

Professional:
W.A. White

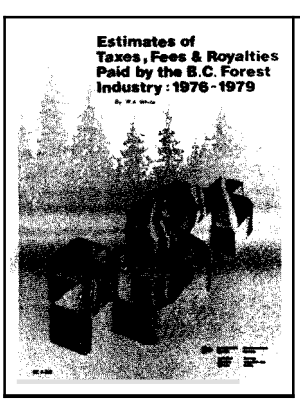
Technicians:
C. Macklin
J. Rudd

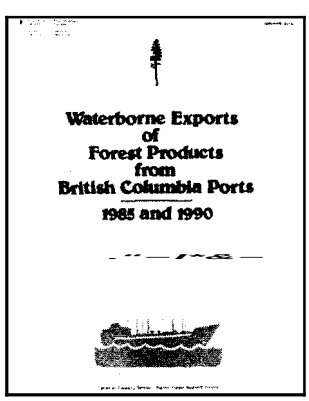
Objectives

To provide economics and policy advice to the department, its cooperators, and the management and staff of PFRC; and to improve the information base in forest economics.

Achievements

In 1981-1982, the staff of this project was brought up to full strength by the addition of one new forest economist. The major thrust of the project continued to be in support of the Canada/B.C. Forestry Subsidiary Agreement and provision of policy and economics advice and services to Canadian Forestry Service management. Project staff participated in the development of two discussion papers on the physical, economic and social impact of the mountain pine beetle, and in a Canada/US. workshop on mountain pine beetle problems. Studies were initiated on federal and provincial forestry revenues, on the relationship between economic cycles and government revenues, and on softwood lumber flows from British Columbia.





Energy From the Forest

Project Leader:
Dr. **G.H.** Manning

Objectives

To develop methodology to quantify the amount of forest biomass available for energy conversion in the Pacific and Yukon Region; to assess its cost in uses; and to assess the physical and socioeconomic impacts of its availability and use.

Achievements

Two studies were initiated in 1981-1982. The first of these was awarded as a contract to Forestal International for the development and testing of a forest residue slasher. The second was awarded to the B.C. Ministry of Forests to evaluate costs and benefits (including silvicultural benefits) of forest residue harvesting. The contract to develop tree weight equations for the Yukon, performed by Nawitka Renewable Resource Consultants of Victoria, successfully completed its second year and will be extended for a further year. The contract to develop a model to forecast slash remaining following logging, performed by Talisman Land Resource Consultants of Vancouver, has completed its second year and will be completed in 1982-1983. Two reports were issued: the first being an evaluation of the feasibility of a firewood business on Vancouver Island; and the second resulting from a contract by T. McDaniels Ltd. describing socioeconomic and institutional constraints to biomass utilization in British Columbia.

Administration

J.J. Ellis • Administrative Officer

Administration

Administrative Officer:
J.J. Ellis

Librarian:
A. Solyma

Finance Officer:
C.P. Sonders

Photographer:
A. Craigmyle

Administrative Support:
J. Anderson
B. Baker
J. Bethune
S. Cochrane
A. Couillard
L. Donk
P. Donovan
H. Gray
D.A. Greenway
H. Hendrickson
E.K. Hopps
R. Hughes
A. Inness
G. Kazmiruk
J. Kronstrom
H. Matson
M. Mitchell
S. Oliver
W.A. Pearce
J.R. Rafter
R.H. Reid
S. Reid
R.M. Richardson
J. Strobbe
B.J. Vander Heiden

Objectives

To provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide general administrative support services including materiel management, records management, secretarial services, vehicle fleet management and personnel services; and to provide physical facilities for the total centre and 11 field locations.

Achievements

Financial management and accountability was conducted in accordance with the objectives of the centre and all accounts were closed at the fiscal year end in a satisfactory manner. The Centre continued to maintain a high level of physical plant corrective and preventive maintenance. In this regard, a major foundation defect was corrected at the base of the north wing of the laboratory tower. The Energy Conservation program was maintained and a feasibility study was undertaken to determine if the hot water supply can be heated by solar energy. This study will continue into 1982. The Department of National Health and Welfare conducted a Health and Safety study of laboratory operations. As a result, steps have been taken to conduct a revised inventory of chemicals. Vehicle fleet management was maintained at 50 units with eight vehicles being replaced. Plans were made to convert several units to propane utilizing funds available through the Department of Energy, Mines and Resources. Heating oil consumption was maintained at base level and recorded at 42 K gallons.

Information Services

E.L. Teske • Information Officer

Information Services

Project Leader:
E.L. Teske

Professional:
S. Glover

Support:
B. Page
J.C. Wiens

Objectives

To provide the centre with editorial and graphic services; to act as the channel through which creative contact is maintained with the public, the forest community, national, regional and local news media, editors and printers; to produce booklets, news releases, exhibits; and to handle telephone and written enquiries.

Achievements

Provided the centre with editorial and graphic services; answered enquiries from clients; published four issues of "Information Forestry"; issued news releases and maintained media contacts; organized seminars and workshops; published the PFRC Annual Report; refurbished a mobile interpretation unit to compliment forest/nature trail and expanded trail facilities; provided tours of PFRC for 16 groups; participated in four major exhibits; edited over 125 articles for journals or research papers; organized international workshop on mountain pine beetle problems; and organized local arrangements for meeting of North American Forestry Commission.

Expenditures

PACIFIC FOREST RESEARCH CENTRE

1981-1982 **EXPENDITURES**

($ '000)

Program Area	Person Years	Salaries	Operation & Maintenance	Capital	Total
Forest Environment	38	1184.8	162.8	37.5	1385.1
Forest Resources	39	1255.3	149.5	60.5	1465.3
Economics	**4**	107.5	402.1*		509.6
Forest Protection	39	1306.3	155.4	15.1	1476.8
Directorate (includes Information Services)	**7**	256.7	134.9""	64.6	456.2
Administration	27	614.7	539.5	88.1	1242.3
Total	154	$4725.3	$1544.2	$265.8	$6535.3

• **includes Biomass project O&M only**
** **includes SYEP** O&M **only**

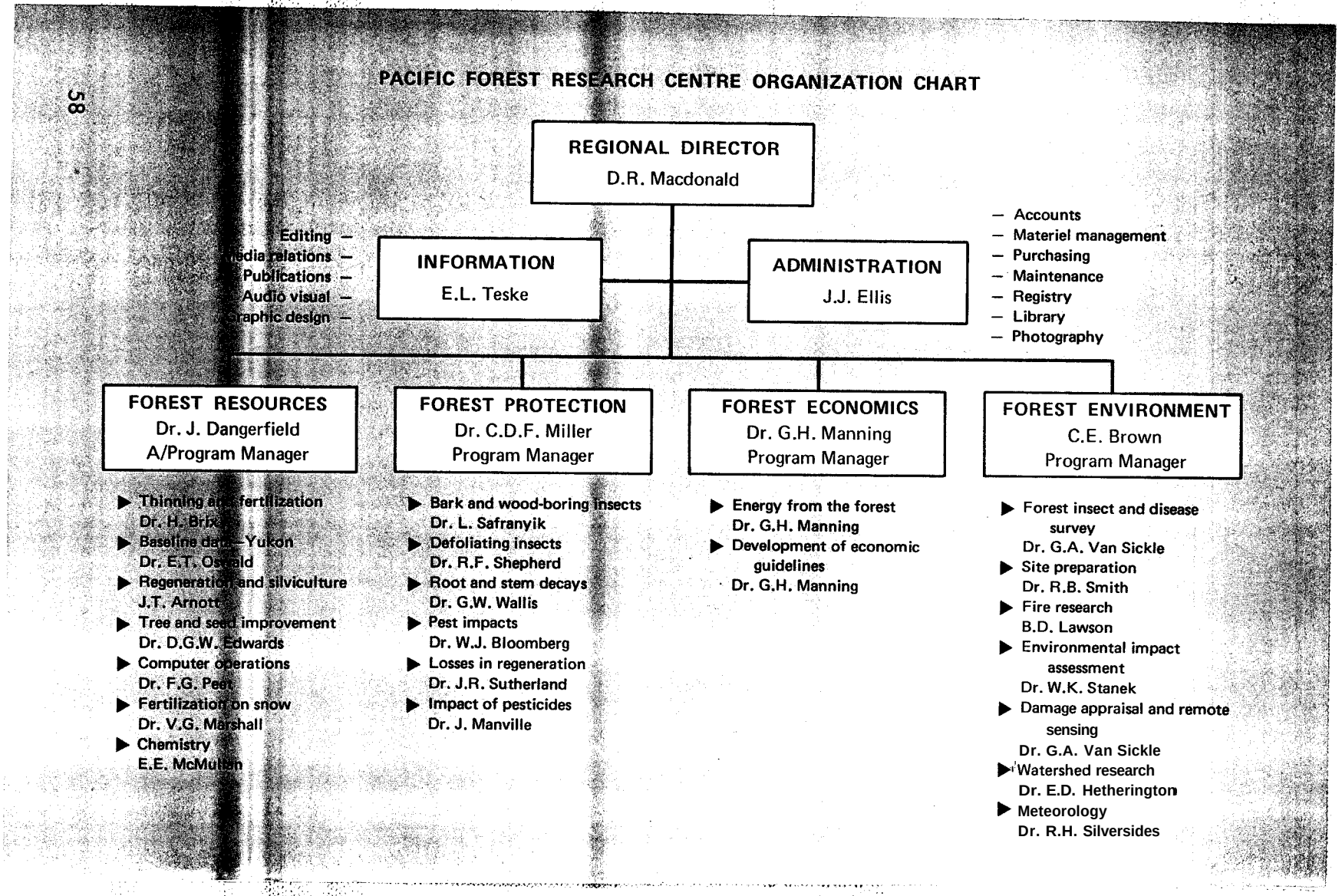
Contracts Let or Supervised

CONTRACTS LET OR SUPERVISED BY PFRC IN FISCAL YEAR 1981-1982

Contractor's Name	Contract Title	Amount
University of British Columbia 312-6344 Memorial Road Vancouver, B.C. V6T 1W5	Analysis of Conifer Root Extracts	$7,942
AMPA Associates Ltd. P.O. Box 6431, Station "C" Victoria, B.C. V8P 5M3	Assessment of Data Obtained on the Effects of Insecticidal Soap Treatments	$825
Her Majesty the Queen in the Right of B.C. Acting Through and Represented by the Ministry of Forests 1450 Government Street Victoria, B.C. V8W 3E7	Evaluation of the Productivity and Cost of HarvestingWet-Belt Cedar and Hemlock Biomass	$200,000
Forestal International Limited 1550 Alberni Street Vancouver, B.C. V6G 1A5	Development of a Field Treatment System for Logging Residues to Facilitate Transportation and Subsequent Conversion to Energy – Phase 2	$214,000
Pacific Soil Analysis Inc. 1560 Rond Avenue Vancouver, B.C. V6P 3G2	Soils Analysis Related to Forestry Management	$4,800
Nawitka Renewable Resources Consultants Ltd. 836-840 Cormorant Street Victoria, B.C. V8W 1R1	Development of Biomass Prediction Equations for Yukon Tree Species	$146,657
Talisman Projects Inc. 1313 West Pender Street Vancouver, B.C. V6E 2V9	Development of a System to Estimate Quantity of Biomass Following Logging in B.C. Forest to Specified Recovery Criteria – Part of the Energy From the Forest Program (ENFOR)	$414.538

Organization Chart

PACIFIC FOREST RESEARCH CENTRE ORGANIZATION CHART



Publications

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and J.H. Borden. **1980.** Predation by Lonchaea *corticis* (Diptera: Lonchaeidae) on the White Pine Weevil, ***Pissodes*** srrobi (Coleoptera: Curculionidae). Can. Ent. 112:1259-1270.

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Le Service canadien de forêts

Le Service canadien des forêts réunit la majorite des specialistes fédéraux en foresterie. Son objectif general est de promouvoir l'amenagement et l'utilisation judicieux des ressources forestières du Canada pour le plus grand bien économique, social et environnemental des Canadiens.

Voici les principales fonctions du SCF: coordonner les politiques federales afin de favoriser l'amelioration de la gestion des ressources et l'expansion de l'industrie forestière; fournir une orientation scientifique et technologique dans le domaine de la foresterie, par la recherche et le developpement; fournir et analyser les statistiques et l'information nationales et internationales qui serviront a etablir les politiques; mettre au point et homologuer des codes et des normes en matière de rendement des produits du bois; proteger les forêts canadiennes et luttant contre les ravageurs etrangers; parrainer l'utilisation éventuelle des ressources forestieres pour la production d'energie; adherer aux objectifs environnementaux du ministère de l'Environnement.

Divers organismes fédéraux participent aux programmes forestiers, et un Comite de la strategie forestiere federale a ete créé pour coordonner les activités fédérales en matière de foresterie. Le Service canadien des forêts a été désigné organisme directeur.

Le Service canadien des forêts comprend une administration centrale, 6 centres de recherches forestières et 2 instituts nationaux. L'administration centrale comprend trois directions generales: direction générale de planification, finance et administration; direction générale des politiques et de l'économie; direction générale des recherches et des services techniques.

Les centres de recherches forestieres doivent reprondre aux imperatifs régionaux et entretenir une liaison etroite avec les ministères provinciaux des Forêts. Ils participent également A des programmes nationaux dont ils assument fréquemment la direction: le Centre de recherches forestieres du Pacifique, à Victoria (C.-B.); le Centre de recherches forestieres du Nord, 8 Edmonton (Alberta); le Centre de recherches forestieres de Grand lacs, à Sault-Sainte-Marie (Ontario); le Centre de recherches forestieres des Laurentides, 8 Sainte-Foy (Quebec); le Centre de recherches forestieres des Maritimes, à Fredericton (N.-B.); le Centre de recherches forestieres de Terre-Neuve, 8 Saint-Jean (T.-N.).

Les instituts nationaux sont les foyers des programmes d'envergure nationale: l'Institut forestier national de Petawawa, à Chalk River (Ontario), et l'Institut de lutte control les ravageurs forestiers, à Sault-Sainte-Marie (Ontario).