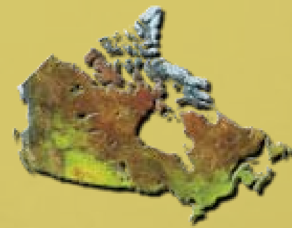
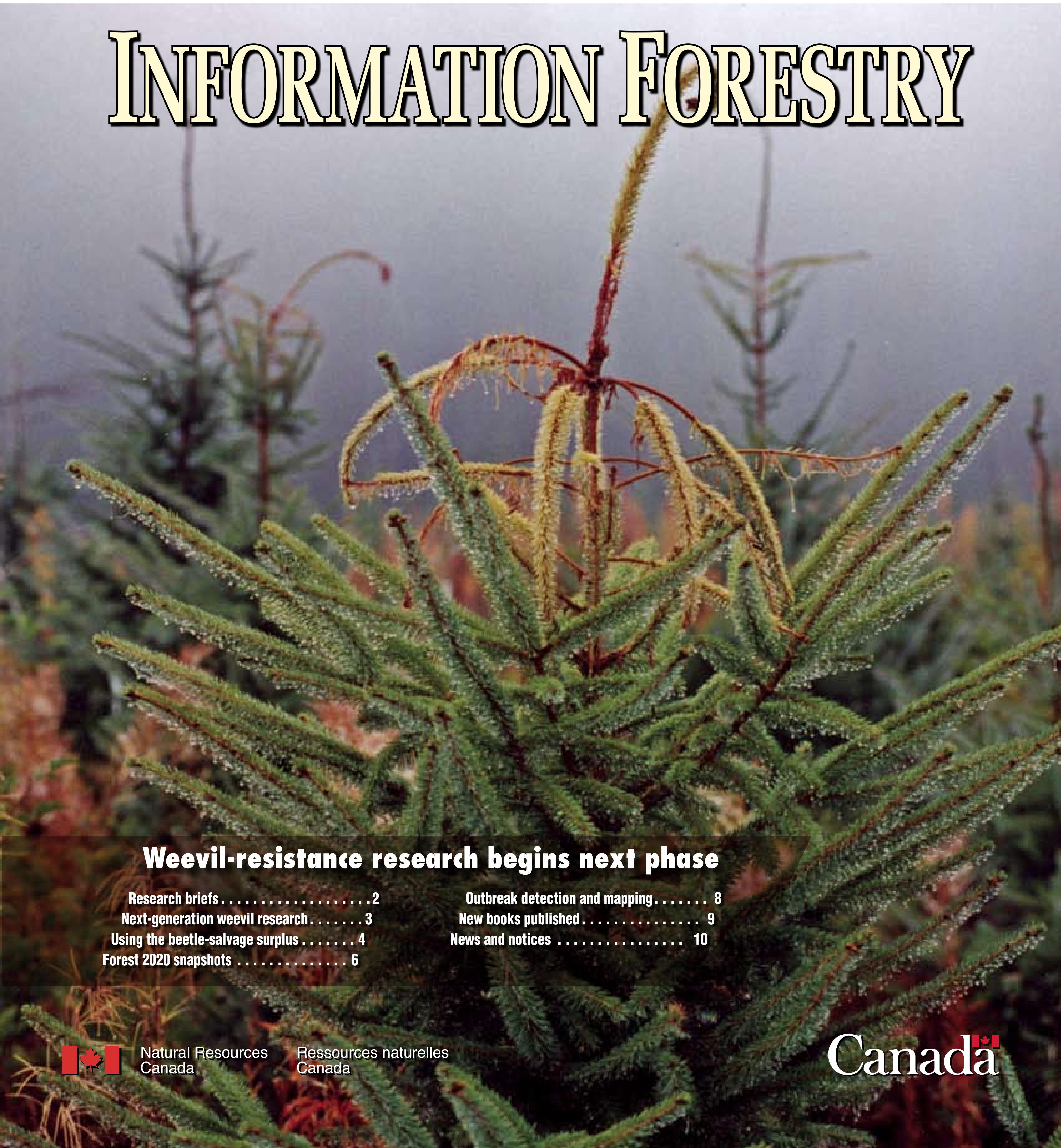
April 2006
ISSN 0706-9413

CFS CANADIAN FOREST SERVICE

Pacific Forestry Centre
Victoria, British Columbia



INFORMATION FORESTRY



Weevil-resistance research begins next phase

Natural Resources Canada
Ressources naturelles Canada

Canada

Approach reveals systematic differences between similar maps

If two digital maps are alike, their differences will appear scattered randomly across the map. Clustering—or spatial autocorrelation—of differences, on the other hand, indicates fundamental differences in how the maps were made.

"Spatial autocorrelation allows us to quantitatively demonstrate underlying systematic differences in satellite-imagery treatment or mapping methodology," says Forest Inventory and Analysis Research Scientist Mike Wulder (**mwulder@pfc.cfs.nrcan.gc.ca**), of the Canadian Forest Service. Wulder and his colleagues used spatial autocorrelation to illustrate and identify consistent, methodological differences between two seemingly similar maps of Canada's land cover.

The maps, produced in 1995 and 1997 with data from the Advanced Very High Resolution Radiometer (AVHRR) satellite, provide similar estimates of the country's total forested area. Yet, when researchers compared the maps' forested areas using spatial autocorrelation of differences, they found about the maps disagreed for about 35 percent of the areas compared.

This means that although similar total areas were mapped as forest, not all of the same locations were mapped as forest. The most widespread differences, says Wulder, can be explained by the different legend categories used by the maps. The legend for one map, for example, provided for two different kinds of forest and one shrub category, while the legend for the other map was much more detailed.

Spatial autocorrelation revealed the more subtle differences in the mapping systems, such as when data were collected, what kinds of things were done to remove cloud in the satellite imagery before classification, or where the people doing the mapping interpreted land cover differently. "All of these make for different map products," says Wulder. For instance, three regions where differences in land-cover interpretation occurred frequently are the McKenzie Delta area, the Hudson Bay lowlands, and the prairie-to-forest fringe—areas with highly varied ground cover and many wetlands. "One person might call a particular segment of one of these areas forest, while someone else might interpret it as wetland, or prairie, or whatever else they thought it was."

The point of the analysis was not to show that one map is better than the other: both maps serve well the purposes for which they were made. "It's a matter of illustrating that each map is very much a product of its own heritage," says Wulder. "Researchers who use these kinds of maps in computer models or to generate other information need to be aware of the differences, because they will affect results."

Western hemlock no athlete when building up nutrients

High-performance athletes spend years preparing for competitions in the hopes that their efforts will give them enough of an edge over rivals to bring home a title. In a recent study, Canadian Forest Service researchers found that matching fertilization to growth did not similarly condition nursery-grown western hemlock seedlings to consistently outperform competitors when field planted. It did, however, induce greater growth in the seedlings while in the nursery, which led to greater performance—compared to control seedlings—in the field.

"Our reasoning had been that the higher the concentration of nutrients stored in foliage before field planting, the greater the head start the seedlings would have," says Pacific Forestry Centre Research Scientist Al Mitchell (**amitchell@pfc.cfs.nrcan.gc.ca**). "But it didn't turn out that way."

He and his team compared nutrient concentrations in seedling needles and seedling growth after two seasons of fertilization in the nursery, and after one and two years in the field. Some seedlings received doses of fertilizer in regular, unvarying amounts; other seedlings were fed regular, but ever-increasing doses of fertilizer to match increasing seedling growth—a feeding system called exponential fertilization.

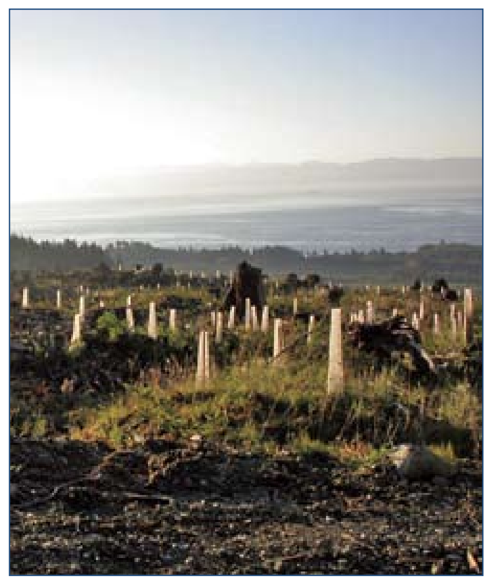
"By the end of the growing season, when seedlings go dormant, exponentially fed seedlings receive very high doses of nutrients, which we thought would be taken up and stored in seedling tissues. Nutrient loading is a way to condition seedlings for greater performance."

Instead, however, seedlings that underwent exponential fertilization grew more in the nursery, but the fertilization regime had little effect once they were field planted. When scientists measured nutrient accumulation in needles after planting, they found concentrations less than one-half percent higher in exponentially fed seedlings than in constant-rate–fed seedlings—a difference that quickly dissipated.

"It's the same with people training to run a marathon," says Mitchell. "Some people become conditioned really easily, and others don't. And some people, once they stop training, lose conditioning quickly. Western hemlock loses conditioning quickly."

Instead of loading nutrients, says Mitchell, western hemlock immediately uses them to grow bigger. This confers its own competitive advantage out in the field.

"Plants that start big get bigger faster; plants that start small never catch up."



Scientists planted 1,500 western hemlock seedlings near Jordan River, British Columbia, to test effects of nutrient loading on subsequent growth. It turns out, western hemlock doesn't load nutrients; it immediately uses them to grow bigger, which confers its own headstart in subsequent growth.

Weevil-resistance research enters next generation of trees and studies

Row on row, young spruce line the hillside. The saplings, growing at a Vancouver Island Western Forest Products nursery and seed orchard, represent the latest development in the largest screening program for genetic resistance to insects in trees in the world. The province-wide field test for white pine weevil resistance in Sitka and interior spruce began 12 years ago, and involved more than 20 researchers from the Canadian Forest Service, the British Columbia Ministry of Forests, universities and industry. Seeds were collected from potentially resistant trees throughout Sitka spruce range in British Columbia; these were planted by Canadian Forest Service researchers, among others, and subjected to repeated, artificially induced weevil attack. More than 35,000 individual trees were screened in this way.

The young spruce growing at the orchard are cross-pollinated offspring of trees that best survived those induced outbreaks.

The Western Forest Products nursery is one of two orchards assisting with controlled breeding of the resistant stock. Every spring, researchers collect pollen from the saplings, and use it to fertilize female cones. "The seeds are used to grow stock that will be established in field trials," says the company's Tree Improvement and Research Coordinator Annette Van Niejenhuis. "Also, the collective stock descended from each parent is assessed for weevil resistance by comparing the numbers of successful weevil attacks on this stock to the overall average for selected populations." From these data, the orchard's 2005 seed crop is estimated to have 87 percent weevil resistance.

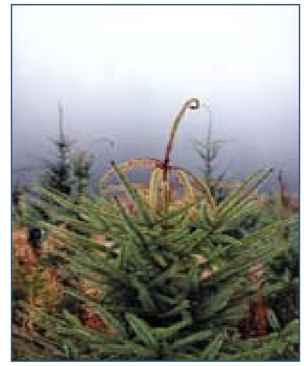
Up to 20 percent of seed produced at the orchard is donated to the province for resistance research. Once the company has met its own reforestation needs, it will make surplus seed available to other companies, as the other seed orchard participating in the program does already. Ultimately, says British Columbia Ministry of Forests Research Scientist John King, of the Coastal Tree Breeding Program, "the goal is to make Sitka spruce an acceptable species for reforestation again."

White pine weevil, named for its preferred eastern North American host, is the most economically damaging native insect limiting spruce and pine regeneration in Canada. In British Columbia, the weevil attacks mostly Sitka, white and Engelmann spruce. Adult and larval weevils eat the cambium layer of a host's leader, killing it. This reduces the tree's height growth, and increases susceptibility to disease. "People have been avoiding planting Sitka spruce for years because of the weevil," says King. "Now that we've identified resistances and resistant seed is becoming available, it'll become a more common species in replanted forests."

Resistance breeding also started a new phase in research. "We're investigating how these trees are resistant," says Canadian Forest Service Research Scientist Rene Alfaro (**ralfaro@pfc.cfs.nrcan.gc.ca**). "And we're studying the ecology of resistance—the ecological conditions under which resistance originated and where it is most likely to be stable."

Studies indicate weevil resistance is inherited and stable over time. When researchers crossed resistant parents, resulting offspring were super-resistant—protected by multiple resistance mechanisms. Other studies show that silviculture methods can also support resistance. Fertilization, for example, increases tree growth to such an extent that resulting gains far outweigh losses due to increased weevil attack.

"The weevil and the tree are in balance," says Alfaro. "The tree has adaptations to prevent or compensate for attack, or to recover faster. But the insect has its own adaptations to overcome these defences. The key for us is to manage this balance in favour of the tree. Silviculture, genetics, and nutrition can tip the balance in the tree's favour."



From the Cover:
Adult and larval weevils damage trees by eating the cambium layer of a host's leader, killing it.

Saplings at a nursery–seed orchard on Vancouver Island represent the most weevil-resistant crosses of Sitka spruce families. Because of genetic resistance screening and breeding programs, Sitka spruce may become a successful reforestation species in its native habitat.

Using the beetle-salvage surplus: Strategy focuses on

"Large volumes of mountain pine beetle-killed wood are and will be coming into British Columbia's timber supply chain in the next few years," says Mountain Pine Beetle Initiative Chief Implementation Officer Dave Harrison (daharris@pfc.cfs.nrcan.gc.ca). "In order to deal with them effectively, we need to know how beetle attack affects wood properties, and how those in turn affect manufacturing processes and markets. We need to determine the economic shelf life of beetle-killed wood in its possible forms."

Recent estimates indicate that 900 million cubic metres of lodgepole pine timber—more than 80 percent of the mature lodgepole pine resource in British Columbia's interior—is at risk during the current mountain pine beetle epidemic. The provincial government is encouraging salvage of post-beetle timber during the next five to 15 years as part of increased annual allowable cut.

The timespan for commercial recovery of post-beetle timber is its shelf life—how long beetle-killed wood will retain properties such as density, toughness and permeability, among others, that allow it to be processed into various products. Beetle-killed salvage timber is drier, more brittle and more permeable than green wood, contains more resin and chemical extractives, and has more checks and splits than healthy wood does. These properties result from *in situ* deterioration of the wood after tree death. Changes in those properties over time affects how the wood can be economically processed and into what products—the economic value of the wood.

Research into the shelf life of beetle-killed timber, along with inventory information, processing capacity and markets, are key elements in planning the timing and distribution of salvage harvests.

And beetle-killed wood does have economic value. For instance, the forest industry does not consider blue stain, discolouration caused by beetle-associated fungi, a defect in most softwood lumber-grading rules. In a study by Forintek Canada Corp., a research partner in Natural Resources Canada's Mountain Pine Beetle Initiative, beetle-killed blue stained wood was found to be only five percent less tough than unstained wood, and tested comparably to unstained wood for density, bending strength and stiffness. A 2005 Chinese Academy of Forestry comparison study of the qualities of blue stained and unstained wood supports these findings.

Under the economic strategic objective of the six-year, $40-million federally funded Mountain Pine Beetle Initiative, further work is being undertaken to determine shelf-life changes and potential impacts. "Initiative research is complementing harvesting and production decisions, investigating how to maintain markets for products manufactured from beetle-killed timber, and integrating non-timber values such as wildlife habitat, view-scape objectives and hydrology with salvage management," says Director of Mountain Pine Beetle Initiative and Policy Research Bill Wilson (**bwilson@pfc.cfs.nrcan.gc.ca**).

"The rate of deterioration of beetle-killed timber will determine the volume of suitable material available for specific forest products during the next 5, 10 and 15 years. Initiative research is providing information on the effects of mountain pine beetle on the timber resource to support harvest-scheduling and timber-processing decisions to maximize value recovery while mitigating risk to communities and natural environments."

Under the Initiative's Epidemic Risk Reduction and Value Capture Research and Development Strategy, existing relevant research was synthesized and explicit information gaps in regards to the situation in western Canada identified. Once it had been determined that processing- and product-performance properties in beetle-damaged wood needed to be examined, the Initiative called for research proposals to deliver this information, as well as to determine cost-effective adjustments in technologies involved in the processing of post-beetle timber.

As a result, scientists across Canada are investigating how shelf life affects the economic value of beetle-killed wood for a range of forest products. Research underway at the University of Northern British Columbia, for example, indicates that beetle-killed trees can remain standing for 15 years or longer in dry conditions—much longer than originally thought. Beetle-killed wood was also found to lose up to 30 percent of its moisture content within a

beetle's effects on processing and markets

year of tree death. This means beetle timber should not be dried at the same temperatures nor for the same lengths of time as green timber in a standard kiln if comparable moisture content is sought. Researchers have also found that shelf life impacts the value of beetle wood for veneer and plywood manufacture—lodgepole pine can lose nine percent of its veneer volume between 90 and 180 days after a tree has died from beetle infestation. The chemical and physical properties of wood chips used by the pulp and paper industry have been found to also vary since time of death and require adjustments to existing pulping processes. Initiative-funded research is also exploring questions around the suitability of beetle wood fuel pellets, firewood and wood energy.

Results from this round of research, in turn, have delineated more specific information needs.

"We met with stakeholders at the outset to set overall research priorities for the Mountain Pine Beetle Initiative, and design the strategy, but as research is completed, additional research needs are identified," says Wilson. Regular research accountability sessions in the regions serve to both transfer research information and identify emerging needs. Calls for research proposals are based on this.

"Think of the research that's being done as an inverted pyramid," says Wilson, "Broader questions and more general problems at the top, narrowing down to questions that are more and more defined and specific. It's a very focussed and methodical approach to research, and will help prevent us from overlooking key information needs."

In terms of big-picture economics, the demand for valuable wood drives the need to investigate issues such as the shelf life of beetle-killed wood. Government and industry in areas impacted by the mountain pine beetle epidemic have large capital investments in infrastructure, sawmills and wood processing plants, and many communities rely on forestry jobs and investment to support economic prosperity and social stability. Research funded by the Mountain Pine Beetle Initiative is helping these communities to assess the impacts of the epidemic and options to mitigate it through an improved understanding of the implications of post-beetle wood shelf life.

For more information about economic research and development under the Mountain Pine Beetle Initiative, visit **mpb.cfs.nrcan.gc.ca/research/economic_e.html**. Results from Initiative-funded research can be found on the Canadian Forest Service's Online Bookstore: **bookstore.cfs.nrcan.gc.ca**

Economic Strategic Objective
Provide information to complement harvesting and production decisions and to maintain markets for manufactured products from post-beetle timber.

Strategic Initiative 1
Development and delivery of market support information on the aesthetic and performance properties of post-beetle wood.

Strategic Initiative 2
Development and delivery of market support information on the physical properties of post-beetle wood.

Strategic Initiative 3
Development and delivery of product and market support information on the chemical properties of post-beetle wood.

Mountain Pine Beetle Initiative-funded economic research documents effects of the beetle on timber to support harvest and production decisions and to maintain markets. For instance, research by the Pulp and Paper Research Institute of Canada quantifies costs associated with mechanically pulping and brightening blue-stained chips, thereby focussing treatment and preparations of pulps to maintain quality and cost effectiveness.

Forest 2020 Plantation Demonstration and Assessment

Just the mention of large-scale terms such as "Kyoto Protocol" and "climate change" can overwhelm us. Sometimes we need to look at what's happening on a smaller scale.

Started in 2004, the Forest 2020 Plantation Demonstration and Assessment program was one component of Canada's Climate Change Plan for Canada. The Canadian Forest Service administered this $20-million, two-year investment.

Nationally, the program's objective was to offset carbon dioxide emissions in the air by sequestering (or storing) carbon in fast-growing plantations. As trees mature, they remove carbon dioxide from the atmosphere and store it as carbon. The areas planted were afforested, meaning they didn't have trees growing on them before.

Provincially, the benefits were numerous and surprising. "The story in British Columbia is that, besides sequestering carbon, we also encouraged a wide variety of secondary goals — producing new fibre, using solid waste for fertilizer and moisture, rehabilitating sites, conserving wetland biodiversity, and growing multiple crops on the same land," explains Dean Mills (**dmills@pfc.cfs.nrcan.gc.ca**), who looked after the program in the province. "Traditionally, wood fibre would have been the main objective, but we broadened the concept of plantation benefits to recognize an exciting range of values and uses including carbon sequestration," he adds.

Through 56 projects, the Canadian Forest Service encouraged private landowners, First Nations, municipalities, and industry to establish plantations. From 2004 to 2006, these partners planted 1,248 hectares in British Columbia.

Hybrid poplar was by far the most commonly planted species (63 percent overall). Conifers such as white spruce, lodgepole pine, western white pine, and ponderosa pine were used as well. To maximize growth, seedlings from superior (or Class A) seed were chosen. A non-native tree, Siberian larch, was also introduced (17 percent overall).

How rapidly will these trees grow? Initial measurements show that we can expect the average gains for the British Columbia plantations to be 18 cubic metres per hectare per year.

Here's a sample of Forest 2020 projects across the province, featuring different goals and different challenges.

Forest 2020 plantations were established on 64 hectares of Lower Kootenay First Nation reserve land next to the Creston Flats canals on the Kootenay River. The plantations will protect agricultural crops, create riparian habitat, and provide much-needed jobs for band members.

Lower Kootenay: Growth of All Kinds

In southeastern British Columbia, the Creston Flats on the Kootenay River are fertile fields separated by canals. Most of the project's 64 hectares were spread out in 40-metre-wide plantations next to the canals. These plantations will protect future agricultural crops and create riparian habitat. Crews from the Lower Kootenay First Nation, along with Caliburn Contracting of Creston, planted most of the area in 2004, with some new and fill planting in 2005.

The land was historically wetland until dykes and the Libby Dam were constructed in the early 1970s. Recently, the band leased the land to farmers, but is buying back a portion of each lease to create these plantations. The band will also be leasing the rows between the poplar for hay production, and is developing a long-term plan for agroforestry.

"The trees have grown pretty darn fast," observes Sheri Walsh, consulting forester and delivery agent for this project. "In some areas, they are over two metres tall after two seasons. But my informal surveys show failures, too. We're trying to explain this inconsistency." Still, she estimates a healthy minimum growth rate of 20 cubic metres per hectare per year.

The project features many benefits for First Nations: use of reserve land, "reclamation" of land from non-native farmers, and much-needed jobs. But the Band faced many challenges. The wet spring and early summer of 2005 created ideal conditions for weeds such as residual Roundup–Ready canola® and shepherd's purse. "I wouldn't have predicted the incredible weed growth…it's phenomenal," explains Curtis Wullum, natural resource coordinator for the Band. Although the sites were brushed continuously in both 2004 and 2005, the crew could barely keep ahead of the invaders.

The weeds, in turn, created perfect habitat and protection from predators for voles. These creatures chewed or nipped the poplar stems right off. By stripping roots, pocket gophers also killed some of

Program: Snapshots of success across British Columbia

the best poplar. The poor quality of planting stock, and browsing by deer and cattle before the fencing was completed, also affected some plantations. Successfully managing fast-growing plantations requires attention and creative solutions.

Peace River: Focus on Conservation

In British Columbia's northeast corner, Forest 2020 took a different tack. On 75 hectares spread over six sites, conserving wetland habitats and creating biodiversity while sequestering carbon were the main objectives. The Nature Trust of British Columbia and Ducks Unlimited Canada owned, either individually or jointly, the conservation properties. The provincial Ministry of Environment holds the 99-year lease on The Nature Trust properties.

"To meet the habitat restoration goals for the sites, we planted locally collected trembling aspen seedlings in the upland, well-drained sites, and balsam poplar (cottonwood) cuttings elsewhere," states Marian Adair, habitat ecologist for The Nature Trust.

As some mortality was expected, crews planted to higher density than the target of 900 to 1,000 stems per hectare. The spotty mortality will produce a mosaic of openings and forest cover, thus creating habitat around the wetlands. Growth rates are anticipated to match those of naturally occurring poplar and aspen.

To restrict weed competition, the crew installed brush mats on 90 percent of the trees. However, voles would possibly use the mats as protective cover from predators, thereby having convenient access to the newly planted trees.

"Our research showed the higher risk for mortality was from the brush, not from the voles," remarks Adair. "So, we went ahead and stapled down the brush mats." This project may showcase plantation and conservation use for other wetland areas across Canada.

Matsqui: Up, Up, and Away

A fertile island in the Fraser River near Mission, British Columbia, is now home to the largest Forest 2020 plantation in Canada. The 80-hectare site lies on Matsqui First Nation lands, which have a long history of forest management. This project aimed to afforest those areas where trees hadn't taken, mostly due to invasive weeds. For example, Himalayan blackberry dominates and suppresses other vegetation on these moist lowlands.

"The biggest surprise was the phenomenal tree growth in the first season," notes Robin Clark, executive director of Envirothon, a Forest 2020 delivery agent. "In spring 2005, we took poplar whips (or sticks) about one-metre-long from the freezer and planted them within a few days. By September, some whips were three metres tall. We expect these trees to grow at rates of 25 cubic metres per hectare per year on a 15- to 20-year rotation." Not as welcome were the beavers, which ate about two hectares of plantation.

Forest 2020 partnered with Scott Paper Limited, which supplied the trees and lots of planting advice. Prospect Equipment from Mission cleared the area, mounded low-lying areas, and transported trees and fertilizer by boat.

Coordination was key to the project's success. Chief Alice McKay and her staff championed the cause, and ensured that planters were hired and logistics ran smoothly. Band members planted the almost 34,000 fast-growing hybrid poplar. Marc Robillard, master in crew motivation and planting technique, made it all come together.

The Forest 2020 Plantation Demonstration and Assessment Program was awarded a Canadian Forest Service Award of Merit for Exceptional Achievement in February, 2006.
See page 10 for details.

More than 1,248 non-forested hectares in British Columbia were planted with fast-growing tree species from 2004 to 2006. In British Columbia, these species included hybrid poplar, white spruce, lodgepole pine, western white pine, ponderosa pine and Siberian larch. The plantations represent a bank of information, not only on growth rates of fast-growing species but also on the complexities of establishment, management, and landowner incentives.

An 80-hectare site on a Fraser River island owned by the Matsqui First Nation is the largest Forest 2020 plantation in Canada. Prior to this project, invasive weeds had prevented reforestation of the site.

Analysis automates outbreak detection and mapping

Because jack pine budworm outbreaks peak quickly, forest managers need to be able to detect and map them quickly and accurately in order to make management decisions. With the multispectral analysis technique developed by Leckie and colleagues, once multispectral images are obtained, analysis of the imagery for outbreaks can occur quickly.

Forest managers now can streamline detection and mapping of jack pine budworm outbreaks using a computerized image-analysis method developed by Canadian Forest Service researchers. The method, developed a decade ago to monitor spruce budworm infestations and now part of many spruce budworm management programs, was found during recent tests to also accurately detect and map defoliation by jack pine budworm.

The technique uses high-resolution imagery obtained from multispectral airborne or satellite cameras, in combination with inventory data, to pinpoint and measure foliage discolouration of conifer over a landscape. During spectral analysis of images taken at a site in eastern Ontario during a severe jack pine budworm outbreak, researchers determined that the automated spectral-classification technique was 84 percent accurate in detecting discoloration due to budworm attack in jack pine stands.

"This is one more tool forest managers can use to get information on which to base management decisions," says Pacific Forestry Centre Research Scientist Don Leckie, the project leader (**dleckie@pfc.cfs.nrcan.gc.ca**). "This method provides better, quicker, more reliable spatial information than what they were getting from sketch mapping." Multispectral imagery from the Multispectral Electro-optical Imaging Sensor (MEIS), IKONOS and Quickbird satellites or from airborne multispectral cameras can be used.

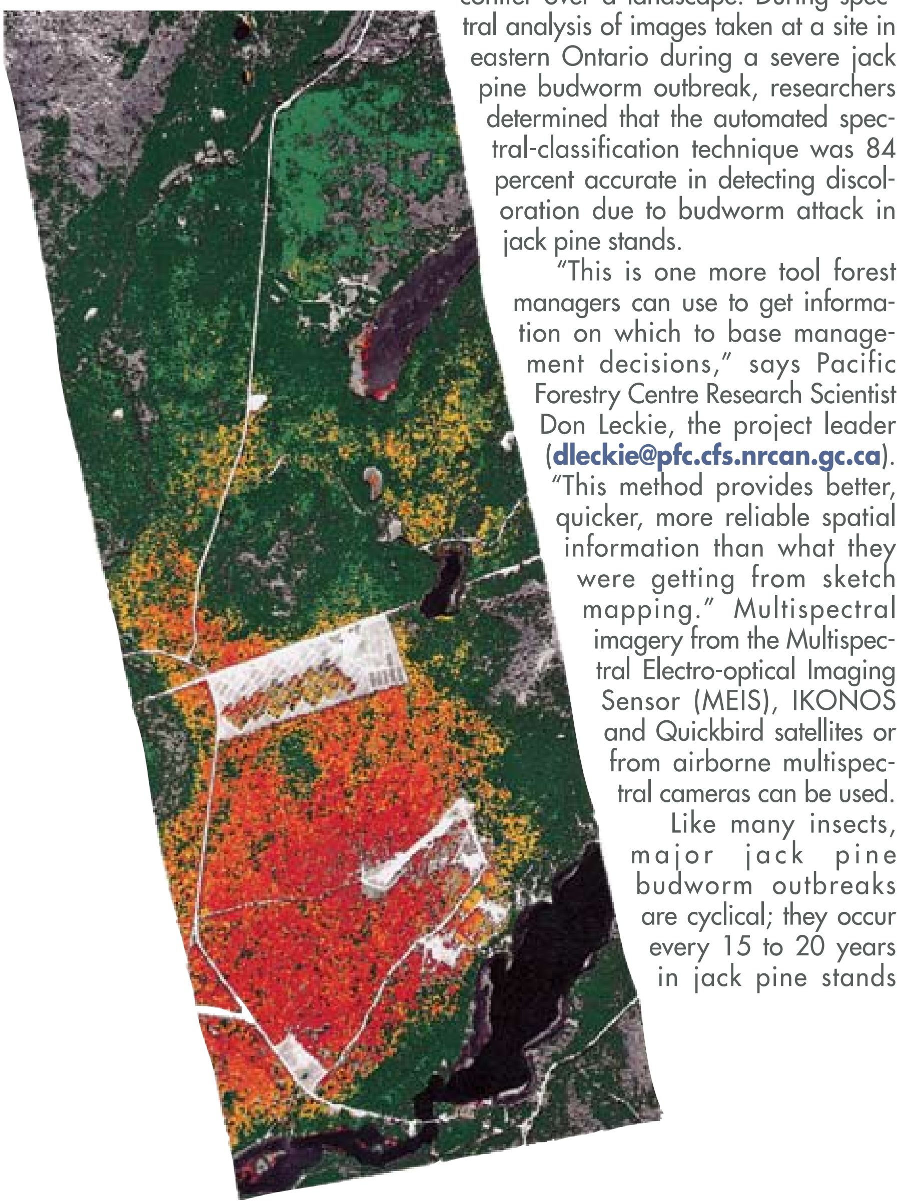
Like many insects, major jack pine budworm outbreaks are cyclical; they occur every 15 to 20 years in jack pine stands throughout the subboreal forest. Unlike spruce budworm, outbreaks tend to be spatially sporadic and short-lived, spiking and disappearing over only a few years. However, in some regions, jack pine budworm outbreaks have become more frequent and more severe in recent decades, leading to greater economic impact.

The increase in frequency and severity may be due to the changing forest, says Insect Ecologist Vince Nealis (**vnealis@pfc.cfs.nrcan.gc.ca**). "In northeastern Ontario, for instance, jack pine has become a more dominant component of the forest. It has replaced white pine in many areas, because we really haven't had much success overall at regenerating white pine there. Jack pine grows—and grows quickly, which is why it's being planted—but it's very likely a bit stressed."

Stressed jack pine trees produce many pollen cones and these pollen cones are critical sources of food for the jack pine budworm early in the season. This dependence on pollen cones makes jack pine budworm outbreaks more difficult to predict than those of the spruce budworm. As well, lab-generated pheromones are not as reliable with the insect, and jack pine budworm moths tend to lay their eggs in large clumps, so more branches and twigs need to be sampled to obtain reliable estimates. "All of these factors introduce errors and make detection of an outbreak's early stages difficult," says Nealis. "And because outbreaks tend to peak and wane suddenly, early detection is necessary if forest managers want to implement any kind of pest management or salvage."

That's where Leckie's automated detection and mapping system comes in. Once high-resolution multispectral imagery is obtained of a landscape believed to be infested, forest analysts train the computer program to pick out and label pixels with spectral values indicating discoloured foliage. The computer can then analyze pixel-spectral values in the landscape imagery to detect and map where budworm infestation is occurring.

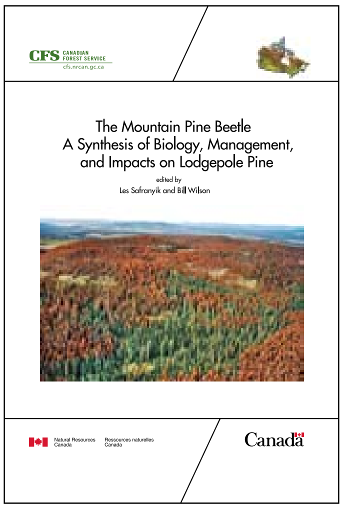
"Only three or four well-defined spectral bands are needed to classify the different defoliation levels," says Leckie, "And either airborne or satellite multispectral imagery can be used, provided it's in the two- to four-metre resolution range. It also works in concert with existing inventory systems and decision-support models. All this makes the method flexible, and fairly easy to apply."



Classified multispectral image, with all six spectral bands. The colours indicate healthy forest (light green) and intensity of infestation (light infestation—yellow; moderate—orange; severe—red). Dark green indicates conifers other than jack pine.

New books feature significant British Columbia insects

Two new titles published this spring by the Canadian Forest Service, Pacific Forestry Centre, contain information of interest to forest managers, researchers, arborists, tree farm and nursery managers and even gardeners across British Columbia. These titles are available from the Canadian Forest Service Online Bookstore, at **bookstore.cfs.nrcan.gc.ca**, and will also be available as CDRom.



The Mountain Pine Beetle: A Synthesis of Biology, Management, and Impacts on Lodgepole Pine presents a synthesis of published information on mountain pine beetle biology and management, with an emphasis on lodgepole pine. It is also intended to assist in identifying the research necessary to effectively respond to the current beetle epidemic in British Columbia.

The book, funded by Natural Resources Canada through the Mountain Pine Beetle Initiative, is intended to be the most comprehensive treatment of mountain pine beetle to date. It covers three main subject areas: mountain pine beetle biology, management, and socio-economic concerns.

"Our synthesis of mountain pine beetle biology highlights the importance of climate and the evolved interaction between the beetle with its associated blue stain fungi and lodgepole pine in determining the onset and course of beetle epidemics," says Research Scientist Les Safranyik, a co-editor of the book. "Information is presented on factors affecting change from endemic to incipient population phase, possible effects of climate change on range expansion, and the structure, growth and development of residual stands following epidemics."

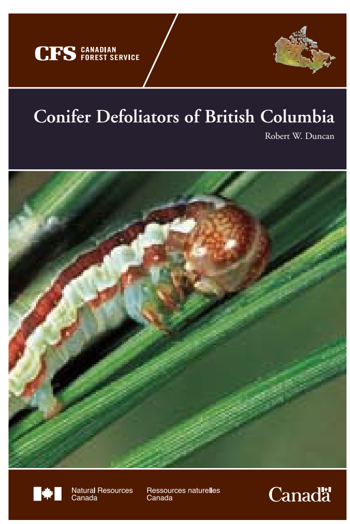
In the management section, information includes an assessment of remote sensing tools in beetle survey and detection, the role of decision aids in management programs, and the potential of preventive forestry practices to reduce losses from the mountain pine beetle.

"The synthesis of the economic aspects of management points out the relatively minor role economic theory has played in beetle management and suggests ways to increase this vital component of decision making," adds Director of the Mountain Pine Beetle Initiative Bill Wilson, a co-editor.

Conifer Defoliators of British Columbia includes information about most of the caterpillars and sawfly larva known to feed on conifer foliage in British Columbia. Larval descriptions, life history data, color photographs and pictorial key are provided to help users identify defoliators occurring on a coniferous host in British Columbia, and quickly locate information on the distribution, hosts, biology, abundance, feeding habits, and economic impact of each species of this important group of insects. Although the geographic coverage for this guide is British Columbia, many of the species included occur throughout much of the western cordillera.

It is hoped, says author and Canadian Forest Service Insect Biologist Robert (Bob) Duncan, who spent nine years collecting, rearing and studying the 175 species described in the book, that the images and information presented will foster improved appreciation and understanding of the forest caterpillars and sawfly larvae of British Columbia. "Although a small fraction of these insects cause significant damage to the forests, most defoliator species are harmless, and perform many vital ecological functions in our forests."

Conifer Defoliators of British Columbia is funded by Natural Resources Canada Canadian Forest Service, with support from the British Columbia Ministry of Forests' Forest Investment Account, Forest Science Program.



People

Rene Alfaro, Bill Wilson, Brad Stennes, and Sen Wang receive awards from Brian Emmett

Raj Prasad

Accolades

Natural Resources Canada **Assistant Deputy Minister Brian Emmett** visited the Pacific Forestry Centre on February 21 to present three Canadian Forest Service Awards of Merit for exceptional work on projects and programs:

In the Collaboration and Partnerships category, Pacific Forestry Centre staff Research Scientist **Rene Alfaro**, Director, Industry, Trade and Economics **Bill Wilson**, and forest economists **Brad Stennes** and **Sen Wang** were recognized for their work on the International Union of Forest Research Organization Special Project World Forests, Society and Environment. Natural Resources Canada Senior Policy Advisor **Mike Fullerton**, of Ottawa, also received this award.

The Forest 2020 Demonstration and Assessment Program was awarded an Award of Merit for Exceptional Achievement. Pacific Forestry Centre participants include Business Development & Marketing Manager **Dean Mills**, Forest Liason Officer **Art Shortreid**, and Afforestation and Carbon Accounting Physical Scientist **Thomas White**.

The third Award of Merit presented, also in the Exceptional Achievement category, was to Research Scientist **Eric Allen** for his work on the development and implementation of international guidelines for phytosanitary measures regarding wood-packaging materials.

Research Scientist **Raj Prasad** was presented with an EcoStar Award for Research and Technology by British Columbia's Capital Regional District in Victoria, last November. Prasad was nominated for his research in dealing with the ecological and biological impacts of exotic invasive plants that threaten southern Vancouver Island's Garry Oak landscapes. EcoStar Awards are presented by the Capital Regional District and community partners to recognize individuals or organizations in the Victoria area that are developing solutions to regional environmental challenges, reducing environmental impacts through innovation, contributing to environmental restoration, or enabling sustainable practices.

Departures

Forest Economist **Cameron Stonestreet** left the Pacific Forestry Centre's Industry, Trade and Economics section this past winter to join the British Columbia Ministry of Energy, Mines and Petroleum Resources. He is working as a policy analyst with the ministry's Electricity and Alternative Energy Division, Electricity Policy Branch.

With the onset of spring and the end of the Government of Canada's fiscal year, a number of familiar faces at the Pacific Forestry Centre are saying good bye and retiring from service:

Technician **Tony Ibaraki** assisted researchers in the Spruce Weevil Resistance Mechanism Program, characterizing resistant and susceptible spruce trees by studying the interaction of the spruce weevil with the trees. Prior to working with weevils, he provided technical assistance in the centre's Bark Beetle Program and Tree Seed Program.

The Pacific Forestry Centre Soil Ecology lab is losing Data and Programmer Analyst **Terry Mahoney** to golden retirement, as well. Terry prepared and analysed data on soils, in collaboration with research scientists and co-workers, to quantify and display research results, patterns and trends.

People who use the Pacific Forestry Centre library will no longer see **Barbara Hendel**, who retired from her position as Library Assistant. Hendel provided administrative and clerical support in the delivery of client and technical services for 12 years.

Arrivals

As the new Canadian Forest Service Pacific Region Policy Officer, **Karen Leslie** is responsible for analysing and developing policy pertaining to issues of interest to the Forest Sector and the Canadian Forest Service within the Pacific–Yukon Region, and for ensuring that the unique regional environment is accommodated in national policy. She will also be fostering and maintaining networks and consultative and collaborative partnerships with key organizations within the sector and central agencies.

The centre's newest Forest Research Officer, **Lara Van Akker**, designs and conducts laboratory and field experiments to study the resistance of conifers to insect attack, and explores characteristics of lodgepole pine that influence attack by mountain pine beetle in effort to refine mountain pine beetle risk assessment methods. She brings several years of research experience with the weevil-resistant spruce screening program, which she will be continuing to work with, to her position.

National Programs Database Administrator **Andrea Wells** is now working in coordination with national programs at the Pacific Forestry Centre, which include the Forest Carbon Accounting System, the National Forest Information System and Canada's National Forest Inventory.

Industry, Trade and Economics Forest Economist **Lily Sun** will be researching competitiveness of Canada's forest industry, forest sector-related taxation in Canada and internationally, and the affects of non-tariff trade barriers on Canada's forest industry.

Forest Economist **Tyler DesRoches** will be working with the Mountain Pine Beetle Initiative and Industry, Trade and Economics section is analyzing mill closures in British Columbia, the relationship between economic well being and forest cover, the history of public participation in British Columbia's forest sector.

Lara Van Akker

Next Issue

Accuracy assessment for remotely sensed mapping

and

The International Crown Fire Modelling Experiment

Sources

Articles in this issue reflect the research and programs of the Canadian Forest Service Pacific Forestry Centre. The following research articles either served as a basis for articles or provide additional information. They can be ordered from the Canadian Forest Service online bookstore: bookstore.cfs.nrcan.gc.ca

Growth and nutrient dynamics of western hemlock …

Map comparison using spatial autocorrelation…

Automated detection and mapping of crown discoloration by jack pine budworm…

Mountain Pine Beetle Initiative economics research:

Mountain Pine Beetle Initiative Interim Report 2005.

An annotated bibliography on the effect of bluestain on wood utilization….

Sample plan to measure tree characteristics related to the shelf life…

Maximizing value recovery from mountain pine beetle-killed pine for veneer products.

Performance of posts laminated with blue-stained mountain pine beetle lodgepole pine.

Bleaching treatments for blue-stained mountain pine beetle lodgepole pine.

Current knowledge of characteristics and utilization of post-mountain pine beetle wood in solid wood products.

Alternative wood products from blue-stained…

Rate of deterioration, degrade and fall of trees killed by mountain pine beetle…

Improving Value Recovery of OSB…

Optimizing Drying of Mountain Pine Beetle Wood.

Machine Stress Rated (MSR) Lumber Grade Recovery…

Predicting Decay and Degrade Rates in Standing and Fallen Trees…

Addressing Marketplace Durability Issues with Post-Mountain Pine Beetle Lodgepole Pine…

Recent weevil research

Weevil resistance of progeny derived from putatively resistant and susceptible interior spruce parents.

Mechanisms of resistance in conifers against shoot infesting insects. The case of the white pine weevil …

Screening of Sitka spruce genotypes for resistance to the white pine weevil in British Columbia. 2

Forest 2020

Carbon credits and afforestation.

Afforestation on private land in Canada from 1990 to 2002 estimated from historical records.

New from the bookstore

Predicting Decay and Degrade Rates in Standing and Fallen Trees Killed by Mountain Pine Beetle: A Literature Review. 2005. Sharp, Barb (UNBC); Lewis, Kathy (UNBC) Mountain Pine Beetle Initiative Working Paper 2005–15.

Detection of red attack stage mountain pine beetle infestation with high spatial resolution satellite imagery. 2005. White, J.C.; Wulder, M.A.; Brooks, D.; Reich, R.; Wheate, R.D. Mountain Pine Beetle Initiative Working Paper 2005–24.

Events

Engineering Challenges and Solutions in the 21st Century Climate Change Technology Conference
May 4–12
Ottawa
Information: John Grefford at Grefford@ieee.org

Social Sciences and Resource Management: Global Challenges & Local Responses 12th International Symposium on Society and Resource Management (ISSRM)
June 3–8
Vancouver, B.C.
Information: Dr. Wolfgang Haider, whaider@sfu.ca
www.issrm2006.rem.sfu.ca

Coastal Silviculture Committee Summer Workshop
Sechelt, BC
June 13–14 (tentative)
Information: Bill Lasuda, blasuta@dccnet.com

Annual Meeting Forest Nursery Association of BC
Penticton, BC
September 18–20
Info: Michael Peterson, michael.peterson@afslimited.ca

National Forest Week
Canada Forests: From Sea to Sea
September 24–30

10th National Forest Congress Canadian Institute of Forestry
September 24–27
Gatineau–Ottawa
hosted by the Canadian Forestry Association and Partners
Information: 1-866-441-4006
www.nfc-cfn.ca

Addressing Marketplace Durability Issues with Post-Mountain Pine Beetle Lodgepole Pine - A Compilation of Three Reports. 2005. Byrne, T.; Uzunovic, A. Mountain Pine Beetle Initiative Working Paper 2005–25.

Social Dimensions of Community Vulnerability to Mountain Pine Beetle. 2005. MacKendrick, N.A.; Parkins, J.R. Mountain Pine Beetle Initiative Working Paper 2005–26.

The Bridge 15: Newsletter of Natural Resources Canada's First Nations Element of the Mountain Pine Beetle Initiative, and of the British Columbia First Nations Forestry Program. Fall/Winter. 2005. Murphy, B., editor.

Conifer Defoliators of British Columbia. 2006. Duncan, Robert W. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre.

The Mountain Pine Beetle: A Synthesis of Biology, Management, and Impacts on Lodgepole Pine. 2006. Safranyik, L.; Wilson, B. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre.

To order free publications online, visit the Canadian Forest Service Bookstore at:

bookstore.cfs.nrcan.gc.ca

Search our catalog of thousands of forestry publications. Order copies quickly and easily using a virtual "shopping cart."

Information Forestry

Published by

Natural Resources Canada
Canadian Forest Service
Pacific Forestry Centre
506 West Burnside Road,
Victoria, B.C., V8Z 1M5
www.pfc.cfs.nrcan.gc.ca
(250) 363-0600

Editor: Monique Keiran
Contributing writers: Lynda Chambers, Monique Keiran, Bernadette Murphy, Roz Penty, Joanne Stone

Questions, comments, suggestions, or requests for permission to reprint?
Telephone (250) 363-0779; fax (250) 363-0775; or
Email: **PFCPublications@pfc.cfs.nrcan.gc.ca**

Information Forestry is also downloadable from our online bookstore at **bookstore.cfs.nrcan.gc.ca**