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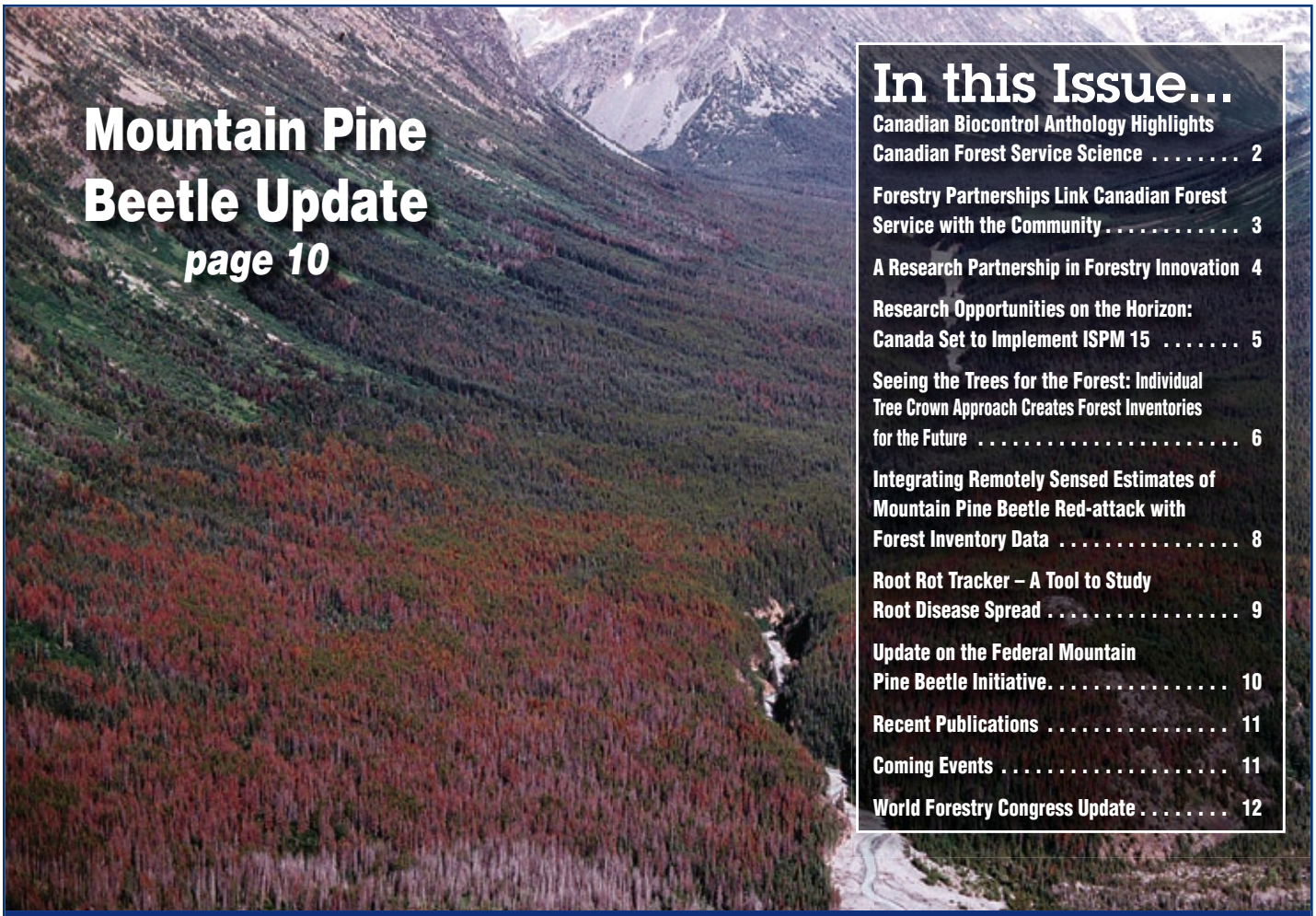

Mountain Pine Beetle Update

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XII[e] Congrès forestier mondial
XII World Forestry Congress
XII Congreso Forestal Mundial

QUÉBEC, CANADA 2003
September 21 to 28
www.wfc2003.org

World Forestry Congress 2003

(see update on page 12)

Natural Resources Canada
Canadian Forest Service

Ressources naturelles Canada
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Canada

Canadian Biocontrol Anthology Highlights Canadian Forest Service Science

"We decided to search areas where the gypsy moth was rare, figure out what natural enemies might be keeping the insect rare in those areas, and then introduce those natural enemies here."

Applying C. purpureum *onto cut stumps of big leaf maple.*

Biological control (biocontrol) is the use of beneficial organisms to reduce populations of noxious organisms. It can be one of the most useful and cost-effective means of controlling introduced and native forest insect pests. A new book, *Biological Control Programmes in Canada, 1981 – 2000* (CABI Publishing), is testament to the strong contribution of Canadian Forest Service scientists in the field of biocontrol. Twenty-five of twenty-nine chapters on forests pests were contributed by Canadian Forest Service researchers and ten of these chapters were led by scientists at the Pacific Forestry Centre.

One contributor, Dr. Imre Otvos (available at **iotvos@pfc.cfs.nrcan.gc.ca**), a research scientist at the Pacific Forestry Centre, has been working in biocontrol with Dr. Roy Shepherd, Tom Gray, Nicholas Conder, and John Cunningham, all of the Canadian Forest Service, as well as with collaborators from the BC Ministry of Forests and the US Forest Service. For over 25 years they have been developing an integrated approach to managing the Douglas-fir tussock moth. Their approach involved three components: most importantly they identified a natural control agent, nucleopolyhedrosis virus (NPV), that can be produced in the lab and used safely in the forest environment; they developed a locally-specific monitoring system to track population levels of the tussock moth; and they studied the response of the host tree, Douglas-fir, to defoliation. The US Forest Service is applying a modified version of the monitoring system of the template to follow Douglas-fir tussock moth populations in the western states. Dr. Otvos is working on extending the template to the western hemlock looper, the western blackheaded budworm, and the forest tent caterpillar in BC.

Dr. Vince Nealis (available at **vnealis@pfc.cfs.nrcan.gc.ca**) took a novel approach to looking for biocontrol agents for the gypsy moth in Europe. "We decided to search areas where the gypsy moth was rare, figure out what natural enemies might be keeping the insect rare in those areas, and then introduce those natural enemies here," he says. Dr. Nealis was active in the Canadian Forest Service National Biological Control Working Group, which coordinated biocontrol of forest pests in Canada and contributed to the development of environmental standards associated with the introduction of beneficial organisms into Canada.

The use of chemical herbicides in Canadian forests is increasingly restricted. Three other Pacific Forestry Centre contributors collaborated on research into inundative methods of biocontrol of forest weeds and diseases. Dr. Simon Shamoun (available at **sshamoun@pfc.cfs.nrcan.gc.ca**), Donna Macey (available at **dmacey@pfc.cfs.nrcan.gc.ca**), Dr. Raj Prasad (available at **rprasad@pfc.cfs.nrcan.gc.ca**) and Dr. Richard Winder (available at **rwinder@pfc.cfs.nrcan.gc.ca**) were part of a team of researchers whose work led to the formulation and commercialization of *Chondrostereum purpureum* in western Canada and the US under the brand name, Chontrol™. *Chondrostereum purpureum*, a common hardwood tree pathogen first discovered in Holland, is registered in eastern Canada by MycoForestris Inc. under the trade name Myco-Tech™.

Dr. Shamoun, Ms. Macey, Dr. Prasad, and Dr. Winder collaborated with researchers at the Atlantic and Great Lakes Forestry Centres, the BC Ministry of Forests, BC Hydro and MycoLogic Inc. at the University of Victoria to fulfill Canada's Pest Management Regulatory Agency's and the US Environmental Protection Agency's stringent requirements for the release of a biocontrol agent. Expected to be registered in 2003 and ready for release soon after, Chontrol™ represents years of efficacy research, environmental fate and risk analyses, and a lot of teamwork. Dr. Shamoun continues to work with biocontrol agents. As project leader of biocontrol of forest diseases and weeds, he conducts efficacy, environmental impact, and risk analyses of biocontrol agents of these forest pests. Dr. Prasad's research now focuses on control methods of the invasive species gorse, Scotch broom, *Daphne laureola* and English ivy on federal lands. Dr. Winder now studies functional roles of microbes in the environment, and is working on developing a knowledge base for ecological processes in forest microbiology.

This research represents only a taste of the information available in *Biological Control Programmes in Canada, 1981 – 2000*. Forest managers, especially practitioners of biocontrol and integrated pest management may find it to be a valuable reference. Copies are available from CABI publishing at **www.cabi-publishing.org**.

Forestry Partnerships Link Canadian Forest Service with the Community

"We can see the changes over the past five years brought about by the ready source of information the Department of National Defense has available for their land use planning."

There is a man who knows where every tree is on the Department of National Defense (DND) property, Rocky Point, located west of Victoria on BC's Vancouver Island. Arthur Robinson (available at **arobinson@pfc.cfs.nrcan.gc.ca**), Federal Lands Program officer at the Pacific Forestry Centre, earned this familiarity after almost 15 years of walking 16 DND properties and more than 4,000 hectares of land. Robinson is responsible for implementing the Natural Resource Program on DND Lands in BC. Out at Rocky Point they know him as "the guy who knows where every single tree is on the property," but he insists, "I haven't been to every part yet."

The Canadian Forest Service has been assisting the Canadian Forces Base (CFB) Esquimalt in managing these properties since 1986. As of 2001 the approach is geared toward forest stewardship. Priorities range from ensuring sustainable military training and operations, to protecting endangered species and sensitive ecosystems, to providing up-to-date Geographical Information System data and environmental information for sound management decision-making. The partnership's overall intent is to facilitate well-informed natural resources management.

Canadian Forest Service research contributes to land management at DND in a number of important ways. Robinson and Dr. Tony Trofymow (available at **ttrofymo@pfc.cfs.nrcan.gc.ca**), a research scientist at the Pacific Forestry Centre, sit on the Environmental Science Advisory Committee (ESAC). ESAC manages proposals, tracks progress, and compiles results for all environmental research carried out on CFB Esquimalt properties. Dr. Trofymow credits ESAC with increasing the significance of scientific information. "We can see the changes over the past five years brought about by the ready source of information DND has available for their land use planning," he says.

Arthur Robinson stands beside one of the oldest Douglas-fir trees on the DND Royal Roads property. The bark shows signs of the fires that burned through the area in the early 1800s, and the breast height diameter is 246.2 cm.

Dr. Brenda Callan (available at **bcallan@pfc.cfs.nrcan.gc.ca**), a research scientist at the Pacific Forestry Centre, is working on a study of fungal biodiversity on cut alder logs. This is one example of the kind of projects ESAC oversees.

Another example is the work undertaken by Dr. Raj Prasad (available at **rprasad@pfc.cfs.nrcan.gc.ca**). A research scientist at the Pacific Forestry Centre, Dr. Prasad researches Scotch broom and gorse management at Rocky Point. Scotch broom and gorse, which form dense thickets and seed prolifically, threaten indigenous and endangered species and obstruct military use of DND land. Dr. Prasad has tested the efficacy of three means of control: plastic mulch, and a chemical and biological herbicide. In the summer of 2003 he will test the effect of insects and sheep, as well as an innovative method called "aquacide" which uses up to 280° F water to scald the weeds. Work crews from William Head Penitentiary did much of the manual cutting for Dr. Prasad's research as part of Correctional Services Canada's Work Release Program. Work release participants gain silvicultural experience, community contact, and practice living skills which help bridge the transition into society.

Robinson's surveys of rare and endangered species connects DND land management with the Garry Oak Ecosystem Recovery Team and the Oregon Spotted Frog Recovery Team.

His work also linked him with Scouts Canada's tree planting program. Through "Scoutrees" boys and girls from the ages of 7 to 17 work toward badges in conservation and learn about the environment. Carolyn Lloyd, the Scouts Canada volunteer in charge of Scoutrees, says, "Art is wonderful at supplying the trees, the site and the education, and we're happy to supply the kid power. We planted 620 trees last year." Lloyd hopes the program will eventually grow to allow for kids to become stewards of reforested areas.

A Research Partnership in Forestry Innovation

In the research community, joint effort is often essential to ensure accurate results. With the common goal of increasing the value of BC forests, the Canadian Forest Service, Pacific Forestry Centre, received support from the BC Forestry Innovation Investment (FII). The following is a small sampling of the current Canadian Forest Service/FII projects.

A small sampling of the current Canadian Forest Service/FII projects.

Impacts on Armillaria Root Disease on Stand Productivity in the Southern Interior

Mike Cruickshank (available at **mcruickshank@pfc.cfs.nrcan.gc.ca**), root disease scientist at the Pacific Forestry Centre, has been studying *Armillaria ostoyae*, a root disease that can infect the roots of trees and shrubs causing growth loss and mortality. This serious disease, widespread in southern BC and across Canada, is particularly damaging in the Interior Cedar Hemlock (Biogeoclimatic) Zone of the southern BC interior.

Cruickshank has been working at determining the volume growth lost by Douglas-fir due to *A. ostoyae* infection in planted stands. His research is in collaboration with Pacific Forestry Centre research scientist, Dr. Duncan Morrison, the BC Ministry of Forests, a private forestry consultant, and licensees.

"Our primary objective is to quantify the growth loss attributable to sub-lethal Armillaria infection in Douglas-fir plantations," explains Cruickshank. "This is a first step in developing realistic operational adjustment factors to account for changes in ecosystem productivity due to Armillaria."

Development of Multi-Attribute Risk Assessment and Management Tools for Results-Based Fire Management in BC

Dr. Brad Hawkes (available at **bhawkes@pfc.cfs.nrcan.gc.ca**), fire research officer at the Pacific Forestry Centre, is the project proponent that is developing multi-attribute frameworks to enhance fire risk assessment and management in BC. He is working with a private sector team (led by BA Blackwell and Associates) with expertise in fire management, fire ecology, socio-economic analysis, risk analysis and management, and policy development. The project team also includes the BC Ministry of Forests, Protection Branch, the key client for the risk assessment tools. A workshop was held on March 21 where key agency, municipality, and disaster management organizations discussed project results and how to incorporate them into their planning requirements.

"We have been developing, testing and disseminating new information, tools and strategies for assessing and managing fire risk within provincial forests," says Dr. Hawkes. "By creating multi-attribute frameworks, risk assessment and management tools will reflect a range of economic, social and environmental values."

Molecular Understanding of the White Pine Blister Rust Pathosystem

Dr. Abul Ekramoddoullah (available at **aekramoddoullah@pfc.cfs.nrcan.gc.ca**), a Pacific Forestry Centre research scientist, has been studying resistance mechanisms of white pine to blister rust. Working with Pacific Forestry Centre research scientist, Dr. Richard Hunt, as well as the BC Ministry of Forests, the University of BC, the US Forest Service (Oregon and California), the University of Washington and the US Department of Agriculture, Dr. Ekramoddoullah has been gaining an understanding of the molecular and histological aspects of white pine blister rust.

"Recently, work at the Pacific Forestry Centre has identified several resistance mechanisms in western white pine," says Dr. Ekramoddoullah. "This current research is the next step in improving and sustaining the genetic resistance in white pine which will ultimately mean healthy forests and timber production with higher resource values."

Forest Fungus, Insect, and Plant Name Database Standardization and the BC Fungal Biodiversity Database

Dr. Brenda Callan (available at **bcallan@pfc.cfs.nrcan.gc.ca**), mycologist at the Pacific Forestry Centre, has been improving the accuracy of provincial species name databases associated with Pacific Forestry Centre's Forest Pathology and Forest Insect Reference collections. Working with Pacific Forestry Centre entomologist, Dr. Lee Humble, the project will improve baseline taxonomic information of the over 30,000 specimens in the Pacific Forestry Centre herbarium, as well as the 200,000 specimens in the Insectary.

Dr. Callan has also been working with Pacific Forestry Centre scientist Dr. Alan Thomson on improving the BC Fungal Biodiversity Database. Called the DAVFP Collection Management System, the software is a database of the Pacific Forestry Centre's Mycological Herbarium. The goal is to speed up the process

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Research Opportunities on the Horizon: Canada Set to Implement ISPM 15

"With import enforcement, the sharing of compliance information between countries and effective inspection frequencies can slow the entry of serious forest pests and diseases."

Does the name "pine shoot beetle" ring any bells? It will ring more of them, perhaps as soon as June 1, 2003. This is the date on which plant protection agencies in Canada, the US and Mexico plan to implement ISPM 15, a global standard for regulating wood packaging material in international trade. International Standards for Phytosanitary Measures (ISPM) 15 mirrors regional standards developed in North America. The Canadian Food Inspection Agency (CFIA), the US Department of Agriculture, the US Forest Service, the North American Plant Protection Organization (NAPPO), and the scientific contribution of the Canadian Forest Service all played a significant role in developing the standard. ISPM 15 should mitigate the risk of introduction of exotic pests like the pine shoot beetle, thought to have been introduced in the 1980s on solid wood packaging into the Great Lakes region of Ontario.

This is good news for the world's forests. Solid wood packaging (used in supporting, protecting or carrying cargo) is involved in 70 percent of world trade and is a pathway for the introduction of pests. This wood is generally of low quality and indeterminable origin, which means regulations must be global – all countries are affected, and all countries need to agree on the regulatory process. "ISPM 15 will allow countries to uniformly establish import controls. With import enforcement, the sharing of compliance information between countries and effective inspection frequencies can slow the entry of serious forest pests and diseases," says Shane Sela, western forest specialist for the CFIA and chairperson of the NAPPO Forestry Panel.

Wire rope spools – a high-risk packing material.

ISPM 15 recommends use of a treatment that is demonstrably effective against most pests. Of the methods currently accepted, heat treatment and methyl bromide fumigation, heat treatment is preferred. ISPM 15 also mandates the application of a globally recognized mark on all wood packaging material made of non-manufactured wood. This mark is used as proof of treatment to ensure "pest-free" status. ISPM 15 was approved by the Interim Commission on Phytosanitary Measures of the International Plant Protection Convention (IPPC) as a part of the United Nations Food and Agriculture Organization's global program of policy and technical assistance in plant quarantine.

The CFIA became active on this wood packaging issue in the mid-1990s. In 1997, CFIA and Canadian Forest Service staff conducted a survey at major Canadian ports of entry to quantify non-indigenous insect interception frequencies. They inspected wood packaging materials used with commodities from Asia, Europe, and South America. The most striking results came from a two-year study examining wooden spools used for industrial wire and cables (used in logging) from China, Korea, and Malaysia. Sixty-three percent of the wooden spools had insect galleries and 23 percent had live insects associated with them. "Imagine these infestation levels, coupled with the magnitude of world trade in materials such as spools, and the capacity of wood packaging materials as a pathway is evident," says Dr. Lee Humble (available at **lhumble@pfc.cfs.nrcan.gc.ca**), a research scientist at the Pacific Forestry Centre.

Dr. Eric Allen (available at **eallen@pfc.cfs.nrcan.gc.ca**), a research scientist at the Pacific Forestry Centre, is helping to create an international quarantine research committee as a link between the global scientific community and plant protection organizations like NAPPO and the IPPC. He proposes a venue in which quarantine specialists can pose questions and meet with potential answer providers. "It will be a place a scientist could go and get a question to work on and regulators could gain access to information they need," he says. Priority topics under investigation include reinfestation of treated wood, efficacy of alternate treatments, and further refinement of heat treatment and methyl bromide use.

The CFIA web site will detail upcoming developments at: **www.inspection.gc.ca/english/plaveg/for/fore.shtml**.

Seeing the Trees for the Forest:

Individual Tree Crown Approach Creates Forest Inventories for the Future

"Fifteen years ago we noticed that, although the computer could recognize individual trees, we only worked with stands. We figured, why think in terms of groups? We decided to go for the most precise inventory possible."

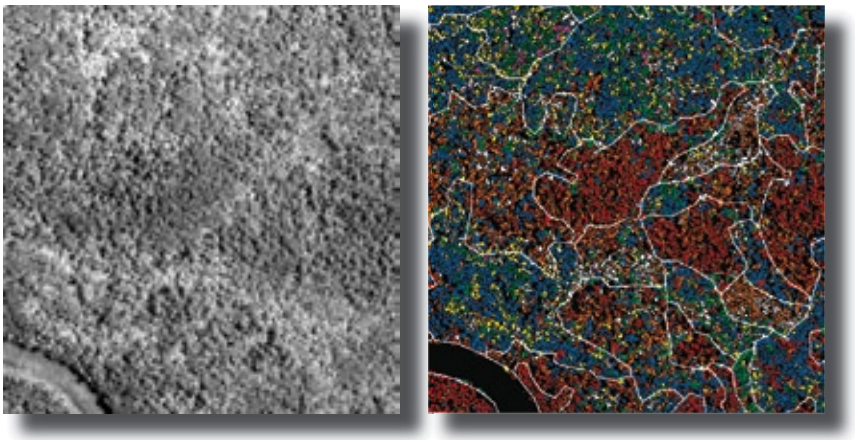
British Columbia has a forest base of more than 60.5 million hectares (605,000 km^2) which can make thinking in terms of individual trees seem like a bit of a stretch. However, BC's new Forest and Range Practices Act encourages innovation in forest management. The Act is one of the first in North America requiring companies to pursue sustainable forest management planning, address biodiversity, and provide measurable results. To plan according to these standards, foresters and decision makers require reliable, current, and detailed information about stand structure, species composition, and tree sizes.

Classical forest inventories provide regional information for strategic management purposes. Foresters must rely on manual gathering of stand-level information (through timber cruises or silvicultural surveys) shortly before a management activity takes place. The goal of this approach might be described as "seeing the forest for the trees." Instead, two research scientists at the Canadian Forest Service, Pacific Forestry Centre, have been working for 15 years on the challenge of seeing the trees themselves. They have developed a series of techniques based on an Individual Tree Crown (ITC) approach. The ITC approach offers the opportunity to create highly specialized digital forest inventories, thereby facilitating better-informed land management decisions. This technology also applies to anything that depends on precise forest inventories – carbon accounting, criterion and indicators, sustainable forestry. The ITC approach has the potential to change forest management in Canada.

Dr. François Gougeon (available at **fgougeon@pfc.cfs.nrcan.gc.ca**) and Dr. Don Leckie (available at **dleckie@pfc.cfs.nrcan.gc.ca**) hope to shift forest management from a stand-based to a tree-based premise. They join a handful of researchers worldwide working on the delineation of individual tree crowns on high definition imagery. When combined with some on-screen human interpretation of images, computer automatic delineation programs can lead to detailed tree crown outlines and species composition assessments. "Fifteen years ago we noticed that, although the computer could recognize individual trees, we only worked with stands," says Dr. Gougeon. "We figured, why think in terms of groups? We decided to go for the most precise inventory possible."

The researchers' efforts have produced a suite of 30 computer programs, all fully integrated in the Toronto-based PCI image analysis system. Says Dr. Leckie, "There are probably 10 to 20 researchers worldwide working on this technology, but we've been able to develop a full suite of software and have tackled most of the initial problems."

Dr. Gougeon and Dr. Leckie used the airborne Multi-detector Electro-optical Imaging Sensor (MEIS-II) for most of their early research. At a resolution of 30 cm per pixel they could clearly separate 81 percent of individual tree crowns. Now they work with IKONOS (and QuickBird) satellite images and, although the resolution is a bit lower (1 m per pixel), the images show a larger and more



Forest information generated from 681 km above Lac à l'Ours, Québec. On the left, an IKONOS 1 m per pixel resolution panchromatic image. On the right, detailed individual tree isolations of the same image classified by species. White lines indicate stand boundaries automatically generated from ITC information.

convenient 11-km by 11-km view. The researchers apply the ITC approach to what are often tree clusters of uniform composition as if they were individual trees. Further improvements in satellite imaging technology will make it possible to work with individual trees again.

The ITC approach interprets digital images in much the same way as people read topographical maps. Rather than looking at lines on topographical maps to read landscape information, ITC programs look at the shade (darker pixels) between trees (lighter pixels) to determine the outline of the crown. In a gray-level image seen in three dimensions (where pixel values are mapped to the third dimension), bright tree crowns look like mountains relative to darker-shaded, valley-like background vegetation.

To assess accuracy, Dr. Gougeon and Dr. Leckie compare their programs' results to information generated through fieldwork. Their computer-generated stand compositions typically come within 10 to 15 percent of ground inventories, a result which suggests the programs function very well. Still, Dr. Gougeon anticipates a slow integration of the ITC approach into mainstream forest inventories. "It will have to be integrated by way of simple pilot projects," he says. "People become accustomed to new technology very gradually."

The ITC approach works like this:

1. Rule out non-forested areas (this can be manual or partially-automatic).
2. Move from shaded area to shaded area following the "valleys" using the "valley following program" (automatic).
3. Outline the precise boundary of each crown (automatic).
4. Identify each crown species using multispectral classification. "Species signatures," or colour characteristics of each species, are generated with the assistance of a human interpreter, followed by automatic classification of the entire image.
5. Re-group species into auto-generated forest stands or environmental strata according to stem density, crown closure, and species composition (automatic).

Of the several pilot projects that have been completed, the most promising is the technology transfer partnership between Dr. Gougeon and CLC-Camint, a forest inventory company based in Gatineau, Québec. For the past three years Dr. Gougeon has worked with CLC-Camint, teaching them how to use some of the ITC programs. In 2000-2001 CLC-Camint mapped the spatial distribution of white pine and yellow birch in a section of the Outaouais. The client, Industries Davidson Inc., was specifically interested in these two species, but their presence and spatial distribution was unknown in stands where they were a minority species.

In their next project they created something closer to a conventional inventory. CLC-Camint worked with twelve species, identifying individual crowns and then regrouping them according to stand composition.

The third pilot is an emerging partnership between CLC-Camint and R&B Cormier, an Ontario-based large-scale photography company that produces high quality, stereoscopic images that generate 3-dimensional images and can be used as a substitute for fieldwork. The two companies will work together to produce a pilot forest inventory for Tembec, one of Canada's largest integrated forest product companies. They will use a combination of the ITC approach and volume assessments from R&B Cormier's photography.

One of the most interesting challenges facing the researchers arises in the limitations of computers. Humans can generally make decisions relying on a combination of information, skills, and auxiliary knowledge. The description one person would use ("That is an antique pine rocking chair.") will probably vary from the description of another ("That chair is brown.") but to a person, a chair is a chair in low light, bright light, and complete darkness. Dr. Gougeon appreciates computers' capacity for stability, predictability, and automation, but also notes their limitation in training for tasks that people can do almost unconsciously.

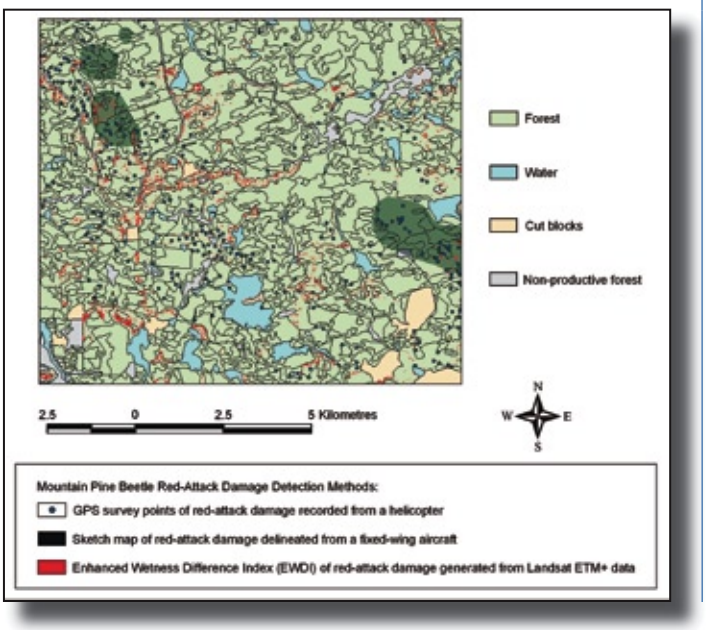
Dr. Gougeon and Dr. Leckie continue to work to create a stronger and more versatile system. They want to train machines to recognize classes of trees (species signatures) across images, instead of having to re-train the machine for each image. They are still working to quantify the program's capabilities in different situations (i.e. using different sensors, view angles, seasons, etc.), and they also hope to create the program capability to adjust species signatures for topographical information. Dr. Gougeon anticipates many more years of research into the ITC approach. "By the time I retire I think I'll see this technology adopted in Canada," he says. But for precise, accurate, and economical forest inventories, the ITC approach's ability to show the trees for the forest is a highly promising option.

Integrating Remotely Sensed Estimates of Mountain Pine Beetle Red-attack with Forest Inventory Data

"This technique allows for the mapping of red-attack representing a given period in time, and at the same time provides the basis for management decisions related to landscape level forest management."

In BC the infamy of the mountain pine beetle is almost as striking as the red colour they leave behind in dying pine trees. Frequent mapping of the mountain pine beetle red-attack forest is necessary if the infestation, currently estimated at over 1.46 million hectares, is going to be managed in the future. Canadian Forest Service and University of Calgary researchers have developed a suite of techniques to assist forest licensees and operators in mapping aspects of the on-going mountain pine beetle infestation in BC. The polygon decomposition approach is based upon the detection of forest changes related to the red-attack stage of a mountain pine beetle infestation.

Forest inventories, based upon the interpretation of air photos, are of high detail yet require time to update and may become dated in areas where forest disturbances are occurring. Satellite remotely sensed data enables estimates of current forest conditions to be included in GIS (Geographic Information Systems) forest inventory data. Dr. Mike Wulder (available at **mwulder@pfc.cfs.nrcan.gc.ca**), a research scientist at the Canadian Forest Service, Pacific Forestry Centre, and Dr. Steve Franklin of the University of Calgary, developed techniques to map red-attack with remotely sensed data. They analyzed satellite imagery using a remote sensing change detection procedure called EWDI, Enhanced Wetness Difference Index. The researchers conducted their most recent study in the Prince George Forest Region in northeastern BC, part of the 2001 outbreak area of the mountain pine beetle. They used helicopter aerial survey data collected in July and August 2001 to calibrate and validate analysis of Landsat ETM+ satellite image data (representing June, 2000 and August, 2001).



Polygon decomposition of forest inventory data with a map of red-attack from satellite imagery enabled stand-by-stand summaries of the red-attack and underlying polygonal data layer in two forms:

1. an assessment of the area (e.g. number of red-attack points within each affected forest stand) expressed as the proportion (in percent) and area (in hectares) of red-attack for each GIS polygon; and,
2. a summary of actual characteristics of infected stands, expressed as a relationship between red-attack points (pixels) and underlying GIS data on forest stand conditions (e.g. age, location).

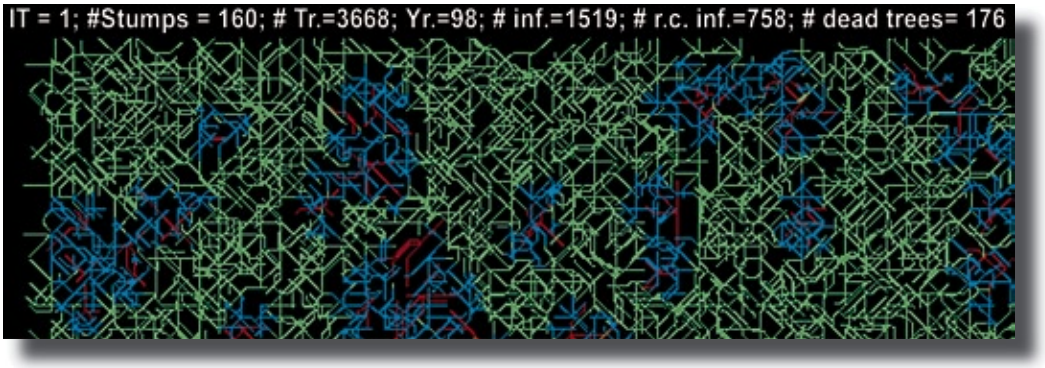
These summaries permitted the researchers to evaluate the intensity of red-attack and extent of damage; information that can be used to prioritize infected stands according to complementary attributes in the forest inventory. These summaries also contribute to the understanding of forest susceptibility to damage during a mountain pine beetle infestation, which could help in prevention and monitoring in beetle-free stands.

"The detection of the changes from the satellite imagery indicate areas that have a high probability of being in the red-attack stage of mountain pine beetle infestation," says Dr. Wulder. "But our technique may also indicate areas that have undergone other types of change. The integration of the remotely sensed red-attack map with the forest inventory data allows managers to combine the differing sources of information to reduce the number of false alarms. This allows for the mapping of the red-attack representing a given period in time, and at the same time provides the basis for management decisions related to landscape level forest management."

Dr. Wulder plans to apply similar polygon decomposition procedures to changes detected on satellite images with smaller pixels, making it possible to work with individual trees. He is also working with partners in using spatial analysis to determine forest polygons at risk of infection based upon their susceptibility and infestation patterns.

Root Rot Tracker – A Tool to Study Root Disease Spread

"This is a tool for the person facing root disease issues."



Part of the schematic diagram that appears on the screen during the running of the simulator at year 98. Infected stump roots (red), healthy new crop roots (green), and infected new crop roots (blue).

Root diseases like *Armillaria, Phellinus* and *Tomentosus* can reduce growth and kill trees in plantations and natural stands. Tools which could predict the future disease impact on regenerating trees would assist in evaluating land management options. Dr. Fred Peet (available at **fpeet@pfc.cfs.nrcan.gc.ca**) thinks Root Rot Tracker, a new simulator of disease spread, might be a useful tool for this purpose.

"This is a tool for the person facing root disease issues," says Dr. Peet, a research scientist at the Canadian Forest Service, Pacific Forestry Centre. "Root Rot Tracker uses terms familiar to foresters. We developed it to be easy to use."

The computer program simulates the spread of root diseases in a single species crop of trees planted after clear-cutting. Root Rot Tracker is stochastic (random) and generic, meaning it can be used in different situations. It is a mathematical representation of the biology of the spread of root diseases arising from contact between healthy and infected roots.

Root Rot Tracker is Windows®-based and uses a point-and-click user interface that runs on IBM-compatible desktop PCs. Users input values based on their particular situation for the variables associated with old infected stumps, new seedlings, and fungus. For example, stump variables include the number of infected stumps in the site, number of roots per stump, length of stump roots, and number of years a stump is a viable source of inoculum. The program generates both numerical tables and graphs to illustrate the results for each year. It predicts the spread of disease and losses in root volumes due to root disease. It also incorporates a simple growth and yield model to give an initial estimate of bole losses.

One interesting thing about Root Rot Tracker is that its basic equations don't vary over space and time. The same version of Root Rot Tracker can be used in different geographic locations, with only the values of the variables associated with the stumps, seedlings, and fungus changing. Root Rot Tracker grows individual roots, changes their directions, tapers them, and tracks the spread of disease from root contact. Once the disease reaches the root collar, growth is reduced and some trees die.

Dr. Peet thinks Root Rot Tracker represents the start of a more realistic representation of what nature is doing in the ground. He compared the simulations of root contacts with field data, and the results were very promising. Barry Janzen, instructor in the Forest Health Management Program at Selkirk College, says it's a useful tool. "Root Rot Tracker is a great tool for my students. It helped them understand and identify the variables involved in root disease," he says.

Dr. Peet's upcoming work on the simulator will include incorporating into the system the effects of secondary roots, three-dimensional root growth, rhizomorphs (another mechanism of root disease transmission), more than one species, thinning, and natural regeneration. He would also like to connect Root Rot Tracker with a more sophisticated growth and yield model. In the meantime, foresters and land managers can obtain the program directly from Dr. Peet.

Update on the Federal Mountain Pine Beetle Initiative

As described in the December 2002 issue of *Information Forestry*, the Federal Mountain Pine Beetle Initiative was put in place to address the pine beetle epidemic that has infested over 1.46 million hectares of trees in BC. The five-year Initiative is a partnership of several federal departments, the BC government, national research institutes, First Nations, and industry. It provides assistance for rehabilitating beetle-devastated federal and private forest lands and funding for research into more effective control, assessing longer-term beetle impacts, and reducing the risk of future mountain pine beetle epidemics.

Partnered with the BC Forest Service, the Canadian Forest Service held a series of regional sessions to identify research priorities. Participants included First Nations, forest land managers and planners, government regulators and policy-makers, and forest companies. In order to address one major concern, the Research and Development Program has sought to explore forest management options to reduce the risk of beetle epidemics. Determining the factors which influence the magnitude and geographic distribution of the beetle is essential in developing a more efficient deployment of control options.

"Enhanced research will concentrate on epidemic dynamics such as detection, mapping and prediction, forest ecology including responses and impacts, and management options at both landscape and stand levels," explains Dr. Bill Wilson (available at **bwilson@pfc.cfs.nrcan.gc.ca**), director of Industry, Trade and Economics at the Pacific Forestry Centre and Canadian Forest Service leader of the Mountain Pine Beetle Initiative. "The program will also include research on factors influencing the shelf-life of beetle-kill timber and mapping these factors to improve scheduling information."

The Initiative will work to reduce the impact of the beetle on federal forest lands. The Federal Forest Lands Rehabilitation Program is being delivered in cooperation with Parks Canada, Indian and Northern Affairs Canada, and the Department of National Defence. This program will deliver a beetle control response aimed at national parks in the Rocky Mountains of BC and Alberta, the Chilcotin Military Reserve and Dominion Coal Blocks lands, and First Nations' reserve lands. The program will support forest rehabilitation (harvesting and restoration activities) and First Nations training in beetle and forest management.

In addition to the Federal Forest Lands Rehabilitation Program, the Mountain Pine Beetle Initiative will assist private landowners in beetle control and rehabilitation activity. The Private Forest Lands Rehabilitation Program will be cost-shared; private landowners will provide a minimum of 20 percent of the total costs.

"Overall management of the program will be the responsibility of Natural Resources Canada but program advisory committees will provide input on design, delivery and positioning of the programs," says Dr. Wilson. "The advisory committees will include representatives from First Nations, woodlot associations, universities, research institutes, companies and government agencies."

Further information on the Mountain Pine Beetle Initiative is available at: **mpb.cfs.nrcan.gc.ca**.

Cover image –
Mountain pine beetle devastation in British Columbia

Recent Publications

Alien invaders in Canada's waters, wetlands, and forests. 2002. Natural Resources Canada, Canadian Forest Service, Headquarters, Ottawa. 320 p.

Envahisseurs exotiques des eaux, milieux humides et forêts du Canada. 2002. Ressources naturelles Canada, Service canadien des forêts, Administration centrale, Direction générale des sciences, Ottawa. 320 p.

First Nation Forestry Program. Success Stories. 2002. Natural Resources Canada, Canadian Forest Service, Headquarters, Industry, Economics and Programs Branch, Ottawa, Indian and Northern Affairs Canada. 98 p.

Programme forestier des Premières nations. Exemples de succès. 2002. Ressources naturelles Canada, Service canadien des forêts, Administration centrale, Direction générale de l'industrie, de l'économie et des programmes, Ottawa, Affaires indiennes et du Nord Canada. 98 p.

Forest information extraction from high spatial resolution images using an individual tree crown approach. 2003. Gougeon, F.A.; Leckie, D.G. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia. Information Report BC-X-396E. 27 p.

Softwood lumber industry funding package targets BC's mountain pine beetle epidemic. 2003. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia.

The Bridge: Newsletter of the British Columbia First Nations Forestry Program. 2003. Bowman, V., editor. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, British Columbia. March 2003, Co-published by Indian Affairs and Northern Development Canada. 12 p.

Coming Events

The Joint Meeting of the Entomological Society of Canada and the Entomological Society of British Columbia

November 2 to 5, 2003
Kelowna, BC, Canada

Join national and regional entomologists at Kelowna's Grand Okanagan Lakefront Resort and Conference Centre for three days of symposia, workshops and submitted paper presentations around the theme of "Insects in Shifting Environments."

For further information see the Entomological Society of Canada web site, esc-sec.org; the Entomological Society of British Columbia web site, esbc.harbour.com; or contact the Organizing Chair:

Dr. Terry Shore
tshore@pfc.cfs.nrcan.gc.ca or 250-363-0666.

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Research Partnership
(continued from page 4)

by which specimens and their associated data are made available for public use.

"Better access to forest disease and biological collection data," says Dr. Callan, "will lead to improved resource management planning with respect to diseases, non-timber forest products and biodiversity."

These are just a few of the research projects currently undertaken by the Canadian Forest Service, Pacific Forestry Centre in partnership with the BC Forestry Innovation Investment.

World Forestry Congress Update

As detailed in the December 2002 issue of *Information Forestry*, the XII World Forestry Congress is taking place September 21 to 28, 2003 in Québec City, Canada. It is the primary global forum on forests and forestry, and participants include governments, forest industries, Aboriginal communities, academia, labour groups, private woodlot owners, and environmental, conservation and special interest groups across the globe.

This year, the theme of the World Forestry Congress is *Forests, Source of Life*. The Canadian Forest Service is submitting many scientific papers in support of this topic and Pacific Forestry Centre research scientist, Dr. Mike Apps, is one of the invited keynote speakers. He will address what many consider the most important environmental issue ever faced by society – climate change. His paper, entitled, "Forests, the Global Carbon Cycle and Climate Change" will provide a global perspective of the role that forests – and forestry – play in the interactions between the carbon cycle and the climate system.

Sponsored by the United Nations Food and Agriculture Organization, the XII World Forestry Congress is being organized as a partnership between Natural Resources Canada and the Ministère des Ressources Naturelles du Québec.

XII[e] Congrès forestier mondial
XII World Forestry Congress
XII Congreso Forestal Mundial

QUÉBEC, CANADA 2003
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