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PACIFIC FOREST RESEARCH CENTRE
506 WEST BURNSIDE ROAD
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THE CANADIAN FORESTRY SERVICE

ENVIRONMENT CANADA

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

The following are the main functions for the CFS:

1. Coordination of federal policies, in the promotion of better resource management and forest industry development.

2. Provision of scientific and technological leadership in forestry through research and development.

3. Provision and analysis of national and international statistics and information as a basis for policy formulation.

4. Development and certification of codes and standards for wood product performance.

5. Protection of Canada's forests from foreign pests.

6. Fostering the potential use of the forest resource for energy.

7. Contributing to the environmental objectives of the Department of the Environment.

A number of federal agencies are involved in forestry programs and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The Canadian Forestry Service has been designated the lead agency role.

The Canadian Forestry Service is comprised of a Headquarters Unit, six Forest Research Centres and two National Institutes. The Forest Research Centres are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments and other clients. They also participate in, and frequently lead, national programs. The National Institutes provide the focus for programs of national scope. The chart on the inside back cover provides additional details.

SERVICE CANADIEN DES FORÊTS

ENVIRONNEMENT CANADA

L'énoncé qui suit est présenté à titre d'introduction pour les rapports annuels qui doivent être préparés par les établissements du SCF. Ce sujet a fait l'objet de discussions pendant les deux dernières réunions du Comité des directeurs d'établissement.

Le Service canadien des forêts réunit la majorité des spécialistes fédéraux en foresterie. Son objectif général est de promouvoir l'aménagement 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:

1. Coordonner les politiques fédérales afin de favoriser l'amélioration de la gestion des ressources et l'expansion de l'industrie forestière.

2. Fournir une orientation scientifique et technologique dans le domaine de la foresterie, par la recherche et le développement.

3. Fournir et anlyser les statistiques et l'information nationales et internationales qui serviront à établir les politiques.

4. Mettre au point et homologuer des codes et des normes en matière de rendement des produits du bois.

5. Protéger les forêst canadiennes et luttant contre les ravageurs étrangers.

6. Parrainer l'utilisation éventuelle des ressources forestières pour la production d'énergie.

7. Adhérer aux objectifs environnementaux du ministère de l'Environnement.

Divers organismes fédéraux participent aux programmes forestiers, et un Comité de la stratégie forestière fédérale a été créé pour coordonner les activités fédérales en matière de foresterie. Le Service canadien des forêts a été désigné organisme directeur.

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Introduction

This report summarizes the research and service program of the Canadian Forestry Service in the Pacific and Yukon region during fiscal year 1980-81.

The major activity is the conduct of forest research to improve the knowledge and understanding of the forests and the practice of forestry in the region for the benefit of all Canadians. Other activities are directed toward providing technical support and advice to other federal agencies and the many clients of the Canadian Forestry Service and to providing a forestry perspective to the activities and responsibilities of the Department of the Environment in the region. The program is organized into five major areas.

FOREST ENVIRONMENT. Federal responsibilities in the Forest Insect 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 B.C. 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, 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 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.

FOREST PROTECTION. Research and operations include studies of insect and disease influences and forest depletion including development of pest management strategies and guidelines, and the development of guidelines for the recognition, control and prediction of growth of stem disease.

ADMINISTRATION. The administrative section provides a system of financial control and accountability in accordance with statutory and regulatory requirements. It also provides the general support services to the regional program including material management, library services, records management, secretarial services, photographic services, vehicle fleet management and personnel services and operates and maintains the physical facilities of the Pacific Forest Research Centre and the 11 field locations.

During this reporting period there were three changes in the regional management group. Dr. Glen H. Manning was appointed Program Manager, Forest Economics. Dr. T.C. Honer, Program Manager, Forest Resources and Acting Director from January 1979 to June 1980 was seconded to Canadian Forestry Service Headquarters to develop and direct the Forest Resource Data and Systems program and Dr. J.A. Dangerfield was appointed as the Acting Program Manager Forest Resources. D. Ross Macdonald was appointed Regional Director.

D. Ross Macdonald
Regional Director
Pacific and Yukon
March 31, 1981.

Forest Environment

PROJECT PC-02

Forest Insect and Disease Survey

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

Achievements: The annual monitoring and assessment of regional forest pest conditions was conducted and results published. Aerial surveys revealed significant lodgepole pine mortality on more than 156 750 ha resulting from mountain pine beetle attack. Spruce beetles continued to kill mature spruce on more than 64 000 ha in the Prince George Region; elsewhere in B.C. 16 000 ha were affected although these infestations were generally declining. Western spruce budworm-caused defoliation continued in parts of the Fraser Canyon and the western portion of the Kamloops Region, totalling 81 400 ha up from 49 000 in 1979. A different, two-year cycle budworm caused mostly light or moderate defoliation over 365 000 ha in south central B.C. Root rots and dwarf mistletoes continue to be major forest disease problems. Seed and cone pests rendered more than 60% of the sampled stands unsuitable for seed collection. As part of the extension and liaison services staff members contributed to numerous pest advisory committees and presented lectures to provincial government and industry personnel as well as community organizations and educational institutes. Requests from the general public for pest identification and recommendations numbered more than 1800.

PROJECT PC-25

Effects of Harvesting and Site Preparation Practices on Forest Resources and Values

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 required.

Achievements: Data on height-growth rates of trees growing on skidroads constructed during post-wildfire salvage operations were published along with a scheme to rate sites on their sensitivity to soil disturbance. Detailed field tests and soil sampling were conducted on skidroad soils in 3 areas on which tree growth was previously studied. Significantly higher soil bulk densities and strengths (resistance to penetration) occur on skidroads than adjacent undisturbed soils. Laboratory analyses of collected soil samples are in progress.

A preliminary examination was made of a root-rot control area from the point of view of potential damage to soil from the stump pulling and root raking operations.

Advice and services functions continued. Forest land management data was gathered in respect to the forestry proposal portion on an Indian land claim. Data on streamflow nitrogen loss following forest fertilization, southern Vancouver Island, were presented at a Northwest Scientific Association meeting.

PROJECT PC-30

Fire Research in Support of Improved Forest Resource Management

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 through development of improved ignition systems.

Achievements: New studies were initiated in cooperation with Parks Canada and with the B.C. Ministry of Forests to investigate fire effects in Yukon and northern B.C. ecosystems. Both studies are geared to the particular land management needs and objectives of those agencies in the northern portion of P & Y Region. The Parks Canada study will document fire's role in the landscape of Kluane National Park, Yukon and will provide part of the information base for a fire management plan for the park. The northern B.C. fire ecology study, in cooperation with BCMF, has documented the ecological role of fire in the ecosystems identified in the Fort Nelson Timber Supply Area. Final reporting of the study findings will be done upon completion of another field season's work in two other northern B.C. TSA's -- the Cassiar and MacKenzie. A workshop was held in Prince George to disseminate first year study results.

Studies on fire hazard appraisal and fire management implications of intensive silvicultural treatments were completed jointly with BCMF and revised guidelines and study methodology reports are being finalized. Symposium and workshop presentations were given during the year.

Safe practices in the use of aerial ignition systems, including the PFRC AID System, were examined by a committee which included representation by PFRC fire staff. Increasing use of the AID System in both prescribed fire ignition and wildfire control was seen throughout the country during the past year, especially in B.C. for prescribed burning and in the Northwest Territories, Prairie Provinces and Ontario for burning out fire control lines from the air.

PROJECT PC-43

Environmental Assessment

Objectives: To fulfill federal responsibilities with regard to the Environmental Assessment and Review Process (EARP), 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 were environmental impact statements of the gas pipelines (Alaska Highway and Dempster Highway), oil pipelines (Trans Mountain's, Foothills' Skagway and overland routes, and Kitimat's), Queenstake Dredging Proposal and Foothills' Revegetation Program for Alaska Highway; Initial Environmental Evaluation (IEE) was completed for Canada – B.C. Subsidiary Agreement on Intensive Forest Management: consultations (mining,

PROJECT PC-56

Carnation Creek Experiment Watershed

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 2 years pre-logging and over 2 years post-logging measurements for the major slope hydrology study area. Early results indicate marked effects of clearcutting on groundwater levels. Mineral soil exposure, characteristics of the organic horizon, presence of bare rock and other surface soil features have been recorded for 6 clearcut blocks, some before logging, after logging and after prescribed burning. Revegetation of clearcuts following logging is being monitored in permanent plots. With new installations in 1980, 8 units are now being monitored. Two of these have their first 3-year sampling cycle completed. A system for data storage and analysis is handling the periodic resurveys.

PROJECT PC-62

Damage Appraisal and Remote Sensing

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 co-operation 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.

Achievements: This new project in 1980 emphasized and brought together work on large scale aerial photography and the assessment and quantification of growth reduction and tree mortality caused by forest pests. A professional to continue the loss measurement study was recruited and a model incorporating the effects of budworm on tree growth was published. Long established plots involving several pests were reassessed. Aerial photography and supporting ground truth were obtained for selected stands affected by western spruce budworm and moutain pine beetle. A pictorial guide to defoliation levels is

reserves, logging, pollutants) were provided; many confidential reports and reviews (DOE Task Force; Northern Pipeline Agency) were written. Three major reports on vegetation types and environmental factors and 28 vegetation type maps were completed. Scientific authority was provided for 11 PFRC contracts.

With the exception of possible attendance at a future EARP public hearing,the Alaska Highway Foothills Gas Pipeline study was completed.

Reviewed the revised environmental impact statement by Foothills Gas Pipe Lines (Yukon) Ltd. and monitoring of the proponent's (Foothills) post-construction phase.

PROJECT PC-46

Improved Use of Meteorology in Forestry

Objectives: To have acquired an applied meteorological knowledge to assist in the solution of forestry and environmental problems in the Pacific Region. In the shorter term, to have developed guidelines for the optimum siting of weather stations, to develop or adapt meteorological equipment to forestry situations, and, to have tested one or more models which simulate climatic influences.

Achievements: Work is continuing on adapting numerical wind models to forestry problems such as budworm dispersal and smoke management. Field experiments have concentrated on obtaining some of the data base required for the modelling studies.

A modest level of instrument development has been carried out in order to be cognizant of current technology in instrumentation, and to be able to make recommendations on meteorological instrumentation to suit forestry needs.

being compiled. The numbers of dead and attacked trees in ground and photo plots are being analysed.

SUPPORTING SERVICES (CHEMICAL)

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.

Forest Resources

PROJECT PC-23

Growth and Biology of Coastal Douglas-fir Ecosystems in Relation to Stand Tending

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 based thereon, to develop a comprehensive model for growth prediction.

Achievements: Research continued on thinning and 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 further development of a model on stand management effects on stand growth. Field sampling was completed at the Shawnigan installation for a study on tree biomass and nutrient content nine years after thinning and fertilization treatments.

Plots fertilized in spring of 1972 were re-fertilized in March 1981 with the same rates as applied originally, whereas those treated in 1971 will not be re-treated and serve as control for study of re-fertilization response.

The Shawnigan installation has become a popular site for demonstration of thinning and fertilization effect on stand growth and discussions of associated research programs. Thus, in the past year 14 tours were conducted with a total of 175 visitors from many countries.

PROJECT PC-39

Operations Research Techniques for Forestry Resource Data

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; 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. A report on the non-visual sensing of stress-affected trees was prepared. Work on data base systems continued. Liaison was maintained with the Western Forestry Conservation Association. The project leader's position was advertised and staffed.

PROJECT PC-48

Regeneration and Silviculture Systems: Pacific and Yukon Region

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

Achievements: Patentability of a new "spread-plate" container is being explored along with candidate manufacturing methods and materials. The basic design still needs modification before tooling and mass manufacture is warranted.

The last phase of the current series of high elevation species and stock type trials, run in cooperation with the B.C. Ministry of Forests, was completed in the spring of 1980. Eight species, three stock types (1-0 PSB 211, 1-0 PSB 211 + 1, and 1 + 1 transplants) and two planting seasons are being investigated to determine the best planting option on high elevation forest sites. Douglas-fir, amabilis fir, noble fir, western hemlock, western red cedar, and western white

pine are being tested in the montane wetter maritime coastal western hemlock biogeiclimatic subzone. Mountain hemlock, yellow cedar, amabilis fir and noble fir are also being appraised for outplanting in the maritime forested mountain hemlock subzones. Twelve test sites, with a total of 48 experimental plantations containing 36,000 seedlings have been established in this study which is being monitored annually.

Field trials of a site preparation machine developed in the B.C. Ministry of Forests showed that design modifications are necessary to obtain a consistently high percentage of inverted patches capped by mineral soil suitable for planting in moist, fertile, interior spruce sites. The machine is designed to produce the type of planting spot that experimental preparations showed give superior outplant performance. Measurements of field performance of various types and sizes of white spruce stock in untreated sites two years following outplanting showed that high or low root growth capacity predicted survival and growth somewhat independently of morphological parameters.

Field trials of bullet and plug reforestation systems in the Prince George Region were measured for 10th year survival and height development. Results will be presented at the Canadian Containerized Seedling Silviculture Symposium, September 1981.

The first installations of mycorrhizal inoculated stock were measured to evaluate three-year response and results are being summarized in preparation for reporting. Two new experimental plantings were established at Naramata and Williams Lake. A large greenhouse trial to assess seed source variation in compatibility with a selected mycorrhizal former was undertaken for the Alberta Forest Service.

The first installations of white spruce direct seeding and planting trials in the Yukon were measured to evaluate fifth-year response. Third-year results of the entire trial have been reported. Information from this study will be incorporated into a bulletin on regeneration of white spruce in Alaska and the Yukon Territory to be produced by the International Committee on Regeneration of North Latitude Forest Lands.

A field trial to demonstrate the applicability of utilizing large scale aerial photography for monitoring regeneration on river flood-plains and for gathering empirical data on stocking status of logged-over and burned-over areas in the Watson Lake area was completed in 1981. The technique was applied successfully and results will be incorporated into the spruce regeneration bulletin mentioned above.

PROJECT PC-49

Tree and Seed Improvement, B.C. and Yukon Conifers

Objectives: To enhance the quality and quantity of forest tree seed supply in B.C. and the Yukon through 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: Arrangements were secured for preparing the Western Hemlock Provenance Experiment for measurement of 10-year growth in 1981; 2250 sample trees were measured and relabelled at the Gold River test site. Within- and among-family variances were appraised from early tests in controlled environments.

Experiments into the influence of gibberellins, water stress and temperature on flower production in hemlock were measured and revealed strong effects of practical significance. New experiments were initiated into a combination of temperature and photoperiod treatments, optimum timing and frequency of gibberellin treatments, and the effects of fall temperatures on flowering response.

Certification of source-identified seed under the Organization for Economic Cooperation and Development (OECD) scheme accounted for 30 seedlots (139 certificates). These presented 1610.6 Kg of seed for the export market. The Certifying Officer was Canadian delegate at the IUFRO Lodgepole Pine Meeting in Norway/Sweden, August 1980, and was nominated co-chairman of the working party.

The Official Seed Testing Laboratory issued 26 orange certificates and 56 blue certificates for export seedlots in accordance with International Seed Testing Association (ISTA) regulations. A further 500 tests were conducted on seedlots in support of reforestation and research programs. A draft set of Regulations for Forest Tree Seeds, pertaining to the Canada Seeds Act, were completed, together with a schedule for domestic certification of seeds. The ISTA Certifying Officer played a leading role in a IUFRO-sponsored seed technology workshop in Mexico.

Further progress was made in the prescription of methods for storing prechilled seeds, and for improving germination in *Abies* and other species through pretreatment and separation of less vigorous seeds. Osmotic priming has also been investigated. An extensive collection of *Alnus* seeds was made on Vancouver Island and has been distributed to several agencies requesting such seed.

A large number of lodgepole pine seed collections were made and examined to evaluate the discriminatory effectiveness of iso-elective focussing and terpenoid characterization.

A cone-crop bulletin was issued for the Region, and bud-identification sheets were completed for four major species. A new study of lodgepole pine seed resources in the Yukon was initiated.

Study leaders played key roles in developing programs for meetings of the Canadian Tree Improvement Association and the Western Forest Tree Seed Council.

PROJECT PC-52

Forest Land Productivity, Pacific and Yukon Region

Objectives: To categorize and map the resources of the Yukon Territory into ecologically sound units suitable for integrated resource planning and management; 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 1, 2 and 3 where satellite imagery was used to map present vegetation and assess forest capability, and in the East Kluane planning area where the vegetation was evaluated in relation to urban and rural development and environmental and resource assessment.

PROJECT PC-55

Integrated Management of Resources on Indian Lands

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: All available background information to aid in an ecological land classification exercise has been gathered. Aerial photography at various scales has been obtained for one reserve within the test case area.

Three Indian students from the Similkameen Band spent 12 weeks at PFRC receiving training in forest protection. Technical advice on alder management was provided to the Nuu-chah-nulth Tribal Council who are developing a forest management program for some of their reserve land.

PROJECT PC-57

Fate of Nitrogenous Fertilizer Applied on Snow

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: This BCMF-CFS project was initiated in 1980. Twenty-four field plots were established near Spillimacheen and instrumented to collect data on volatilization; nutrient movement in snow, water, soil and trees; and meteorological information relative to the interpretation of nutrient movement and tree growth. Eighteen single-tree plots were fertilized with 15-N tagged nitrogen and data collection is in progress. A preliminary report was submitted to the BCMF.

SUPPORTING SERVICES (COMPUTER)

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 PDP11/45 has supported the majority of work and using multiple interactive terminals, and batch processing, has logged an average workload of 14,000 tasks per month.

Forest Protection

PROJECT PC-06

Reduction of Losses from Bark and Wood-boring Insects

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

Achievements: Ten scientific papers were published on the biology and management of bark and ambrosia beetles. Project scientists and technical staff undertook a number of information transfer assignments, the highlights of which were the two-day spruce beetle workshop in Prince George, B.C., and the training of three DINA students in bark beetle biology and management. Work continued on testing pine oil and one of its fractions, -terpineol, for protecting host material against ambrosia beetles and the mountain pine beetle and, in a new study, against Douglas-fir and spruce beetles. Excellent protection was achieved against all test insects, pine oil was more effective than -terpineol. It was found that logs infested with spruce beetles required at least 35 days of complete submersion in water to achieve complete mortality of broods. In experiments testing the effects on emergence of burying infested logs in soil, mountain pine beetles readily emerged from logs buried 5 and 10 cm deep and some beetles emerged from a log buried 40 cm deep. Preliminary results with soaking logs infested by mountain pine beetle indicated that this procedure could be highly effective in destroying beetles and in reducing emergence from logs or log decks. Field testing of the pathogenic fungus *Beauveria* spp. against mountain pine beetle, studies of bark beetle population quality, the nature of host resistance, and primary attraction continued. Work commenced on analysis of the spruce beetle population data and development of guidelines to reduce losses.

PROJECT PC-08

Reduction of Losses from Defoliating Insects

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

Achievements: The relationship between altitude, climate, host tree phenology and spruce budworm emergence were determined and should provide a better predictive capability of insect trends. Pheromone monitoring systems showed the low-density population trends of a number of defoliators. Effects of NP Virus and *Bacillus thuringiensis* carried over one year but not two when applied to small plots of spruce budworm.

PROJECT PC-13

Reduction in Losses from Root Rot and Stem Diseases In Second-growth Stands

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, prescribe sound control procedures.

Achievements: A book "Parasitic microfungi of western trees" has been completed, ready for publication. A brochure "Tree hazards in recreation sites in British Columbia: management guidelines" which describes a rating system, causes and abatement for hazard trees was published. Two new species of parasitic fungi were described on coniferous trees in British Columbia. Tests showed that zinc sulphate was an effective stump treatment to prevent infection by *Fomes annosus* root rot.

PROJECT PC-40

Development of Pest Management Systems

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

Achievements: A phellinus root rot model has been tested and integrated with the stand growth model BUSH. A spruce budworm population dynamics and impact model with applications, as well as a root rot model, have been com-

pleted 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.

PROJECT PC-44

Protection of Seeds, Cones and Seedlings from Insect and Disease

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: Research achievements during the year included (i) development of a gel electrophareris for rapidly and accurately identifying *Caloscypha fulgens* - infested seedlots from pathogen - free ones, (ii) adding information on the incidence, biology and histopathology of *Sirococcus strobilinus* - diseased seeds and infested seedlots, (iii) significant findings were made on the impact of Inland spruce cone, (iv) determination of isozyme profiles of hormone treated (and control) Douglas-fir cone tissue (in the cone and seed insect diapause study), (v) identified the pheromone for the Douglas-fir cone moth and initiated work on using it in seed orchard management, and (vi) made significant progress on studies of gall midge biology. In technology transfer, over 130 replies were made to user agencies in 1980. Also completed were eight research publications, one file report and two important technology - transfer bulletins, i.e., by D.S. Ruth (A Guide to Insect Pests in Douglas-fir Seed Orchards) and J.R. Sutherland and E. Van Eerden (Diseases and Insect Pests in British Columbia Forest Nurseries). Mr. G. Miller (cone and seed insects) replaced Mr. A. Hedlin who retired after an outstanding research career.

PROJECT PC-50

Utilization of the Host Tree Defense Reaction as Natural Control Mechanisms for Forest Pests

Objectives: To have: (a) described 3 host defense processes in the tree and the interaction of these processes with root rot and bark beetles and to have identified various stress conditions (biotic and abiotic) that affect these

processes, thereby predisposing the tree to disease and insects infestation: (b) established the presence, diurnal and seasonal variation in the ethanol content of bark and wood of white spruce and lodgepole pine and determine its role as a bark beetle attractant.

Achievements: Studies were completed on the effect of set levels of water stress on the cellular reactions involved in non-specific healing reactions of *Abies* seedlings. The phellogen restoration process was characterized in Douglas-fir roots at various times of the year and *Phellinus weirii* - tree interactions studied through innoculations done in April, June and August. The requirement for research into the "spots only" response of white pine to *Cronartium ribicola* (white pine blister rust) was evaluated and presented in a file report. Analysis of ethanol in tree tissues established that the ethanol did not originate from readily cultured microorganisms. An overview and synthesis of Dr. D.B. Mullick's concepts of non-specific healing reactions in trees was presented to an IUFRO conference on "Genetics of Host-Pathogen Interactions in Trees" held in Wageningen, Holland. Consultation and direction was provided to the Southern Appalachian Research/Resource Management Cooperative for dealing with balsam woolly aphid infestation on Fraser fir in the Appalachian Mountains.

PROJECT PC-51

Impact of Pesticides on Forest Ecosystems

Objectives: To assess the impact on the forest ecosystem of the more common pesticides used to manage forest pests in B.C. and the Yukon.

Achievements: As this is a new study a research proposal has been developed to assess the impact of pesticide use in the forest ecosystem. The planned program will require extensive analytical chemistry to ascertain sub-lethal chemical changes occurring within plant material caused by the unavoidable contact of herbicide applications. This study will also determine the extent and duration of such induced chemical changes occurring in crop trees. These studies are designed to provide new knowledge that will help forest managers to select herbicides that have the lowest adverse impact on the cash crop (i.e., conifers that are being released).

PROJECT PC-58

Plant Lipids as Control Agents

Objectives: To have: (a) Bioassayed the effects of fatty acids and their derivatives alone and in combination with petro-chemicals and biological agents on pathogenic fungi, especially *Botrytis, Ceratocystis* and *Fomes;* insects, especially *Lymantria, Operopthtera* and *Adelges;* and moss, algae and liverworts. (b) Establishing the feasibility of using these compounds operationally. (c) Investigated the role of fatty acid compounds as natural control agents in trees.

Achievements: The Insecticidal Soap (IS) formulation was tested and recommended by the B.C. Ministry of Agriculture (BCMA) for treating balsam woolly aphid while an IS-methoxychlor formulation was recommended by BCMA for wintermoth control. A cooperative project with industry (COPI) contract was negotiated with a private company to commercialize three fatty acid based pesticides *viz.* cryptocide for control of moss, algae and liverworts, IS - methoxychlor formulation for defoliators and an adjuvant. An unsolicited research contract was awarded to Retech Ltd., Victoria, B.C. for development of a fatty acid based systemic fungicide. Bioassays were completed on several fatty acid derivatives for *Botrytis cinerea* control and storage tests established. The final treatment for *Fomes annosus* root rot control was evaluated. Analysis of IS effects of white fly and its parasitoid *Encarsia formosa* were completed and tests on potted plants planned for next spring.

PROJECT PC-61

SUPPORTING SERVICES (MICROTECHNIQUE)

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 service was provided to three projects, encompassing six studies as follows:

Service to PC-44-246
Completed - microtechnique work concerning *Sirococcus* blight of container-grown spruce seedlings.

Completed - microtechnique aspects of seed-invading fungus, *Caloscypha fulgens.*
Continuing - microtechnique aspects re *Chrysomyxa pirolata* systemic study on *Pyrolata sp.*

Service to PC-44-161
Completed - microtechnique work with *Botrytis cinerea* infected western hemlock as requested.

Service to PC-06-033
Completed - whole cell preparations of bark beetle fat body and testis re RNA synthesis for scanning-microspectrophotometry.
Completed - sectioning and staining of bark beetle tissue for acid phosphatase presence and location, for use in image enhancing.
Continuing - sectioning (in plastic) (semithin sections) and staining of bark beetle oocyte tissue to coroborate findings of whole cell preparation of similar material.

Forest Economics

PROJECT PC - 05

Development of Economic Guidelines for Allocating Resources for Forest Management and Research

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

Achievements: As in 1979/80, staff vacancies severely hampered progress in this project. The major thrust of this year concentrated on supporting the Canada/B.C. Forestry Subsidiary Agreement, and the Evaluation Task Force on Intensive Forest Management. Research-oriented activities were curtailed until staffing vacancies have been completed. Reports were issued on waterborne forest product exports and the proceedings of a seminar held in conjunction with the CIF.

PROJECT PC-53

Energy from the Forest

Objectives: To develop methodology to quantify the amount of forest biomass available for energy conversion in the Pacific and Yukon Region, assess its cost in uses, and the physical and socio-economic impacts of its availability and use.

Achievements: Two studies were initiated during 1980/81. The first of these, awarded as a contract to Talisman Land Resource Consultants of Vancouver, is evaluating green and dry weights of tree components, with the aim of developing a model to forecast the slash remaining following logging in B.C. The second study, also a contract, is being performed by Nawitka Renewable Resource Consultants of Victoria. The objective of this study is to derive tree component weight equation for the four most common Yukon tree species. The study of socio-economic and institutional constraints to biomass utilization, performed by T. McDaniels Research, was completed and a report is in hand. An information report on Forestal's study of chipping forest residues was released, as was one for Nawitka's survey of costs of logging residual forest biomass.

Administration

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; 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 experienced heavy plant maintenance repairs and upkeep during the fiscal year including major roof repair and replacement of heating transmission lines servicing the Annex Building. The departmental Facilities Management Division conducted an Energy Conservation and Plant Management study of PFRC's operations and found that an efficient operation is in existence. Vehicle fleet management was maintained at 50 units with eight vehicles being replaced. The Department of National Health and Welfare conduced a Health and Safety study of laboratory operations

and submitted its report to local management PSAC, PIPS and the Treasury Board. As a direct result special departmental funds were allocated to improve the ventiliation in the Photographic Unit, construct a chemical storage bunker and to design specifications to update the fire alarm system. Heating oil consumption was maintained at base level and was actually down slightly from 40.6 k gallons to 39 k gallons. This is considered to be as low as consumption can go.

Information Services

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: During the year 12 news releases were issued to the press, 80 reports were published, and 150 scientific manuscripts and technical reports were edited for publication. Countless enquiries were received from the public and over 80 000 pieces of literature were distributed in response. In addition 15 tours were conducted through the centre and four exhibits were prepared and displayed at various locations. A total of 17 seminars and lectures took place featuring both inhouse and guest lecturers. Four publications were co-published with the B.C. Ministry of Forests and a major tri-government publication on cone and seed insects of North American conifers was also produced by Information Services staff.

APPENDIX A

PACIFIC FOREST RESEARCH CENTRE
1980/81 EXPENDITURES
($'000')

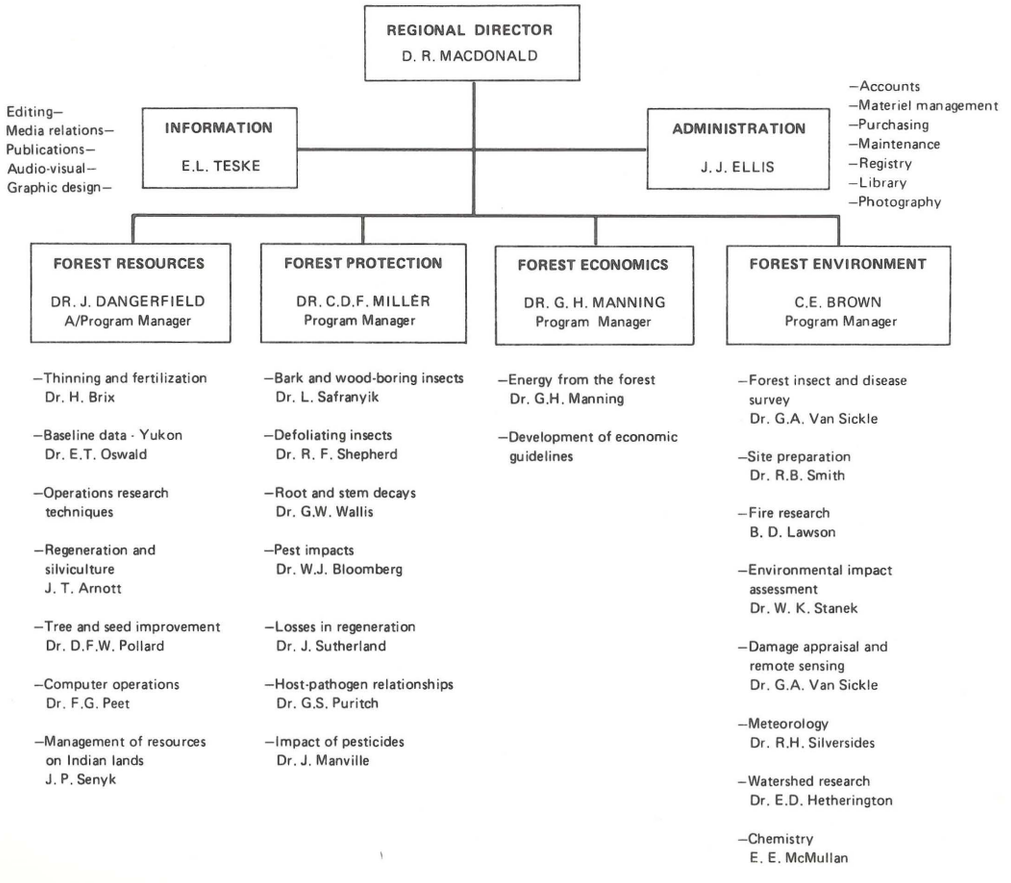
PROGRAM AREA	PERSON YEARS	SALARIES	OPERATION & MAINTENANCE	CAPITAL	TOTAL
Forest Environment	38	$1,034.6	$119.0	$18.9	$1,172.5
Forest Resources	39	$996.9	$135.7	$51.2	$1,183.8
Economics	4	$97.6	$214.2*		$311.8
Forest Protection	38	$1,171.7	$127.0	$26.1	$1,324.8
Directorate (includes Information Services)	8	$197.0	$51.8	$54.4	$303.2
Administration	27	$506.3	$571.0	$42.6	$1,119.9
TOTAL	154.0	$4,004.1	$1,218.7	$193.2	$5,416.0

* includes Biomass project O & M only

CONTRACTS LET OR SUPERVISED BY PFRC IN FISCAL YEAR 1980/81

Contract's name	Project Title	Amount
Capital Applied Research & Technology Ltd. Discovery Park University of Victoria Campus Victoria, B.C. V8W 2Y2	A study of fatty acid compounds for the protection of commercial conifers (UP-C-344) 1980–	$90,869
McDaniel Research Ltd. 640 - 240th Street, R.R. 9 Langley, B.C. V3A 6H5	Analysis of the resource industry and socio-economic effects of the forest biomass energy use in B.C. - part of the Canadian Forestry Service ENFOR Program	$62,000
Nawitka Renewable Resource Consultants Ltd. 836 - 840 Cormorant Street Victoria, B.C. V8W 1R1	Development of biomass prediction equations for Yukon tree species	$8,250
Pacific Soil Analysis Inc. 1560 Rand Avenue Vancouver, B.C. V6P 3G2	Soils analysis related to forestry management	$4,800
SCABA Associates – Statistical Consultant & Data Analysts 14 Cottonwood Crescent London, Ontario N6G 2Y8	Analysis of vegetation, soil and other environmental data collected along the Dempster Highway in 1979	$2,000
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. forests to specified recovery criteria – part of the Energy from the Forest Program (ENFOR)	$414,538
T.M. Thomson & Associates Ltd. 1006 Government Street Victoria, B.C. V8W 1X7	Survey of ENFOR (Energy from the Forest) biomass estimation projects	$15,000

PACIFIC FOREST RESEARCH CENTRE ORGANIZATION CHART



APPENDIX D

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

ORGANIZATION AND PROJECT STAFF LISTING 1980 / 81

REGIONAL DIRECTOR	D. R. Macdonald	
PROGRAM MANAGERS	C. E. Brown	Forest Environment
	Dr. J. A. Dangerfield	Forest Resources
	Dr. G. H. Manning	Economics
	Dr. C. D. F. Miller	Forest Protection
ADMINISTRATIVE OFFICER	J. J. Ellis	
INFORMATION OFFICER	E. L. Teske	
SECRETARIES	J. Kronstrom	
	A. Inness	
	S. Ticknor	

PROJECTS

Project No.	Title	Professional Staff	Technical Staff
	FOREST ENVIRONMENT (C.E. BROWN)		
PC - 2	Forest insect and disease survey	Dr. G.A. Van Sickle (Project Leader) Dr. J.W.E. Harris Dr. J.C. Hopkins D. Evans	R.L.Fiddick R.J. Andrews H.P. Koot L.S. Unger R.D. Erickson D.F. Doidge S.J. Allen R.O. Wood E. Pass D.P. Lowe C.S. Wood E.V. Morris R. Duncan R.G. Brown
PC - 25	Effects of harvesting and site preparation practices of forest resources and values	Dr. R. B. Smith (Project Leader)	E.F. Wass
PC - 30	Fire research in support of improved forest resource management	B.D. Lawson (Project Leader) B.C. Hawkes	G.A. Robertson G.R. Lait
PC - 43	Environmental impact assessment of northern pipelines	Dr. W.K. Stanek (Project Leader)	
PC - 46	Improved use of meteorology in forestry	Dr. R.H. Silversides (Project Leader)	W.L. Cave
PC - 56	Carnation Creek Experimental Watershed	Dr. R.B. Smith (Project Leader) Dr. E.D. Hetherington	R.J. Rowswell
PC - 62	Damage appraisal and remote sensing	Dr. G.A. Van Sickle (Project Leader) Dr. R.I. Alfaro Dr. J.W.E. Harris P. Gimbarzevsky	W. Adams E. Wegwitz A. Dawson R.G. Brown
	Services		
	Biochemist	E.E. McMullan	

Project No.	Title	Professional Staff	Technical Staff
	FOREST RESOURCES (DR. J. A. DANGERFIELD)		
PC - 23	Growth and biology of coastal Douglas-fir ecosystems in relation to stand tending	Dr. H. Brix (Project Leader) Dr. V.G. Marshall Dr. P.C. Pang Dr. J.A. Dangerfield	A. Mitchell C.R. Layton M. Clayton K. McCullough J. Dronzek
PC - 39	Operations research techniques for forest management	Dr. F. Peet (Project Leader) Dr. Y.J. Lee Dr. J.W.E. Harris	
PC - 48	Regeneration and silviculture systems: Pacific and Yukon	J.T. Arnott (Project Leader) J.M. Kinghorn Dr. R.G. McMinn A.C. Gardner Dr. J.A. Dangerfield Dr. S. Eis Dr. Y.J. Lee	G.J. Goodmanson D. Beddows M.T. Hughes M.A. Grismer D. Barwise J.J. Dennis D. Craigdallie
PC - 49	Tree and seed improvement: B.C. and Yukon conifers	Dr. D.F.W. Pollard (Project Leader) Dr. D.G.W. Edwards Dr. S. Eis Dr. H. Brix E.E. McMullan	J.F. Dronzek F. T. Portlock D.W. Taylor D. Craigdallie A. Mitchell
PC - 52	Forest land productivity, Pacific and Yukon Region	Dr. E.T. Oswald (Project Leader) Dr. Y.J. Lee	R.K. King B.N. Brown
PC - 55	Integrated management of resources on Indian lands	J.P. Senyk (Project Leader)	B.N. Brown
PC - 57	Fate of nitrogenous fertilizers applied on snow	Dr. V.G. Marshall (Project Leader) Dr. J.A. Dangerfield Dr. P.C. Pang Dr. E.D. Hetherington	S. Reynolds T. Bown R. Benton
	Services (Computing)		
	Head Forest Resource Systems Head Applications Programming Applications Program Analyst Head, Operations & Systems Development Computer Operator Keypunch Operator Applied Statistician	Dr. F. Peet A. Van der Wereld R. Robertson J. Partridge J.E. Foster M. Simpson Dr. C.S. Simmons	

Project No.	Title	Professional Staff	Technical Staff
	FOREST PROTECTION (DR. C.D.F. MILLER)		
PC - 06	Reduction of losses from bark and wood-boring insects	Dr. L.Safranyik (Project Leader) Dr. T.S. Sahota Dr. D.M. Shrimpton Dr. H.A. Moeck Dr. L.H. McMullen Dr. S. Whitney	D.A. Linton W.W. Nijholt A. Ibaraki L.E. Manning C. M. Lawko R.E. Betts O. Spanier
PC - 08	Reduction of losses from defoliating insects	Dr. R.F. Shepherd (Project Leader) Dr. I. Otvos	T.C. Gray M. Talmon de l'Armee
PC - 13	Reduction of losses from root and stem decays in second-growth stands	Dr. G.W. Wallis (Project Leader) Dr. D.J. Morrison Dr. R.S. Hunt Dr. A. Funk	G. Reynolds A.L.S. Johnson D. Chu H.M. Craig
PC - 40	Pest impacts on growth of managed stands	Dr. W.J. Bloomberg (Project Leader) Dr. A.J. Thomson	A.A. Hall
PC - 44	Reduction of losses in regeneration forestry	Dr. J.R. Sutherland (Project Leader) G. Miller	W. Lock T.A.D. Woods D.S. Ruth
PC - 50	Utilization of the host tree defense reaction as natural control mechanism for forest pests	Dr. G.S. Puritch (Project Leader) G.D. Jensen Dr. D.J. Morrison Dr. H.A. Moeck Dr. D. M. Shrimpton	W.W. Nijholt H.M. Craig A. Johnson C. M. Lawko L.E. Manning
PC - 51	Impact of pesticides on forest ecosystems	Dr. J. Manville (Project Leader)	
PC - 58	Plant lipids as control agents	Dr. G.S. Puritch (Project Leader)	W.W. Nijholt
	Services		
	Microtechniques	S.H. Farris	

Project No.	Title	Professional Staff	Technical Staff
	ECONOMICS (DR. G.H. MANNING)		
PC - 05	Development of economic guidelines for allocating resources for forest management and research	Dr. G.H. Manning (Project Leader)	J. Rudd C. Macklin
PC - 53	Energy from the forest	Dr. G.H. Manning (Project Leader)	J. Rudd C. Macklin

ADMINISTRATION (J.J. ELLIS)

Librarian	A. Solyma
Library Clerk	M. Mitchell
Photographer	A. Craigmyle
Clerk/Typist/Receptionist	C. Kilpatrick
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	J. Andersen
Manuscript Typesetter	A. Banner
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Central Registry Clerk	P.A. Donovan
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Accounts Supervisor	J. Fuller
Jr. Accounting Clerk	J. Jickling
Purchasing Clerk	W.H. Gray
Jr. Purchasing Clerk	K.C. Vose
Storeman	J. R. Rafter
Assistant Storeman	D.A. Greenway
Chief Engineer	E.K. Hopps
Sr. Maintenance Carpenter	W.A. Pearce
Maintenance Craftsman, Instrumental	M. Buck
Maintenance Craftsman, Mechanical	R.H. Reid

Stationary Engineers	G. Kazmiruk
	H. Hendrickson
	R.M. Richardson
	A. Couillard
Gardener	R. Hughes
Greenhouseman	B.J. Vander Heiden

INFORMATION (E.L. TESKE)

Scientific Editor	A. MacEwan
Draftsman	J.C. Wiens
Distribution Clerk	B. Page

VISITING SCIENTISTS

Dr. Ernst M. von Rudloff	Ian Hood
National Research Council	National Research Advisory Council
Saskatoon, Saskatchewan	Rotorua, New Zealand
(Chemosystematic Studies)	(Pathology)

APPENDIX E

PUBLICATIONS

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Direction générale des relations et de la régénération forestières

Direction générale des politiques et de l'économie

Direction générale des recherches et des services techniques

Les centres de recherches forestières doivent réprondre aux impératifs régionaux et entretenir une liaison étroite avec les ministères provinciaux des Forêts. Ils participent également à des programmes nationaux dont ils assument fréquemment la direction.

le Centre de recherches forestières du Pacifique,
à Victoria (C. -B.)

le Centre de recherches forestières du Nord,
à Edmonton (Alberta)

le Centre de recherches forestières de Grand lacs,
à Sault-Sainte-Marie (Ontario)

le Centre de recherches forestières des Laurentides,
à Sainte-Foy (Québec)

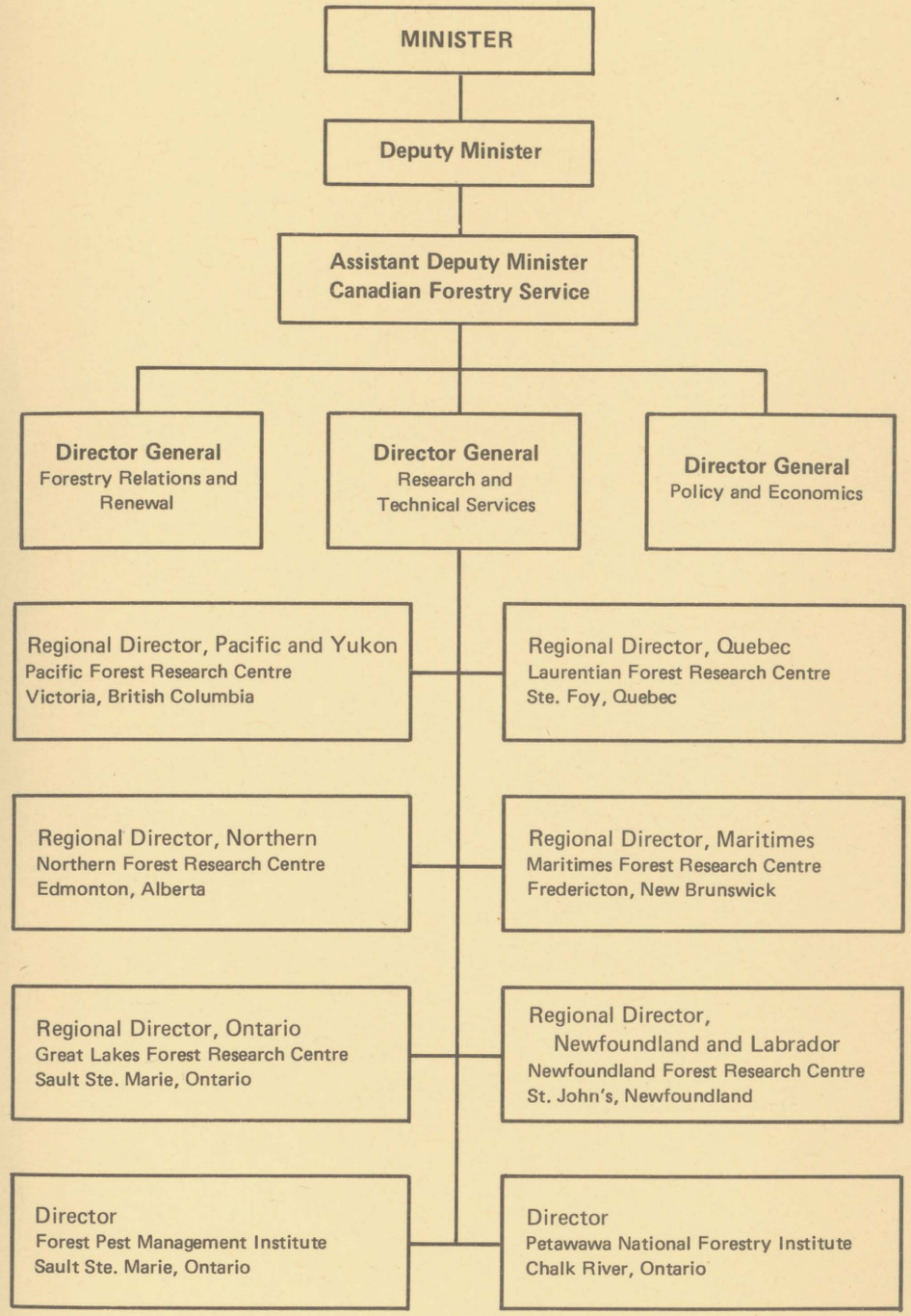
le Centre de recherches forestières des Maritimes,
à Fredericton (N. -B.)

le Centre de recherches forestières de Terre-Neuve,
à 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).

ENVIRONMENT CANADA



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