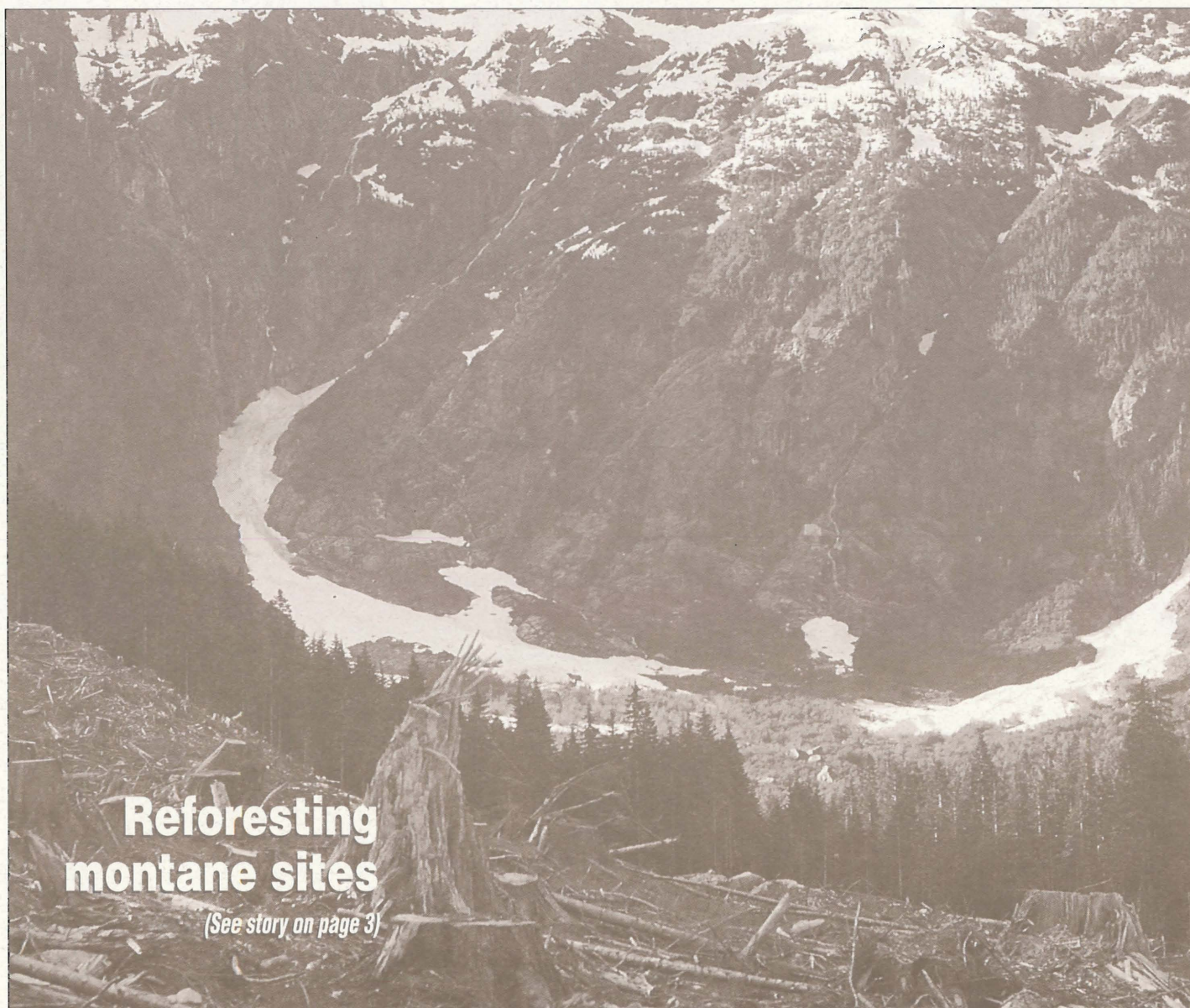




OCTOBER 1994

INFORMATION FORESTRY

Pacific & Yukon Region



Reforestation montane sites


(See story on page 3)



Natural Resources
Canada
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Activities and Goals of the Canadian Forest Service in the Pacific and Yukon region

Forest Protection Research

To help protect the forests of British Columbia from insects, disease, and wildfire.

Integrated Disease Management
Integrated Insect Management
Fire Management

Sustainable Forestry Research

To develop technical solutions and build knowledge of sustainable forestry.

Forest Ecosystem Dynamics see page 4, 5
Silvicultural Systems see page 3
Timber Production

Applied Programs

To conduct surveys and deliver applied programs.

Forest Insect & Disease Survey

Northern Centre for Applied Research

In Search of Hi-Tech Solutions

To supply British Columbia forestry with emerging hi-tech, new science solutions.

Advanced Forest Technologies..... see page 6
Biocontrol of Forest Weeds

Forest Development

To manage targeted federal forestry programs on sustainable and small scale areas.

FRDA II

Tree Plan Canada

Model Forests see page 6

South Moresby Forest Account

Canada-Yukon Forestry Agreement

Industry

To enhance industry, government, and public understanding of forestry opportunities, and increase the global competitiveness of Canada's forest industry.

The Pacific
Forestry Centre

INFORMATION FORESTRY

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363-0606 for further information

front cover: montane study site by Mt. Matchley
near Gold River on Vancouver Island

back cover: vigorously-growing Noble fir seven years
after planting at 1000 metres above sea
level near Harrison Lake, B.C.

Reforesting montane sites in coastal B.C.

“The higher you go, the shallower the soils become and the greater the variability in each site’s climate, soil type and exposure to weather conditions.”

For its first 100 years, logging on the B.C. coast stayed pretty close to sea level where high-value timber was easy to access and nature made reforestation fairly easy. But over time logging moved further and further upslope to the montane forests where climates are harsher, and soils are thinner.

Montane forests have played an increasingly important role in coastal wood supply over the last thirty years. About one-third of Vancouver Island is montane forest, approximately two-thirds of which remains as mature timber today. This will be the source of a good part of the coastal timber supply until lower-elevation second growth matures.

As loggers moved further upslope in the ‘60s, foresters began to find those reforestation practices that were reliable down in the valleys didn’t always work at higher elevations. According to Jim Arnott, a senior research scientist with the Canadian Forest Service, “Up until the ‘70s, coastal foresters were planting Douglas-fir and western hemlock just about everywhere. The problem with this is that once you get above 800 metres elevation, these tree species don’t do well. In a few extreme cases, entire plantations failed.”

Obviously, the most important feature that separates high-elevation forests from those in the valleys is the climate; growing seasons are short and snow accumulations are high. Arnott, though, adds that much more is involved. “The higher you go, the shallower the soils become and the greater the variability in each site’s climate, soil type and exposure to weather conditions. The extremes tend to increase.”

Arnott, together with Frank Pendl, recently retired from the B.C. Ministry of Forests, has released the results of a thirteen-year cooperative study to determine which species are best for a range of montane sites, when they should be planted and which type of seedling stock is preferable.

Jim Arnott

For their study, Arnott and Pendl planted about 36,000 trees in montane study plots on Vancouver Island and the south coastal mainland. To “test the limits”, they tried to make as many varia-

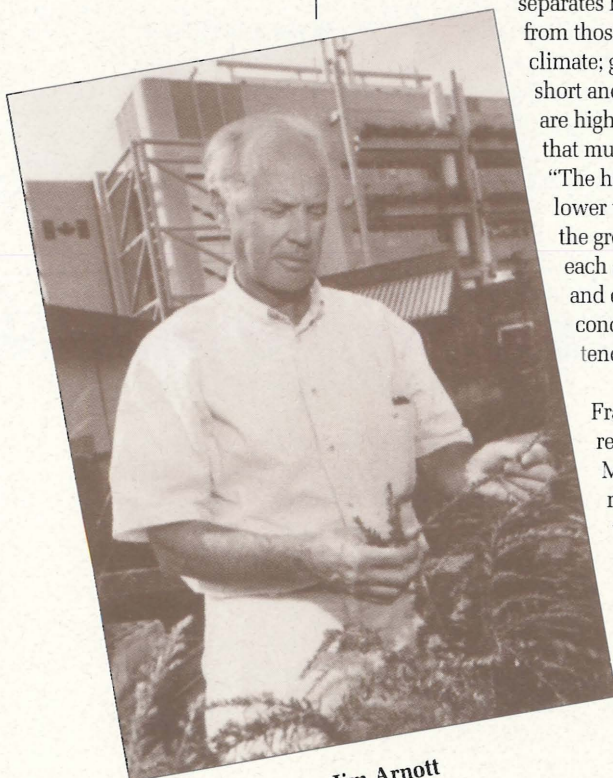
tions in their study as possible. The seedlings themselves were raised as three stock types and planted in the spring or fall on twelve sites across the range of Mountain Hemlock (MH) and montane Coastal Western Hemlock (CWH) biogeoclimatic zones. Yellow cedar and mountain hemlock were planted in the MH zone and western white pine, western redcedar, Douglas-fir and western hemlock went into the CWH zone. Amabilis fir and noble fir were planted in both.

Arnott and Pendl recorded the ecological characteristics of each plot as well as its logging history. They regularly returned to the plots and looked at tree survival, growth and form to judge each species’ reliability and productivity.

Their results? Although each site must be specifically assessed for planting, Arnott and Pendl say there are some general trends. In the MH zone, amabilis fir should be the first species choice for moist sites. On the more open, warmer areas, they may be intermixed with noble fir on a trial basis. Mountain hemlock performs moderately well in this zone, but yellow cedar displayed many form defects over the study period. For lower elevation sites within the montane CWH zone, Douglas-fir, western hemlock and western redcedar are good species choices. For higher elevations within this zone, foresters should choose amabilis fir or noble fir on a trial basis. In the MH zone, results were equally good from either a fall or spring planting while in the CWH zone, spring planting gave significantly better survival rates. Plug or plug-transplants are the preferred stock types for each of the zones.

Arnott and Pendl see their research on these sites as continuing for some time. “We have not yet fully answered the question of what is the best species choice for planting in montane forests because our trees are just starting to emerge from permanent winter snow,” Arnott says. “You might not realize it but deep snow cover can seriously damage trees. Species like yellow cedar might prove themselves to be superior once they rise above the winter snow level.”

Arnott sees the study as a database for another important research project in which he is now participating: The Montane Alternative Silvicultural Systems (MASS) Partnership. A cooperative effort by several federal agencies, universities and MacMillan Bloedel, MASS is testing innovative approaches to harvesting and regeneration in high-elevation areas. “The trees in the 13-year-old species study were all planted in fairly large clearcuts. Now that we have tested their performance in those conditions, we will have a baseline against which to compare results from our studies of forests harvested and planted using new and different methods.” More information on the high elevation species study can be found in a recent Information Report BC-X-347 available from the Pacific Forestry Centre.



Root-loving fungi keeps trees healthy

"Goodman's studies are an important step in learning about the importance of ectomycorrhizae to our healthy forests.

Some of the largest animals on earth benefit from tiny friends. Elephants are relieved of their pests by small oxpecker birds who cadge a free meal, and a free ride, from the pachyderm's back. Poorly sighted sharks provide minute pilot fish with protection from predators in exchange for their guidance in navigating. These mutually beneficial relationships between the large and the small exist in realms beyond the animal kingdom. The next time you marvel at the size of a giant Sitka spruce or Douglas-fir, remember that they stand healthy and tall thanks in part to the microscopic fungi that live at their roots.

Doug Goodman, a researcher with the Canadian Forest Service's Ecosystem Dynamics Program, has spent the last four years finding and cataloging these

root-loving fungi, called mycorrhizae. "Mycorrhizae," Goodman explains, "are found on the roots of almost every plant where they take up residence when the plant is very young. Mycorrhizae absorb water and nutrients like nitrogen and phosphorus for the plant and also seem to protect roots from pathogens and toxic soil substances. In return, the plant provides carbohydrates and amino acids to the mycorrhizae." Goodman's main interest is the fungi that envelop and penetrate tree roots, called ectomycorrhizae.

While many ectomycorrhizae have been described in Europe, few people in British Columbia have studied the various species that exist in this area or their importance to our forests. Goodman estimates there are only six people in B.C. researching ectomycorrhizae and he is the only

of these working full-time

to describe them. Goodman's studies focus on the ectomycorrhizae found in old-growth forests, com-

paring them to those in forests of eighty-year-old second-growth trees. He has so far found and identified 69 different species. "Only a dozen of these are common and few, if any, been described by others."

Goodman focussed his search for samples on two different sites, one in the Greater Victoria Water District lands and another high above the Koksilah River west of Shawnigan Lake. Both sites are in areas where old-growth forests are in close proximity to stands of mature second-growth. This ensured that his comparison plots were affected by similar weather patterns, soil type, drainage, elevation and direction of slope.

For the actual collection, Goodman removed cores of soil from the base of trees, logs, stumps, soil on rocks and elsewhere at random points within the sites. "I had to do a lot of looking to pick the sites and places to take soil cores, but that's fun. I like bushwhacking," says Goodman. Having obtained his soil cores, Goodman was faced with the task of extracting, photographing and recording the ectomycorrhizae. The process, he explains, is tricky. "First you have to extract the roots from the soil. Then you have to look carefully to distinguish the different types of mycorrhizae. I spent hours peering through microscopes."

Goodman had the soil analyzed to determine whether certain nutrients could predict the presence of particular mycorrhizal species. He also examined the fungi under a scanning electron microscope to explore their structures. His findings will be detailed in a report soon to be published.

Meanwhile, Goodman continues to research mycorrhizae and would like to publish a colour guide of his finds, showing their multitude of variations. Mycorrhizae come in different shapes and sizes, and their range of textures is phenomenal: smooth or stringy, lumpy or fuzzy. Their colours span the spectrum from brilliant yellow, to muted orange, to shades of cream and brown.

Goodman's studies are an important step in learning about the importance of ectomycorrhizae to our healthy forests. "Others studying interactions between mycorrhizae and ecosystems will be able to use my work as a starting point for identifying some of the species, and their own research will be that much faster."

"I'd also be happy if what I do helps people appreciate the complexity and diversity out there, help them notice tiny things that are so important to life. Almost every plant gets its water and nutrients from the soil by way of mycorrhizae. They depend on mycorrhizae as much as we depend on plants. And a knowledge of these symbiotic relationships may help us maintain the health of managed forests."



Doug Goodman taking a core soil sample from a research plot

The mystery of the declining forest

“Recognizing the two forest types was only a piece of the puzzle.

For the last eight years, CFS researcher Dr. Caroline Preston has been one of a team of scientific sleuths working to solve a mystery in the forests of northern Vancouver Island. The team are partners in SCHIRP, the Salal Cedar Hemlock Integrated Research Program.

Made up of scientists and foresters from universities, forest companies and the federal and provincial governments, SCHIRP is dedicated to solving the mysterious decline of young trees in northern Vancouver Island forests.

The story begins in the 1960s, when harvesting moved into these previously inaccessible forests. After harvesting, the sites were replanted and all appeared well. Then, after four to seven years, the young trees in many of the sites began to weaken and die back. The experts were puzzled. Neither insects nor diseases were affecting the trees and other nearby stands planted at the same time were thriving.

Dr. Preston says the first clue to the mystery was unearthed in the 1970's

CH stands, HA sites respond well to regeneration.

Recognizing the two forest types was only a piece of the puzzle. The questions of how and why CH forest ecology hampers later tree growth remained unanswered. Then, in 1986, the University of British Columbia, Western Forest Products Ltd., MacMillan Bloedel Ltd., Fletcher Challenge Canada, B.C. Ministry of Forests and the CFS joined to form SCHIRP. The partners undertook a variety of research on the ecology of the forest types, the impacts of salal on CH tree growth, and improving growth on replanted CH areas. “When we started out, we thought we would find some simple identifiable key to the problem. We now know that a combination of many little factors is to blame.”

The researchers have learned that the soils of the two forest types are quite different. Using Nuclear Magnetic Resonance, Dr. Preston and fellow CFS researcher Dr. Valin Marshall, traced the amount of nutrients cycling in the forests. They found that soils in the CH sites contain more decomposing wood, less nutrient cycling, lower levels of nitrogen, and poorer soil aeration than the

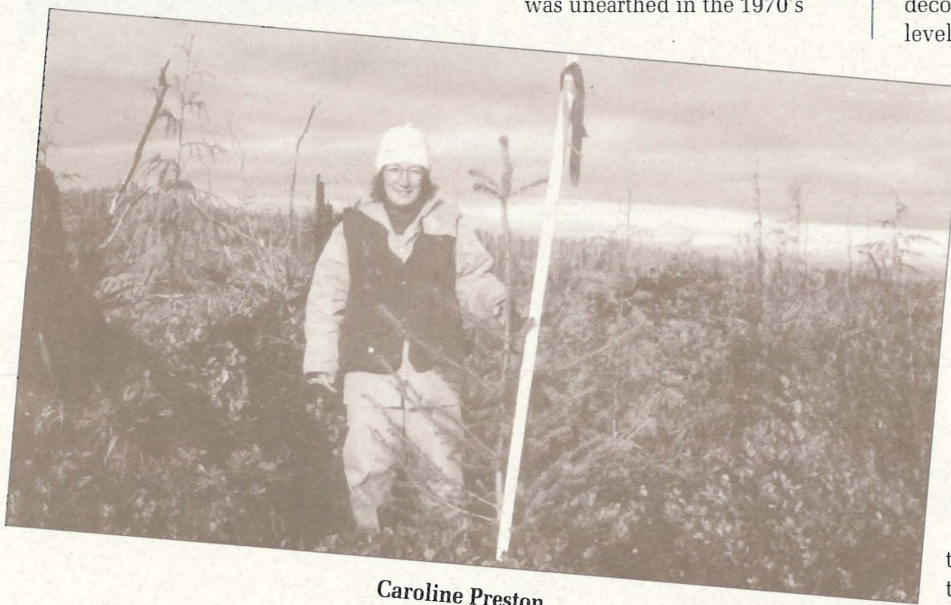
HA sites. The soils of CH sites also support fewer numbers of creatures, which adversely affects soil productivity.

Another factor is salal itself. “Salal is highly competitive and grows from a large network of roots,” says Preston. “Even after site preparation, the salal quickly takes over.” But, the plant does more than simply out-compete seedlings. “Salal has its own kind of chemical warfare going on,” Preston explains. The plant releases tannins and phenolics from its roots, which inhibit tree growth, uptake of nutrients and germination of seeds. Tannins also slow down the rate at which other forest materials decompose and return nutrients.

SCHIRP researchers are also testing ways to stimulate better growth by improving the fertility of the soil. They have found organic fertilizers like sewage sludge and fish wastes to be most promising.

Of the mechanical methods tested to prevent salal from out-competing the trees, burning and scarification before planting seems to be most effective. Densely planting an area may also help by increasing the rate at which the forest canopy is able to block out the light-hungry plant.

The SCHIRP project has vital implications for forestry in British Columbia's northern coastal regions. “There are many old cedar-hemlock ecosystems on the mainland coast that haven't been disturbed for a long time,” says Preston. “Before we can even begin to think of harvesting in these areas, we have to learn much more about salal and CH nutrients.”



Caroline Preston

when forest ecologists found that the north Island, indeed the northern coast of B.C., is a mosaic of two types of forest, cedar-hemlock (CH) and hemlock-amabilis (HA). “The original forest type of each area seemed to dictate which replanted stands flourished or declined.” The CH forest, which is linked to the failure of later trees, is characterized by uneven-aged stands of old-growth western red cedar, western hemlock and a small number of amabilis fir. The floor of these forests is a dense jungle of salal, a leafy dark green shrub. The floor of HA forests, so called because they are composed mainly of western hemlock and amabilis fir, is a sparse carpet of ferns and mosses. In contrast to

Linking governments - sharing information

"Both governments are concerned about our forests and environment...

"This joint venture will avoid costly duplication while focusing on social, economic and environmental objectives," said Hon. Anne McLellan, Minister of Natural Resources, when she officially opened the first inter-governmental high-speed data link in Canada.

The fibre optics link was made possible through the cooperative efforts of the Advanced Forest Technologies group of the Canadian Forest Service in Victoria and the B.C. Ministry of Environment, Lands and Parks.

"Both governments are concerned about our forests and environment," she added. "We recognize the opportunities for this network to increase public knowledge of Canada's forests and the need for sustainable forest management."

Through this initiative, sometimes referred to as the information super highway, the pro-



The Hon. Anne McLellan watches as Pal Bhogal demonstrates the benefits of the high-speed fibre optic link.

gram partners will share data, in the form of images of forests and lands in areas such as Clayoquot Sound, for future land management. This high-speed link can transmit the equivalent of 10 000 printed pages every second and will provide leading edge transfer rates between the two levels of government on forest and related environmental research.

Long Beach Model Forest Agreement Signed

Anne McLellan, federal Minister of Natural Resources, and Andrew Petter, provincial Minister of Forests, announced the signing of an agreement to establish the Long Beach Model Forest on the west coast of Vancouver Island. Fourteen partners representing a diverse spectrum of forest perspectives participated in the signing ceremony, which marked the completion of the Canadian network of ten model forests representing major forest ecosystems in Canada.

"A Model Forest Partnership demonstrates how all societal values and interests in forests can be accommodated, not compromised, in the delivery of its programs, projects

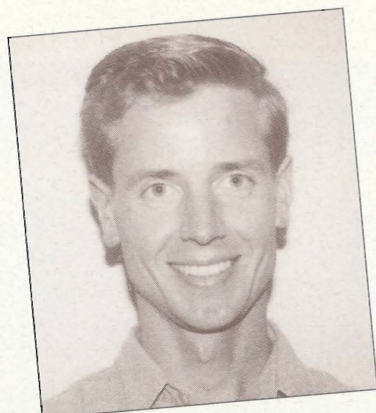
and activities," Minister McLellan said. "A cooperative decision-making process provides a firm foundation for a lasting agreement."

Each Model Forest is designed to be a working model of sustainable forest management for innovative solutions as well as scientifically sound management strategies. This will enable the sustainable development of the forest, while meeting the diverse demands made on the use of the forest lands.

The Long Beach Model Forest encompasses approximately 400 000 hectares of forested land.

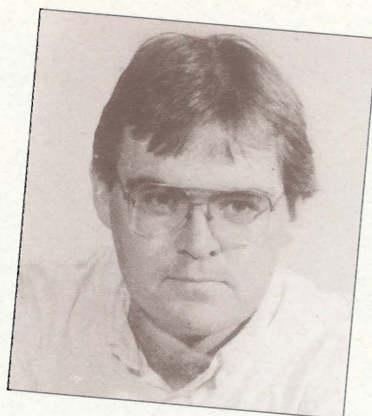
Staff Comings and Goings

Research Officer Rene de Jong has left us to accept a position as Inventory Officer with the Ministry of Forests in Queen Charlotte City. Rene has been a research officer with the Timber Production program at PFC since 1988.



Rene de Jong

Scientific Systems Analyst Doug Say has left the CFS to accept a position as head of Computing Services with the Inventory Branch of B.C. Ministry of Forests. Doug joined the CFS in 1981. His most recent work was with the Advanced Forest Technologies program.



Doug Say

“Canada’s industry would like to create a level playing field for all forest products producers throughout the world. Ideally, environmental regulations and programs that are based on sound science should be applied equally and fairly throughout the global marketplace.”

*– The State of
Canada’s Forests
1993*

Recent Publications

The State of Canada’s Forests. 1993 Forests, A Global Resource. Fourth Report to Parliament

The fourth annual report to parliament on the State of Canada’s Forests addresses the growing links between trade and the environment and provides a brief introduction to the importance of biological diversity. Recent forestry statistics are also included.

Forest Insect and Disease Conditions in Canada 1992

compiled by J. Peter Hall in cooperation with officers of Canadian Forest Service establishments.

Provides quantitative and interpretive data on damage and depletion caused by forest pests in Canada during 1992. Compiled from regional FIDS surveys. Published 1994.

Recent Publications - 1994

A listing of the reports and publications authored by staff of the Canadian Forest Service in the Pacific and Yukon region.
BC-X-350

Field performance of several tree species and stock types planted in montane forests of coastal British Columbia

by J.T. Arnott and F.T. Pendl

Results of 13 years of research into reforestation in coastal montane forests compares the performance of a variety of tree species and stock types and planting seasons in both the Mountain Hemlock Zone and the Coastal Western Hemlock Zone.
BC-X- 347

INFORMATION FORESTRY

(See story on page 3)

