INTRODUCTION

Hardwoods are a common and often important component of British Columbia's forests. In recent years, interest in managing hardwoods has grown due to an increase in demand for hardwood products such as pulp, paper and sawlogs. Furthermore, hardwood species can contribute to nutrient cycles, reduce the spread of root rot, increase ecosystem productivity and promote biodiversity. Major hardwood species in B.C. include red alder, bigleaf maple, black cottonwood, balsam poplar, paper birch, and trembling aspen.

Research will help acquire, communicate and apply information central to the sustainable and integrated management of hardwood and mixedwood forests. The Hardwood and Vegetation Management Technical Advisory Committee has identified the following topics as priorities for investigation: hardwood silviculture, ecology, integrated resource management, and forest health. The objective of the Technical Advisory Committee is to develop an integrated and adaptive research, extension and demonstration program.

Funding for hardwoods research has been provided by the Canada—British Columbia Partnership Agreement on Forest Resource Development: FRDA II (1991–1995) and by the B.C. Ministry of Forests under the Forest Renewal Plan.

Brief project summaries, incorporating progress to September 30, 1992, are presented in this memo. Further project details are available from project leaders (whose addresses are included at the end of this memo) or from Marilyn Blache, Hardwood Management Program Administrator, Ministry of Forests, Research Branch, 31 Bastion Square, Victoria, B.C. V8W 3E7 (356-2553).

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GENERAL

Project B25  Strategic assessment of the hardwood resource

Project Leader: Michael Massie, Nawitka Resource Consultants

Objectives:

This study is designed to evaluate the strategic importance of the hardwood resource, in pure or mixedwood stands, to supply and markets. The broad range of advantages and disadvantages of the hardwoods for other resource uses, and integration with timber production, are considered.

Progress

A draft report in three volumes — an economic component, an ecological component, and a multiple use component — was delivered to the Research Branch in September, for review. The final report will be available in early 1993.

Benefits:

Changes in production technology and markets combined with a growing knowledge of the environmental, ecological and silvicultural importance of hardwood forests have changed the historic status of this resource within the province. Improved management of hardwoods can contribute significantly to the achievement of the full potential of all forest-based resources in B.C.
General - Continued

Project BC-FR12  Membership in the Hardwood Silviculture Cooperative

Project Leader:  Paul Courtin, Vancouver Forest Region

Objectives:
The Hardwood Silviculture Cooperative, based at Oregon State University, has initiated an alder management study to examine spacing effects in natural stands and in plantations. The B.C. Forest Service is a member of this cooperative.

Progress:
Using the cooperative’s guidelines, two installations (spacing in natural stands) have been established near Sechelt. Two plantation spacing installations are planned for the near future.

Benefits:
Membership in the Hardwood Silviculture Cooperative will provide an increase in knowledge about hardwood management in the Pacific Northwest.

SILVICULTURE/ECOLOGY

Project B03  Effects of red alder density on conifer growth and nitrogen availability

Project Leaders:  Phil Comeau, Research Branch
                  Brian D'Anjou, Vancouver Forest Region

Objectives:
Long term studies are required to examine the effects of differing amounts of red alder on the growth of conifers, under different site conditions. Installations will be established for research on, and demonstration of, the effects of red alder on conifer growth and nitrogen availability.

Progress:
During 1991/92, work included the location of candidate sites for field trials, the layout of three installations, and the establishment of microclimate stations. Red alder, western redcedar and Douglas-fir were planted at three installations. During 1992/93, work will include planting Sitka alder and bigleaf maple, soil sampling, and measurement of these three installations, as well as the location and establishment of future installations.

Benefits:
Results will provide information on the impacts of different densities and proportions of red alder on both conifer and whole stand yield. Installations will also provide long-term research on the impacts and benefits of alder management. Study sites will be useful as demonstration areas in the future, and will provide opportunities for cooperative research.

Project B07  Stand tending regimes for red alder plantations

Project Leader:  Paul Courtin, Vancouver Forest Region

Objectives:
This study will improve knowledge of red alder growth and yield and provide a basis for the management of this species. Eleven density treatments will be established. Data for the modelling and prediction of red alder growth and yield in the Pacific Northwest will be collected.

Progress:
One site in the Campbell River District is currently being logged, and stock for the trial is being grown at Surrey Nursery. When logging is completed, the planting blocks will be surveyed. Stock will be planted in spring 1993, and seed collection is planned for October 1993 to produce stock 1993/94 planting.

Benefits:
Results will be used for the development of growth and yield models, and for making density management decisions.

Project B09  Evaluation of the consequences of red alder control and management on the growth of conifers

Project Leader:  Phil Comeau, Research Branch

Objectives:
The FORCYTE-11 model is being calibrated and used examine the consequences of a variety of approaches to the management of red alder, and the impacts of red alder management on the growth of coastal conifers. Other objectives for 1992/93 include the publication of simulation results, and demonstration and evaluation of the FORCYTE-11 model.

Progress:
FRDA Report 187 provides a summary and evaluation of the results of simulations of alternative scenarios using FORCYTE-11. A poster was prepared and presented at the International Conference on Forest Management, Auburn, Alabama.

Benefits:
The FORCYTE-11 model has been calibrated to evaluate alternative approaches to managing red alder and potential impacts on the growth of Douglas-fir, western redcedar and western hemlock. Simulated red alder management scenarios include the effects of the timing of alder control on conifer yield; the growth of stands of alder and conifers in mixed proportions; crop rotations of alder and conifers; and the use of nitrogen fertilizers to replace nitrogen fixation by red alder. The ecological consequences of various scenarios, and their effects on growth and yield, being evaluated.
Project B12  
**Project Leader:** Suzanne Simard, Kamloops Forest Region  
**Objectives:**  
Management of paper birch for commercial sawlog production is gaining favour in the interior of the province. This study examines the response of 5- to 15-year-old paper birch to a range of thinning intensities, and determines the effects of density reduction treatments on the growth and yield of paper birch. The study will also provide preliminary data for the development of growth and yield function tables for managed birch stands.

**Progress:**  
Four installations have been established in the Kamloops Forest Region. Pre-treatment measurements and photographs, tree marking, thinning, post-treatment measurements and photographs, sign posting, data review and entry are all complete.

Preliminary ecophysiology measurements in various treatments at each of the four thinning trials included measures of light attenuation, leaf area and photosynthesis of birch and understory Douglas-fir. Light saturation curves are being developed for paper birch and interior Douglas-fir seedlings.

Each site was assessed for winter damage and vigour of resprouts from cut birch stumps. No damage was visible over the winter; however, resprouting was vigorous at two sites.

**Benefits:**  
This project will provide information about thinning regimes in 5- to 15-year-old birch stands in the ICH Zone and enable silviculturists to predict growth and yield of stands when thinned to different densities. Information will be used for the development of growth and yield function tables for managed birch stands.

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Project B16  
**Project Leader:** Craig DeLong, Prince George Forest Region  
**Objectives:**  
Management of hardwoods and softwoods on the same land base has become an important component of forest management in northern B.C. This project summarizes data from existing plantations of spruce under aspen in Alberta, and investigates light and soil moisture under aspen canopies of varying basal area. A study of spruce planted under aspen will be conducted. Site selection and appropriate nursery and site preparation criteria will be developed to ensure optimum survival and growth of spruce planted under aspen.

**Progress:**  
Second-year light and soil moisture data have been collected in aspen stands of different basal areas. Normal and shade-adapted stock will be planted in the spring of 1993. A report and presentation on the microenvironment under aspen canopies of different basal areas are in preparation.

**Benefits:**  
This study will provide an understanding of the microenvironment under aspen canopies, and its effect on spruce seedling performance, thereby ensuring optimum survival and growth of planted white spruce. It will also summarize existing underplanting trials and determine the reasons for their success or failure.

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Project B20  
**Project Leader:** Dave Coopersmith, Prince George Forest Region  
**Objectives:**  
The recent establishment of hardwood processing industries in northeastern B.C. has resulted in a major shift in thinking, towards hardwood management as opposed to conifers alone. The goal of this project is to develop stand tending strategies to maximize the quantity and quality of biomass production for all appropriate hardwood species in each district. These installations may be used as a teaching resource for the study of hardwood management, by district and industry silvicultural staff.

**Progress:**  
Plot layout and installation, pre-treatment measurements, and crop tree numbering and thinning have been completed at 3 sites. Foliar samples were collected at the Chetwynd site and shipped to Victoria for nutrient analysis prior to next spring’s fertilization. Because of a limited amount of high quality aspen, only 12 plots were installed at the Vanderhoof site. This study area will be used as a demonstration site for Vanderhoof district staff.

At the MacGreggor trial site in the Prince George area, initial investigations will focus on first year survival of wild versus stool bed whips and cuttings. All trees in the trial area were tagged and evaluated for first year survival and quality response. Areas where wild cuttings were collected last year were assessed for whip stocking in the fall of 1992. At the unnamed site in the Fort Nelson area, site preparation work for a cottonwood trial is complete. Whip counts began this fall and collection is scheduled for spring 1993. Additional areas along the Fraser and MacGreggor valleys were identified in preparation for gathering 15,000 whips in the spring.

In October 1992, a presentation was made to a hardwood cooperative in Grand Prairie, Alberta, describing the work in progress on this project.

**Benefits:**  
Information on the long-term stand dynamics of northern hardwoods is vital in assessing the options for hardwood management. Data generated by this study will be used to calibrate the FORCYTE-11 model and to predict the sustainability of the chosen hardwood management strategies. Guidelines will be developed, for thinning of planting escapement, for each hardwood species in each district.
**Silviculture/Ecology - Continued**

**Project B31** Pure and mixed paper birch stand management studies in the ICH Zone in the southern interior of British Columbia: regeneration study

**Project Leader:** Suzanne Simard, Kamloops Forest Region

**Objectives:**
Mixed plantations of paper birch and conifers may reduce the spread of Armillaria and Phellinus root rot, increase ecosystem productivity, and increase biodiversity compared with mono-specific conifer plantations. This long-term study (expected to continue for at least 20 years) will help to determine the effects of species interactions between paper birch and conifer seedlings on the performance of each species, and the effects of species interactions on environmental conditions and resources.

**Progress:**
Three sites were de-stumped, cleared of slash, and treatment plots were established and permanently marked. Soils were collected and bioassays initiated for the mycorrhizae study. Microclimate stations and decomposition stations have been installed at all sites. The three sites were planted in May and June 1992. Dead seedlings were subsequently replaced, and extra seedlings were planted for the mycorrhizae studies. All seedlings were measured immediately after planting, assessed for condition in the fall, and dead trees marked to facilitate fill-in planting.

Sample preparation was done for the leaf litter decomposition study, and mineral soil and organic matter were sampled and sent to Victoria for analysis. A duff disturbance survey was conducted, seedling ecophysiology initiated, and bioassays were completed for diversity of ectomycorrhizae. An additional 5000 birch seedlings have been sown for fill-in planting in spring 1993.

**Benefits:**
Mixed plantations of paper birch and conifers may reduce the spread of root rot, increase ecosystem productivity, and increase biodiversity. This project will study and quantify the effects of species interactions between paper birch and conifer seedlings on the performance of each species, and the effects of species interactions on environmental conditions and resources.

**Project B34** Suitability of native hardwoods for reforestation and their effect on long term soil nutrient status

**Project Leader:** Nola Daintith, Cariboo Forest Region

**Objectives:**
This study will compare the survival and growth of three native hardwoods (aspen, paper birch and black cottonwood) to lodgepole pine and interior spruce over a range of sites in the Cariboo Forest Region. The aim is to determine the susceptibility of these species to Armillaria root rot, damage from mammals, and frost. The project will also study the effect of native hardwoods on long-term soil nutrient status, and provide appropriate spacing guidelines for growing hardwoods in the ICHwk2 subzone of the Cariboo Forest Region.

**Progress:**
Site selection, site preparation, and layout work are complete. Aspen and birch seedlings were grown and are stored in overwinter cold storage. Cottonwood cuttings will be collected this winter for rooting in early spring 1993. Coniferous stock (lodgepole pine and interior spruce) will be secured this winter for the five sites. Preparations are being made for spring planting.

Due to the late completion of much of the site preparation this fall, baseline soil sampling and description was not completed. However, detailed procedures for sampling and description have been written, and this work is scheduled for August, 1993. Various options for protecting seedlings from wildlife and cattle are being considered.

**Benefits:**
This study will provide insight into the suitability of native hardwoods for reforestation on different sites (e.g., Armillaria root rot areas), and their effect on long term soil nutrient status.

**Project B35** Effects of aspen density and stocking on the performance of coniferous plantations in the Cariboo Forest Region

**Project Leader:** Teresa Newsome, Cariboo Forest Region

**Objectives:**
The effect of aspen density and stocking on plantation performance must be documented over time in order to determine if and when stand tending activities are necessary. This study will investigate and quantify the effects of trembling aspen competition on lodgepole pine, identify measures of competition to determine how trembling aspen competition is affecting lodgepole pine survival and growth, and monitor lodgepole pine survival and growth where partial removal is used.

**Progress:**
Phase 1 is a retrospective study which will provide information from field studies on pine-aspen competition in two subzones of the Cariboo Forest Region. Data collection for this phase is complete; three sites in the IDFdk and three sites in the SBSdw have been sampled. Vegetation measurements, seedling measurements, and light measurements have been taken, and an ecological description has been completed for each site. Data analysis of phase one and a report outlining the results of this stage will be completed by March 1993.

Phase two involves monitoring and assessing competition on a site for at least 10 years. Sites for this phase will be established by fall 1993. Sites will be selected in the SBSdw, and, if possible, in the IDFdk.

**Benefits:**
This study will provide stand tending guidelines for conifer plantations with hardwood competition. The interaction between aspen and pine will be documented to determine when competition occurs, and at what competition level pine growth is impeded.
Project B39  The use of red alder to enhance Sitka spruce growth in the Queen Charlotte Islands

Project Leaders:  Paul Courtin, Vancouver Forest Region  
                 Robert Green, Vancouver Forest Region

Objectives:
On many forest sites in the Queen Charlottes, and in other coastal areas in the province, Sitka spruce growth is limited by low nitrogen availability. Interplanting red alder in managed stands may enhance stand productivity and improve wildlife habitat. The aim of this project is to determine the effect of varying admixtures of interplanted red alder on the productivity of Sitka spruce, on nutrient poor to medium sites, and to monitor the effects of the red alder admixtures on chemical and physical soil properties, and spruce foliar nutrients.

Progress:
Sites have been established and 3100 spruce were planted and labelled. Alder stock will be planted at two trial locations in late 1992 or early 1993. Baseline soil chemistry sampling and foliar sampling from last year’s plantings will be conducted. Alder and spruce height, and caliper measurements and plot maintenance will be completed. Soil descriptions will be finished by March 1993.

Benefits:
Managing conifer stands with a component of red alder may not only enhance stand productivity but also may improve the habitat quality for bird populations. This project may increase the yield from a shrinking forest land base while maintaining or improving wildlife habitat. Comprehensive scientific findings will be reported, and field tours and workshops will be conducted.

Project B40  Poplar demonstration plantation at Surrey Nursery

Project Leader:  Tony Willingdon, Surrey Nursery

Objectives:
This project will demonstrate the potential for poplar culture in the lower mainland, and provide measured comparisons of growth between irrigated and non-irrigated poplar plantations. This study will also compare the growth rates and characteristics of different poplar clonal types in South Surrey.

Progress:
The plantation was established by planting 5000 cuttings in an area which was cleared and prepared in 1991. The planted poplar were severely browsed by deer and the site may have to be re-prepared and re-planted with larger stock in the spring of 1993. Until the degree of success of the planting is evaluated in the spring, no further activities are planned on this project. If poor success is realized with cuttings, whips will be obtained to stock the plantation in the spring.

Benefits:
The findings of this project will determine if discarded fertilizer solution from the nursery can be used to enhance poplar growth. Use of this runoff will reduce a potential source of pollution to streams and watercourses. The site will be used as a fully documented demonstration area, and a report produced in year five of the project.

Project BC-FR14  Northern mixedwood forests, the carbon cycle, and sustainable production

Project Leaders:  Phil Comeau, Research Branch  
                  Dave Spittlehouse, Research Branch

Objectives:
This project will provide an estimate of the carbon budget in northern mixedwood forests, and examine the impact of harvesting and prescribed burning. It will also examine the impacts of different management strategies (hardwood, mixedwood and conifer) on the long-term productivity of boreal mixedwood forests.

Progress:
In order to estimate carbon budgets, available data pertaining to carbon cycling have been gathered. Field data on carbon content and distribution, from 24 aspen and mixedwood stands in the Dawson Creek Forest District, have been collected and will be summarized.

Benefits:
The management and use of the northern mixedwood forest is increasing. This study will provide important information on long-term productivity of these forests and their role in the global carbon budget.

Project BC-FR38  Geographic variation of red alder (Alnus rubra) in British Columbia

Project Leader:  Cheng C. Ying, Research Branch

Objectives:
In recent years, interest in managing red alder as a commercial species has grown dramatically because of the increasing demand for high quality red alder logs, and because of the capability of red alder to improve soil fertility. This study is designed to investigate the amount, distribution, and patterns of geographic variation of red alder in B.C. with respect to germination rate, seedling growth, biomass production, vegetative phenology and nitrogen fixation.

Progress:
Seeds have been collected from about 70 source locations in the natural range using a systematic sampling scheme. A common garden study is being conducted in a nursery environment. Data collection is underway.

Benefits:
The results of this study will be used to guide the planning of seed transfer, seed source selection, gene conservation, and biodiversity preservation. A breeding strategy will also be developed.
**Silviculture/Ecology - Continued**

**Project BC-FR42**  
**Pure and mixed paper birch stand management studies in the ICH Zone in the southern interior of British Columbia: birch biomass study**

**Project Leader:** J. P. (Hamish) Kimmins, University of British Columbia

**Objectives:**
In the Interior Cedar-Hemlock Zone, paper birch often regenerates naturally following a disturbance. Although paper birch efficiently cycles nutrients and helps to maintain stand productivity, it can suppress conifer growth. Consequently, it is often removed during the regeneration period. Another source of birch removal is through harvesting since the value of birch is increasing. In order to investigate the long-term effects of removing paper birch from ICH ecosystems, biomass and nutrient content of paper birch stands needs to be quantified in immature and mature stands. This study will develop biomass equations applicable to a wide range of tree ages and sizes in the ICH Zone, determine nutrient concentration in birch tree components, and determine the nutrient capital of mineral soil and organic matter in pure birch stands.

**Progress:**
A chronosequence of birch stands has been sampled, covering a range of age classes and site productivity types. Laboratory analysis is underway, and will be complete in early 1993.

**Benefits:**
This study will estimate the contribution of paper birch components to site nutrient capital. This information will be used to evaluate the long-term effects of the removal of juvenile birch from conifer plantations and the removal of mature birch through commercial whole-tree harvesting. The data collected in this study will be used to calibrate FORECAST, so the effects of management practices on long-term productivity can be predicted. The calibrated model will then be linked to the user-friendly management simulation “game” FORTOON.

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**Project FC-FR07**  
**Analysis of cottonwood management problems in British Columbia and related research needs**

**Project Leader:** Donald McLennan, Oikos Ecological Consultants

**Objectives:**
The aim of this project is to prepare a review of black cottonwood resources and management in British Columbia and identify outstanding information gaps and management opportunities.

**Progress:**
A FRDA report has been prepared which assesses the extent and value of the present cottonwood resource in British Columbia; provides a synopsis of management options and regimes, with their opportunities and limitations; and analyses the impact of cottonwood silviculture and management on non-timber resources. Information on cottonwood is assessed in three categories:

1. basic biology and silvics;
2. management options and impacts; and
3. economics and markets.

A list of research requirements has been developed from these three categories. Research priorities are identified short term (less than 5 years) or long term (results after years).

**Benefits:**
This review will identify and rank the direction of cottonwood research in British Columbia. FRDA Report 195 is now available.

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**INTEGRATED RESOURCE MANAGEMENT**

**Project B01**  
**Wildlife diversity in coastal alder stands**

**Project Leader:** Dale Seip, Prince George Forest Region  
J.P. Savard, Canadian Wildlife Service

**Objectives:**
The purpose of this project is to determine the importance of hardwood stands in maintaining wildlife diversity coastal forests.

**Progress:**
Breeding bird abundance has been determined in four hardwood stands on the south coast by territorial mapping. Relative abundance of breeding birds was determined using census point counts in hardwood stands on the south coast, southern Vancouver Island and the Queen Charlotte Islands. Salamanders have been inventoried in hardwood stands on the south coast and southern Vancouver Island using transect searches and pitfall traps. Small mammals were sampled by trapping on the south coast, southern Vancouver Island and the Queen Charlotte Islands. Winter bird surveys were conducted in hardwood stands on south coast. Data analysis and report preparation are in progress.

**Benefits:**
This study will determine the importance of hardwood stands in maintaining wildlife diversity in coastal forests, and will also complement a larger study on wildlife diversity managed coastal forests which compares vertebrate communities in old-growth and second-growth conifer forests and clearcuts.

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**Project B27**  
**Impacts of hardwood management on B.C. wildlife: a problem analysis**

**Project Leader:** Katherine Enns, Larkspur Biologi Consultants

**Objectives:**
Hardwood management is increasing in British Columbia and the impacts of various management practices on wildlife may be significant. Although some research on this topic does exist, the objectives of this study are to prepare a review of available information on the effects of hardwood management on wildlife, and to identify priorities for future research.
Integrated Resource Management - Continued

Project B28  Changes in bird diversity and abundance following aspen clearcutting in the BWBS biogeoclimatic zone

Project Leader:  Art Lance, Industrial Forestry Service Limited

Objectives:
This project examines the variety, abundance, and habitats of birds in boreal aspen forests subject to logging. The study covers:
1. an inventory of the bird species in BWBS aspen woodland;
2. the effect of different cutblock sizes; and
3. the course and rate of response by the bird community during aspen regrowth after logging.

The aim is to suggest a harvesting regime which will sustain both the bird community and aspen timber supply.

Progress:
A review of the literature revealed that little attention (none in B.C.) has been given to the impacts of logging on bird diversity and abundance in boreal aspen forest. Pilot fieldwork was completed in 1991 to design a study for 1992–1995. Thirty-two sample stands of aspen, in different sizes and regrowth stages, were censused 15 times apiece in April–July 1992. Some 6400 observations on 74 species are now being analyzed stand by stand. Results from 1992–1995 will be compared.

Benefits:
A report on the pilot fieldwork and literature review was completed in 1991. A report on years 1992–95 will be done in 1996. The findings will indicate the importance of aspen at different stages of regrowth, and will help forest managers to integrate wildlife with aspen harvest planning.

Project B29  The diversity of bird assemblages in the interior aspen forests in the western end of the dry, cool subzone of the Sub-Boreal Spruce Zone (SBSdk) in the Prince Rupert region

Project Leader:  Rosamund A. Pojar, Mountainview Ecological Service

Objectives:
This study will provide base-line data, help determine habitat requirements and suggest possible management indicator species which may be used to manage hardwoods and maintain biodiversity in the region.

Progress:
The fieldwork for this study is complete. Samples of relative bird abundance and behavior were taken, at fixed points, over a given period. The sites sampled are in the Prince Rupert Region and reflect different seral stages of aspen stands (e.g., young clearcuts, young dense stands, mature aspen stands and mixed deciduous-coniferous stands). Data analysis is in progress.

Benefits:
Data will provide information about the species present in the different seral stages and those likely to be impacted by hardwood management. This information will assist in managing for biodiversity at the landscape level and could affect the way PHSP’s are done. A final report outlining the results of this study will be ready by March 1993.

Project FC-IRM21  Mixedwood wildlife management

Project Leader:  Art Lance, Industrial Forestry Service Ltd.

Objectives:
The effects of mixedwood forest management on wildlife are poorly understood, particularly at the landscape level. This project examines bird species composition and abundance in boreal mixedwood forests of different spatial complexity and management history.

Progress:
Site selection in the B.C. Peace River district will be completed in 1992. Landscapes will be categorized by number of different cover-types, extent of each type, and amount of previous logging. Beginning in spring 1993, birds will be censused in a random sample of stands in each landscape, and differences between logged, unlogged, and simple versus complex landscapes will be compared.

Benefits:
This project will assess the importance of mixedwood forest diversity for wildlife, and specifically the role of timber harvesting in maintaining this diversity. The findings will complement a companion study on the responses to harvesting in hardwood (aspen) dominant stands in the same district (Project B28).
FOREST HEALTH

Project B08  Assessment of decay and waste factors and decay organisms for red alder (Alnus rubra)

Objectives:
Red alder is receiving increasing attention as a crop species for pulp and sawlog operations. This project will study the dynamics of decay in harvested alder logs and identify the primary fungal organisms involved in decay.

Progress:
Log degradation study: Data collected and summarized showed similar results for spring and summer cuts, with more rapid fungal ingress in summer. Moisture content appears to limit fungal development; however, time is more important in controlling fungal ingress.

Wood Block Decay Tests: A computer database, encompassing characteristics of decay-causing fungi grown in culture and host, was constructed and is in use. Five species of decay fungi were isolated from alder and grown on sterilized blocks to determine the decay potential of the test fungi. Results are being analyzed and a second run is being set up using some old and some new test fungi.

Effects of Alder Wood Extract on Fungal Growth: Tests were initiated to determine the fungitoxic/fungistatic potential of extracts from living alder wood. Extracts will be isolated on blocks of freshly cut alder wood through compression. Extracts will then be filter sterilized and incorporated in fungal growth media. Test blocks will be obtained during log degradation harvests.

The Western International Forest Disease Work Conference (WIFDWC): Information was presented in Durango, Colorado in July 1992, and was well received.

Benefits:
This project will provide an understanding of the infection process of fungi in alder, particularly in recently harvested trees. This will improve and maintain sawlog quality and develop an effective, rational strategy to reduce decay losses. Improved decay and waste factors for red alder will benefit forest managers in determining stand volumes, pathological indicators, timber values, and gross/net volume of cruised stands for use in timber appraisal systems.

Project B33  Pure and mixed paper birch stand management studies in the ICH Zone in the southern interior of British Columbia: root disease study

Objectives:
Armillaria ostoyae is one of the most common causes of growth loss and mortality among tree species in the IDF and ICH Zones. Mixing susceptible and less susceptible species in plantations may reduce the spread of the disease, but little research has focused on the underlying mechanisms. This study will examine root morphology and infection patterns of paper birch and Douglas-fir in mixed stands, and compare Armillaria groups by isolating and culturing mycelia from each species.

Progress:
Three study sites were surveyed for incidence and frequency of diseased and healthy trees. Birch root systems were excavated and examined for A. ostoyae. None of the birch present at the study sites was infected. Infection levels for Douglas-fir varied from site to site. In some cases, birch were growing in clumps of infected conifers and, occasionally, disease-free birch roots were intertwined with infected conifer roots. Birch roots appeared to be extremely resistant to invasion or infection.

This project suggests that birch would be a suitable species for root disease infected sites. The low susceptibility of birch to this disease indicates a potential for uses in root disease infected areas as a managed species. However, it should be noted that the sites chosen for this study were quite young and of a limited geographic distribution; additional study is therefore recommended.

Benefits:
This study will help to develop an understanding of the species/disease interactions that occur in mixed Douglas-fir/paper birch stands, in order to manage crop trees along with the disease.
Project B37  Pathology study: development of diagnostic tools for poplar disease in British Columbia

Project Leader: Brenda Callan, Forestry Canada

Objective:
The increased interest in poplars as a source of pulp and wood products has not been complemented by up-to-date disease diagnostic information. The purpose of this study is to acquire baseline diagnostic information on native and hybrid poplars in B.C. This information is fundamental to making accurate projections on productivity and management of this resource.

Progress:
Extensive collection, identification, and photography of pathology specimens is continuing. Several sites were revisited in the far northwest of the province, and new distribution record collections were identified and accessed into the Herbarium. In July 1992, during an expedition to the Tatshenshini River, two relevant ecosystems were observed: mixed spruce aspen forests and large stands of mature cottonwood. Collections made there should provide new host distribution records.

The joint American Phytopathological and Mycological Societies annual meeting, held in Portland, Oregon, included several presentations on diseases of hybrid poplars, as well as brief visits to plantations affected with 2 newly introduced and potentially devastating rusts. Two Forestry Canada Pest Reports were written; one on the U.S. hybrid poplar rusts (Melampsora medusae and M. larici-populina) and their potential for damage to Canadian trees, and the other on poplar pathology surveys and research in the Pacific region.

The literature review for the annotated host-fungus checklist is complete, and has been cross-referenced with data for B.C. Identification of collections made in the field continues and new records are being added to the host-fungus checklist. The checklist should be complete by early 1993.

Benefits:
This project will provide accurate, up-to-date diagnostic information on poplar diseases and management of diseased stands in order to make accurate projections on productivity and management of the resource. A field guide entitled “Common Diseases of Populus for the Pacific and Yukon Region”, with photographs of symptoms, causal agents, and diagnostic descriptions and techniques, will be completed by December 1995.

Project FC-FP36  Use of red alder in managing Phellinus weirii root disease

Project Leader: Rona Sturrock, Forestry Canada

Objectives:
Planting a pure stand of a Phellinus weirii-immune species such as red alder on sites currently affected by the disease may be useful in reducing inoculum levels and sanitizing sites for future rotations of conifers. This project will investigate the effects of alder versus Douglas-fir crops on the decomposition of stumps, and the growth and survival of P. weirii inoculum on affected sites.

Progress:
Two areas affected by laminated root rot have been identified for trial establishment; one in the Greater Victoria Watershed, the other in the Chilliwack Forest District. All stumps in the first area have been mapped and tagged and their condition recorded. Soil and stump sampling were also conducted. The site was planted operationally to 0.5 ha each of pure red alder and pure Douglas-fir. The Chilliwack site was harvested in the fall of 1992. Stump mapping will be done in January 1993, and the site will be planted in spring 1994. Hardwood survival, stump deterioration and Phellinus growth will be monitored periodically until the alder reaches a commercial size (20–30 years).

Benefits:
The project will provide foresters with a greater range of techniques to manage laminated root rot. Field tours will be conducted on the sites and interim results will be reported.

GROWTH AND YIELD

Project BC-GY01  Reconstruction of mixed-species stands

Project Leader: Ian Cameron, Kamloops Forest Region

Objectives:
In B.C., there are very few long-term studies of the growth of mixed-species stands. In the short term, analysis and reconstruction of chronosequences will provide a retrospective look at stand development and interspecific competition. This project will describe and quantify the patterns of stand development in the ICH and in selected subzones of the CWH. In the CWH, the study concentrates on natural and managed mixtures of Douglas-fir, western hemlock and western redcedar. In the ICH, the study focuses on the complicated fire-origin stands where as many as eight conifer and four hardwood species coexist.

Progress:
Chronosequences have been located in each study area. A systematic series of stand structure plots has been established. In the CWHdm and CWHxm, 40 stand structure plots have been measured and 13 have been reconstructed. In the ICH, 342 stand structure plots have been measured and 5 have been reconstructed to date. Data analysis is in progress.
Growth and Yield - Continued

Benefits:
The understanding of stand dynamics in mixed-species stands will be incorporated into recommendations for silvicultural prescriptions. The data collected will contribute to the development of growth models for mixed-species stands.

Project FC-GY12  Creating a data base for modelling the growth of aspen and aspen-conifer stands

Project Leader:  Michael Bonnor, Forestry Canada

Objectives:
More information is required on the growth and yield of B.C.’s forests as the wood supply diminishes and forest management activities intensify. The aim of this project is to assemble all permanent sample plot data relevant to modelling of growth and yield in aspen and aspen-conifer stands in B.C., and to create a complete data base of this information.

Progress:
The availability of suitable data, both inside and outside B.C., has been determined and relevant data are being acquired. Using procedures developed at the Pacific Forestry Centre (PFC), the data are undergoing assessment for errors and completeness. Data will be corrected and completed, and a data base for aspen and mixed aspen-conifer stands will be constructed. The procedures and results will be documented and presented as a report.

Benefits:
The end product of this study will be a data base for aspen and aspen-conifer stands ready for growth modelling. This data base and companion report will be of interest to mensurationists and other professional foresters, in both industry and government, who undertake stand treatments and growth modelling.
ADDRESSES OF PROJECT LEADERS AND CONTACTS

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