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Remote sensing software pinpoints diseased trees

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Canada

Scientist debunks litter-decomposition myths

"Accurate prediction of litter decay is critical to carbon modellers, as carbon storage information is the key to better reforestation management," says Canadian Forest Service Soil Chemistry Research Scientist Caroline Preston (**cpreston@pfc.cfs.nrcan.gc.ca**). Working with the University of British Columbia's forest biologist Cindy Prescott, Preston set out to study how fast litter decomposes, how litter qualities and climate affect decomposition rates, and whether clearcuts affect litter decomposition.

The research team collected foliar litter from 14 typical British Columbian tree species across the province. "We studied the elemental composition, nutritional elements, and the amount of carbon present." Preston also used spectroscopic analysis to 'fingerprint' the litter.

The five-year study was unique, as there have been few long-term litter decomposition studies; most studies last only one to two years, leading to a wideheld assumption among soil chemists that broadleaf litter decomposes quicker than needleleaf litter—but Preston and Prescott's research refuted this. "While there is a big difference in decomposition rates in the first year, it tends to even out after four to six years—we found that there wasn't a big difference between them. They all slowed down—like needleleafs are perceived to do—eventually." They also debunked the myth that litter decomposes faster in a clearcut. "In the first year or two, it may go faster, but again, it slows down like the rest."

While Preston was unable to find a set of chemicals that significantly affect decomposition, she found in some sites a chemical that could be an influence on decomposition: acid unhydrolysable residue (AUHR). "One of the challenges in the litter-decomposition field is we haven't been able to find any distinctive set of chemicals that indicate decomposition rates yet. It's a common problem, but AUHR is a good place to start. This study showed us that there isn't just one thing contributing to decomposition, but a combination of changes that make it necessary to do more long-term studies."

Measuring efficiency in bark beetle traps

Canadian Forest Service scientists have found which traps are the most efficient for capturing bark beetles.

"Insect traps are very important tools in insect management—especially in the case of bark beetles," says study leader and Research Scientist Les Safranyik (**lsafranyik@pfc.cfs.nrcan.gc.ca**).

In their research, scientists use a variety of common traps, which use not only different materials but also come in different shapes and sizes. "The results of bark beetle research are based on specific types of traps without knowing much about trap efficiency, making the data difficult to compare. Trap surface area or the number of captured insects per trap are not true indications of trap efficiency."

Safranyik designed a study with the intention of developing a method by which dissimilar traps could be directly compared. "We set out to make an equation that could be applied to linear, cylindrical, and cross-barrier traps, which are used in mountain pine beetle work."

The model that Safranyik developed defines trap efficiency as the ratio of total trap surface area to interception area. Based on this ratio, the scientists discovered that linear traps were the most efficient, followed by cross-barrier traps, with cylindrical traps the least efficient. Safranyik then found that the equation was supported by his field experiments—while there was a large variation in catches in traps of the same type, the ratios of average catches per trap conformed to the equation.

In addition to the study's use in assessing efficiency of other popular traps', this research could prove most beneficial to foresters looking for ways to battle the beetle. As Safranyik says, "These methods can be used by others who wish to devise more efficient traps for other bark beetle species."

Cylindrical trap
Using a mathematical equation, Research Scientist Les Safranyik was able to compare the efficiency of different bark beetle traps. With only 31percent efficiency, the cylindrical trap, pictured here, was found to be the least effective of three types studied.

Remote sensing the key to root rot detection

Laminated root rot (*Phellinus weirii*) may be the scourge of regenerating Douglas-fir plantations, but Canadian Forest Service scientists' research has shown that remote sensing technology is a valuable tool in detecting and assessing trees infected with the disease.

"Laminated root rot is one of the principal root diseases affecting Douglas-fir in northwestern North America. It causes a lot of damage and kills trees, and decreases growth and productivity in managed stands," says Research Scientist Rona Sturrock (**rsturrock@pfc.cfs.nrcan.gc.ca**).

Detecting laminated root rot is difficult, time-consuming, and costly. "We wanted to see if remote sensing imagery could identify laminated root rot in stands so that foresters could save time and money by avoiding having to conduct extensive ground surveys—if they could get a picture ahead of time."

She joined forces with Research Scientist Don Leckie (**dleckie@pfc.cfs.nrcan.gc.ca**), a specialist in remote sensing, based out of the Pacific Forestry Centre. They, along with Digital Remote Sensing Scientist Francois Gougeon (**fgougeon@pfc.cfs.nrcan.gc.ca**), collected two sets of Compact Airborne Spectrographic Imager (CASI) multi-spectral imagery from two Douglas-fir sites near Nanaimo, British Columbia. CASI is a sophisticated commercial sensor that can record in many parts of the spectrum while taking aerial photographs; it is deployed by being mounted on an aircraft used for aerial photography. Itres Research, of Calgary, provided the imager for the project, which was a joint effort from Weyerhaeuser, the Canadian Forest Service, Forestry Renewal British Columbia, and Itres Research.

To detect root rot, says Gougeon, the trees must first be identified as distinct objects. This is done by processing the imagery with the Individual Tree Crown (ITC) software suite, a sophisticated set of computer programs developed by Gougeon. It does this by noting sunlight that reflects off a tree crown and creates a surrounding pool of shadow. "Once it has identified the tree, the ITC software gets 'inside' it, reading its spectral values. Stressed trees are way down in their infrared—with loss of needles changing the tree's colour even more—and it picks up all this information. The level of 'sickness' in the tree as detected in the spectral bands of the imagery is translated into the different classifications: healthy, light-healthy, light, moderate, severe, dead snag, and shaded snag."

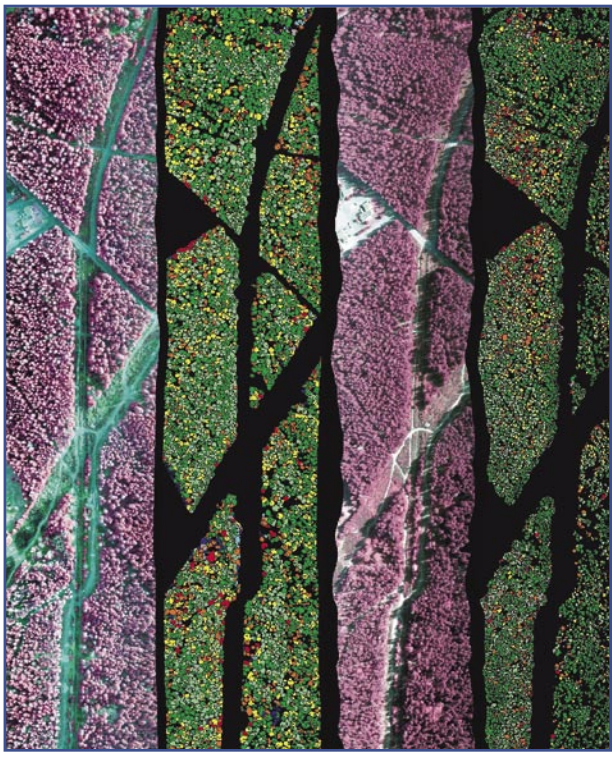
The scientists detected laminated root rot with 80 percent accuracy, a degree of precision unattainable by most other technologies and systems. "Most imaging systems present you with images that mix an amalgam of forest components within each pixel; this is hard to sort out," says Leckie. "But the CASI system enables analysis of a single tree. So on a single-tree-analysis basis, it's a real success."

In distinguishing between the different classes, however, the scientists had only a 55 to 60 percent success rate, due to a number of false positives. But CASI pinpointed moderately to severely affected trees with great accuracy. "It's a viable operational tool," Leckie says. "In cases with more subtle symptoms, it may not be recommended, as false alarms are the nature of the beast." But that can be fixed, too: root-diseased trees tend to occur in clusters, so if the spectral readings show one tree to be infected, it may not be root rot. The Pacific Forestry Centre has done some work with the British Columbia Institute of Technology to create an automated geographic information system capable of point-pattern analysis that could identify root-rot clusters.

Right now, Gougeon says, "The computer can only do so much, but we just have to work towards making it a more and more automatic process which will let the computer do all the work. That's the holy grail in this field."

Sturrock says that, by providing a first look at a forest's health status, remote sensing is a great decision aid for forest activities. Weyerhaeuser BC Coastal Group Research Analyst Nick Smith agrees: "If we know ahead of time where the root-rot centres are, it helps with planning, like whether to plant a different species after harvesting. Remote sensing could help by obviating some field surveys."

The Individual Tree Crown software suite recently garnered the Canadian Forest Service and research scientists Gougeon and Leckie awards (see the News and Notices section of this newsletter). For more information, visit **www.pfc.cfs.nrcan.gc.ca/diseases/ctd/Group/Root/root7_e.html**, and **www.pfc.cfs.nrcan.gc.ca/profiles/gougeon/itc_research_e.html**



This section of forest appears mostly healthy. Root rot centres, which correspond to the colours red and orange, can be identified, allowing foresters to choose whether to start salvage logging, bulldoze the stumps, or plant alternate species.

From the cover: A Douglas-fir seedling shows symptoms of laminated root rot, which affects regenerating plantations in northwestern North America.

Ecologically-based biological control manages salal

Visiting scientist Johanna Witzell, from Sweden, will be working with Shamoun at the Pacific Forestry Centre next summer to study Valdensinia, and how the fungus and related methodologies might be applied to Vaccinium, which is as much a challenge to regenerating conifer forests in Sweden as salal is in coastal British Columbia.

Salal is a menace to regenerating conifer stands in coastal British Columbia, but a Canadian Forest Service scientist has found a powerful biocontrol agent with which to fight this floral foe—the fungus *Valdensinia heterodoxa*.

Research Scientist Simon Shamoun **(sshamoun@pfc.cfs.nrcan.gc.ca)** says, "Salal is one of the most competitive plants in regenerative sites, aggressively robbing the economically valuable conifer species of nutrients and water, and slowing the growth and establishment of healthy conifer plantations." The plant is dangerous because it becomes very aggressive after harvest. It is impervious to chemical herbicides, due to the impermeability of its leathery leaves; manual brushing causes the salal to sprout even more vigourously than before. "Neither option is economically feasible."

Shamoun wanted to add a new tool to the toolbox that the forester can use to manage the salal in conifer stands. He decided that using a biocontrol agent could be the answer to combating the weed, and went with using an innundative biocontrol concept, which uses a naturally occurring indigenous plant pathogen to target the weed and suppress.

He collected ailing salal plants from 25 sites in British Columbia. "We took diseased salal to the lab," says Shamoun. "We identified the fungus that showed the most promise as a potential biocontrol agent—*V. heterodoxa*."

Salal chokes conifer plantations, the hearty shrub pumping water and nutrients out of the soil and suppressing the survival and growth of seedlings like the one pictured here. *Valdensinia heterodoxa* is a biocontrol agent that can suppress the salal for a short period of time, allowing seedlings to become established.

V. heterodoxa is unique among fungi because of its dispersal method. Shamoun says that the ripening fungus's 'arms' resembles those of an octopus—the 'tentacles' holding the spores explode open, and the spores attach themselves to the undersides of the salal leaves. The fungus causes disintegration and premature defoliation of leaves.

Shamoun investigated growing conditions to culture *V. heterodoxa* in the lab, trying a variety of substrates including whole oat grains, rolled oats, rice, fresh salal leaf pieces, alder wood chips, and mixed fir shavings. Salal turned out to be the most appropriate substrate. Shamoun attributes this to the fact that the fungus is host-specific, and the micronutrients provided by salal are conducive to the fungus' establishment on the plant.

Shamoun found that salal leaf pieces worked as an excellent delivery technique as well. Inoculum delivered at pot-soil level resulted in 8 to 41 percent leaf damage in the salal plant. The success of Shamoun's study has led to a U.S. patent of his formulation and delivery techniques.

One drawback of the fungus' biocontrol abilities is that it flourishes only in cool conditions—salal populations covered by canopy. But the recent increase in retention silvicultural systems will provide sufficient shade. Shamoun is working to give foresters yet another tool. "We're attempting to find a fungus that works on salal in wide-open, cut areas, so we have something in the pipe for foresters who might ask, 'Well, what about the cut areas?' *Phoma exigua*, newly recorded in British Columbia, is not limited by microenvironmental conditions." Shamoun continues researching *V. heterodoxa* and its possibilities: by using molecular markers to study the genetic diversity and population structure of both salal and the fungus in detail, the scientist is investigating the possibility of mixing different *V. heterodoxa* genotypes, which would be able to attack different salal populations.

"Combating salal using biocontrol is an environmentally-friendly alternative for sites where prescribed fire, chemicals or mechanical treatments are not appropriate," says Cascodin Forest Products Forest Ecologist Bill Beese. "It's important that the biocontrol agent is host specific, so there's no chance of it spreading to other species." And *V. heterodoxa* fits right in with the Canadian Forest Service's mandate for sustainable development and ecological diversity, as the fungus cannot eliminate salal—only suppress it. "We just want to give our seedlings the window of opportunity to get established," Beese says. "We only need to suppress salal for a short period of time, which gives the conifer species enough of a jump on the salal to flourish."

Soil disturbance hinders seedling growth in montane sites

Although use of alternative silvicultural systems in high-elevation coastal montane and subalpine ecosystems has increased recently, little is known about the effects of soil disturbance caused by ground-based operations on soil properties and tree growth and survival. Five-year results of a 10-year study conducted by Canadian Forest Service Research Scientist Doug Maynard reveal that these logging operations may reduce seedling growth and survival.

Maynard (**dmaynard@pfc.cfs.nrcan.gc.ca**) wanted to find out why regenerating stands of western hemlock and amabilis fir sometimes suffer growth checks after 10 to 15 years. He planted seedlings in undisturbed plots, within and between tracks of skidtrails, and in rehabilitated trails, and studied tree growth and survival on skidtrails left by single-pass hoe forwarding and multiple-pass hoe forwarding, and flexible track grapple skidder forwarding within differing silviculture systems, including clearcut, shelterwood, patch-cut, and green tree retention sites. He also tested whether decompacting the soil with excavators decreased soil bulk density. Started by soil scientist John Senyk in the spring of 1994, the study was conducted in Campbell River, British Columbia. It was part of the Montane Alternative Silvicultural Systems (MASS) trial, a multi-agency research cooperative that tests alternative silvicultural systems for coastal montane forests and studies biological and silvicultural impacts such as those looked at in this study.

Maynard found significantly reduced tree growth and survival after five seasons of growth.

"The primary causes are compaction, which increases soil bulk density and hampers root growth and ability to receive nutrients, puddling in the skidtrails, which increases moisture and decreases drainage needed for growth. Both reduce tree growth and survival," he says.

Maynard also measured foliar nutrient concentrations at the end of four growing seasons. He found that harvesting disturbance did not reduce nutrient concentrations, but nitrogen levels were lower than those in undisturbed or skidtrail treatments.

Attempts to mitigate soil disturbance with rehabilitation produced mixed results. In the case of the well-drained, deeper soils, soil bulk density was reduced by tilling to levels below those of undisturbed soils, which improved tree growth in the short term. But in other treatments, growth and survival—mainly of seedlings growing in wetter conditions—suffered as a result of rehabilitation.

"This means that foresters would need to assess their site and determine whether rehabilitation would be effective," Maynard says.

According to Mike Curran, a research soil scientist with the British Columbia Ministry of Forests, "This research would be helpful to foresters planning the lay-out of their harvest and which sites would be suited to rehabilitation. Where the soil and site conditions are suitable, appropriately applied rehabilitation can restore productivity and drainage on those disturbed areas."

The study is useful not only for determining harvesting practices and site-appropriate rehabilitation but also for implementing forestry regulations.

"The Forest and Range Practices Act specifies specific soil disturbance types that count towards the soil-disturbance limit based on research and other experience used to determine which disturbance types should be of specific concern," Curran says. "Research like this helps provide important data on the effects of soil disturbance."

Maynard recently finished 10-year measurements on the sites' trees, and, with research scientist and MASS coordinator Alan Mitchell, is continuing the study of soil disturbance factors at work in seedling growth and survival.

More information about Montane Alternative Silvicultural Systems research is available at **www.pfc.cfs.nrcan.gc.ca/silviculture/mass/index_e.html**

Maynard's study found that skidtrails' disturbance of the soil reduced tree growth significantly. Seedlings planted within and between tracks of skidtrails suffered the most growth loss. The altering of the soil's physical properties by machine traffic is the most likely reason for differences in tree growth; soil compaction and puddling were the main detriments to seedling survival.

Rehabilitation met with varying results, depending on soil moisture regime:

- well-drained, deeper soils, rehabilitation, improved tree growth
- wetter soils: rehabilitation, decreased tree survival and growth

Excavator and skidder traffic compacted the soil in the shelterwood treatments, resulting in the soil becoming prone to puddling. This decreases soil drainage conducive to tree growth.

Report identifies effects of salvage logging for mou

"When Mt. St. Helen's erupted, we got a lesson in how resilient nature is—it was very encouraging," says renowned conservation biologist Fred Bunnell, of the University of British Columbia's Department of Forest Science. "The mountain pine beetle epidemic is a lesson closer to home, and we can really learn from this."

Mountain pine beetle has damaged more than 7 million hectares of the province's prime forest, and salvage logging operations are underway to retrieve as much beetle-damaged timber as possible. But the Canadian Forest Service is acting as an advocate for creatures that could be affected by large-scale salvage logging. Last year, the Pacific Forestry Centre requisitioned a working report on possible effects of salvage logging on terrestrial and aquatic vertebrates of the Lakes, Quesnel, and Prince George timber supply areas.

"We want to conserve, instead of rebuild," says Mountain Pine Beetle Initiative Chief Implementation Officer Dave Harrison (**daharris@pfc.cfs.nrcan.gc.ca**). If forestry companies follow Bunnell's recommendations, large-scale salvage logging will have a neutral or positive effect on two-thirds of the affected species. Canada's reliance on forest products might make one think that economic concerns take precedence over ecological ones, but Harrison says that looking after our furry, fishy, and feathery friends is key to our economic well-being. "We're showing the global market that we're taking care of biodiversity. As with product specifications or global marketing, our due diligence protects ecological and economic integrity. This working paper is the science that backs us up. Sustainable development must be ecologically and economically sound —you need to pay attention to both."

Unfortunately, there is little literature on effects of large-scale salvage operations on the ecological integrity of the timber supply areas. "So we had to use the natural history of the vertebrates, coupled with what we imagined the possible effects could be, to write this report," says Bunnell.

"This compendium of vertebrates allows us to make sure that the critical elements of the indigenous species' habitats are retained as much as possible," says Harrison. "It really acts as a proxy index of biodiversity." The working paper paints a picture for the reader of the diverse fauna—including all forest-dwelling and non-forest-dwelling terrestrial vertebrates and freshwater fish—within the proposed salvage areas.

Bunnell, a self-described "native son" of British Columbia (his grandfather homesteaded on Adams Lake in the Okanagan), knew the massive mountain pine beetle epidemic was going to change the face of his beloved province and, "since we were already doing related research for the British Columbia Ministry of Water, Land, and Air Protection, we needed to pull together our best insights as to what salvage logging's effects on biodiversity would be as soon as possible." As a local boy, Bunnell was already familiar with the most widespread tree in the province—the lodgepole pine.

Due to the pine's status as a ne'er-do-well tree species unable to reach old-growth status before being ravaged by bugs or fire, none of the forest-dwelling species in the timber supply areas are explicitly restricted to lodgepole pine.

According to the report, leaving non-lodgepole pine stands in place is one of the two most important recommendations for sustaining biodiversity. Doing so benefits riparian species, species who need forest edges, species who do not like large clearcut areas, and species who can live in a clearcut with a few remaining trees. Sixty-four per cent of forest-dwelling species present cannot thrive unless some forest is left. Fishers, martens, and wolverines, for example, use downed non-lodgepole wood for dens. Hardwood species remnants are critical, too. Woodpeckers, one of five keystone species within the timber supply areas, are essential in their work as primary excavators—they create cavities where other cavity nesters, such as rodents, birds, and bats, may later live. Forty-five species show a marked preference for hardwood trees, while fungi, bryophytes, lichen, mosses, and invertebrates complete a symbiotic cycle that demonstrates why it is crucial to save non-lodgepole pine species from harvest.

Salvage operations could have a positive effect on the grizzly bear—an "at risk" species—as cutblocks give the bears better foraging area. Due to the bears' popularity with hunters and poachers, deactivation of salvage logging roads is critical.

ntain pine beetle on critical wildlife species

Bunnell's working paper has the two key recommendations: leaving stands of dead lodgepole pine and hardwood trees behind, and reserving riparian areas from salvage.

"In addition to leaving non-lodgepole pine species behind," says Bunnell, "we need to stay out of riparian areas." Most non-forest-dwelling species require wetlands, rivers, or riparian habitat. Unharvested riparian buffers around wetlands and lakes provide a first line of defense against the widespread negative effects that salvage logging could have on both freshwater fish and non-forest-dwelling vertebrates, as well as on forest-dwelling vertebrates. Thus, maintaining riparian areas is the second most improtant of Bunnell's recommendations to mitigate impact on the widest array of species.

Salvage logging of riparian areas can cause stream-bank collapse and removal of important riparian vegetation, which result in sedimentation. Sedimentation harms more than half the aquatic vertebrates present; it decreases foraging and the ability of predators to see prey, and even causes physiological damage.

Of the 29 species of freshwater fish found in the timber supply areas, almost one-quarter are at-risk species, making harvest of riparian areas especially counterproductive in terms of sustaining biodiversity. The province is especially responsible for more than half of the freshwater fish in the timber supply areas as over 30 percent of the species' global range or population is found in British Columbia. And the global range of four species—peamouth, pygmy whitefish, prickly sculpin, and sockeye salmon—is restricted to the province. Most extinct North American fish are species that had small geographic distributions.

Canadian Forest Service Director of the Mountain Pine Beetle Initiative and Policy Bill Wilson points out that Bunnell's report is part of a research package the Initiative is assembling to reduce possible biodiversity losses. "The taxpayers have given us a lot of money to combat the mountain pine beetle epidemic. We need a soundly developed response to mitigate where possible the epidemic impacts," says Wilson (**bwilson@pfc.cfs.nrcan.gc.ca**). He says that Bunnell's report will be used by a variety of people, including those trying to manage their own response to beetle attack, as well as environmentalists and the British Columbia Forest Practices Board.

For additional information on Mountain Pine Beetle Initiative research, visit **mpb.cfs.nrcan.gc.ca/index_e.html**

The report by Bunnell, Squires and Houde covers a wide range of recommendations to maintain ecological integrity within the forests set for salvage logging. While his most important recommendations are to retain dead lodgepole pine and non-lodgepole pine species from harvest and to leave riparian areas alone, he has many other suggestions for keeping timber supply area biodiversity thriving. They include:

- Control minor vegetation sparingly;
- Create tall stumps or stubs as cavity sites where other tree species have not been reserved from harvest and where harvest method permits;
- Get in and out of salvage areas quickly, and deactivate new roads wherever possible; and
- Avoid log storage in lakes.

Program report available

The *Mountain Pine Beetle Initiative Interim Report* provides an overview to March 2005 of progress and developments under the six-year, $40-million Mountain Pine Beetle Initiative. Included are summaries and highlights of land-based programs for private, non-industrial forestlands, First Nations forestlands, national parks and other federal forestlands within the area affected by the current mountain pine beetle epidemic, as well as of research and development in the key areas of ecology, economics, social outcomes and risk reduction. Directions for future research and development are also indicated.

Download or order your copy starting September 1 from **mpb.cfs.nrcan.gc.ca/publications_e.html**, or visit the Canadian Forest Service On-line Bookstore, **bookstore.cfs.nrcan.gc.ca**

Spaced stands aid in beetle-attack prevention

Located near Campbell River on Vancouver Island, the Montane Alternative Silvicultural Systems project, a research and operations partnership founded in 1993, is one of the first operational demonstrations in coastal montane forests of the Pacific Northwest to compare conifer regeneration, nutrient cycling and biodiversity in conventional and alternative silvicultural systems that vary in retention and dispersion of overstorey trees, as well as size of forest opening.

Canadian Forest Service Research Scientist Les Safranyik (**lsafranyik@pfc.cfs.nrcan.gc.ca**) wanted to ascertain whether regular spacing of mature lodgepole pine stands is effective in preventing bark beetle attack.

In the summer of 1992, Safranyik and a team of scientists and technicians set out for southeastern British Columbia's East Kootenay region. "There, in three different areas, we took an unmanaged stand and retained trees at regular intervals on a grid, while cutting the remaining trees, creating a uniformly spaced stand." The experiment involved two spacing treatments and an unspaced control treatment in each of the three areas; they also wanted to inventory the bark beetle species present.

Research Technician Doug Linton wanted to see if spacing treatments affected bark beetle diversity. "Bark beetles make such an economic hit on the forestry industry and communities that we need to understand the interactions among the various species of bark beetles at low population levels so we can avoid problems like the present mountain pine beetle epidemic. Population dynamics might suggest a possible method of control." They set out traps to capture beetles in flight and emerging beetles and to monitor bark beetle temporal distribution and diversity in the stands.

The scientists captured approximately 30 species of bark beetle on the three sites, representing about three-quarters of all bark beetle species known to inhabit British Columbia's mature lodgepole pine forests. They found no difference in species richness among the three areas or between treatments.

The study also confirmed that spacing treatments can be used to prevent bark beetle outbreaks.

"Residual trees experience accelerated growth and produce more resin, both of which act as defense mechanisms against bark beetles," Safranyik says. "This increases the trees' vigour, and alters the stand's microclimate—higher temperatures are needed during the bark beetle dispersal period."

The spaced stands allow higher wind speeds and more light, which stimulate beetles to fly and disperse, rather than land. "Increased wind in a stand may also disperse pheromones that beetles use to concentrate attack on trees—these winds may even prevent the beetles from being able to land on potential host trees."

While 70 percent of infested trees occurred in the two spaced treatments, three-quarters of successfully attacked trees (i.e., where broods were produced) occurred in the untreated control stand. Attacked trees in spaced treatments had been injured previously by logging equipment or wind damage, leaving them vulnerable to many bark beetle species which attack stressed trees. "Nearly all of those trees were suppressed or diseased or injured in some way," says Safranyik. "These results indicate that stand hygiene is a very important factor in maintaining low bark beetle population levels."

"We want to use this research to help predict and prevent the build-up of mountain pine beetle populations capable of killing trees," says Linton. As mountain pine beetle population was low in the area during the study period, the scientists couldn't assess the effect of spacing under epidemic conditions; however, of seven trees that had been infected by mountain pine beetle in the first 10 years after treatment, only one tree was located in the spaced stand. "This indicates that the practice of spacing mature stands in previously mountain pine beetle-attacked areas could prevent population build-up," says Safranyik. The stands are still cruised annually to detect new attacks and monitor long-term effectiveness of the treatment.

Consulting Entomologist Art Stock is pleased that the research has demonstrated clearly that spacing treatments reduce tree mortality caused by mountain pine beetle. "It proves the validity of spacing as a preventive remedy for bark beetle infestation."

One of the study's three spacing treatments was located near Parson in southeastern British Columbia, where healthy trees were retained at each grid point. "We cut the smaller diameter trees, and the injured and diseased trees, and we retained the large specimens with good crowns," says Safranyik.

New organization encourages forest research collaboration

A collaborative forest-research effort was launched earlier this year to harness research and innovation capabilities in British Columbia with the goal of improving forest industry competitiveness and increasing the economic and social value of Canada's forests.

Known as Forest Research Opportunity B.C., the partnership will bring together the governments of Canada and British Columbia, as well as universities and industry unto research clusters that focus on delivering results that meet industry and public policy needs in areas such as sustainable forest management and forest products, climate change, energy supply and the mountain pine beetle infestation.

"British Columbia has rich resources in its forest, industry, universities and world-class forest-products research institutes," says Minister of Natural Resources Canada John Efford. "Forest Research Opportunity B.C. will better coordinate the activities of everyone involved in the B.C. forest-research community and help spur more robust business development and breakthrough technology."

"Through this collaboration, we will advance the technology efforts in this sector and provide the B.C. industry with a competitive advantage, which will lead to better use of our forest resources and wealth coming into the province," says Minister of Industry and Co-Senior Minister for British Columbia David Emerson.

Forest Research Opportunity B.C. Executive Director Alan Potter brings experience as former vice-president of Technology and Environment for Nexfor Inc. His first steps will be to identify priority issues in the forest and forest products sector, determine where local skills can be applied in a collaborative fashion, and then set up programs and joint investments.

"This is an exciting mission," says Potter. "It is an opportunity to harness some of the world-class talent for innovation available in B.C. and focus it on this important sector."

According to Canadian Forest Service, Pacific Forestry Centre Director General Paul Addison, the clusters are "one part of the Pacific Forestry Centre's agenda to develop closer working relationships with universities and industry." Other parts of this agenda include Canadian Forest Service staff working onsite at the University of Northern British Columbia, the collaboration with the University of Victoria's remote sensing program, and work with the University of British Columbia on mountain pine beetle research. "We also offer graduate student awards to encourage young people to do research in key areas in forest science and to encourage collaboration between our scientists and university researchers."

With the launch of the research cluster, the Government of Canada builds on its partnerships with the Government of British Columbia, the province's industry and universities for a healthy forest and strong forest sector. The cluster advances the federal government's commitment to sustainable development of our natural resources sectors and their allied industries, which are vital parts of Canada's economy and society.

"At this point, the cluster is in its infancy," says Addison. "The focus to date has been on establishing relationships with the universities and identifying mountain pine beetle as a key area for cooperation. It's not clear what other specific project it will stimulate; however, we will be working with Dr. Potter and others as the cluster develops."

More information about Forest Research Opportunity B.C. can be viewed at **www.nrcan-rncan.gc.ca/media/newsreleases/2005/200537a_e.htm**

Sources

Detection and assessment of trees with *Phellinus weirii* (laminated root rot) using high resolution multi-spectral imagery.

Influence of initial chemistry on decomposition of foliar litter in contrasting forest types in British Columbia.

Potential approaches to integrating silvicultural control of mountain pine beetle with wildlife and sustainable management objectives.

Soil disturbance and five-year tree growth in a montane alternative silvicultural systems (MASS) trial.

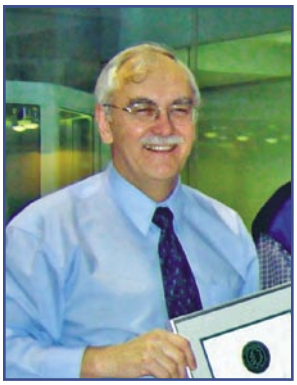
Measuring trap efficiency for bark beetles.

Evaluation of an inoculum production and delivery technique for *Valdensinia heterodoxa*, a potential biological control agent for salal.

Growth, sporulation, and conidia discharge of *Valdensinia heterodoxa*, a foliar pathogen of salal, as influenced by temperature and photoperiod in vitro.

People

Director General ponders change and new objectives



Pacific Forestry Centre Director General **Paul Addison** has a well-developed sense of recent history within the Canadian Forest Service (CFS). Prior to his appointment as director general in 1998, Addison managed research programs at the Pacific Forestry Centre (PFC) and the Great Lakes Forestry Centre, served as network manager for the CFS Effects of Forestry Practices and Landscape Management networks, and led the Green Plan Forestry Practices Initiative in the early 1990s. From 1984 to 1989, he coordinated the acid rain, climate change, and environmental protection and assessment files for Forestry Canada in Ottawa. As a research scientist at Northern Forestry Centre, from 1976 to 1984, he carried out ecological and physiological research into the effects of air pollution in boreal and mountain forest ecosystems.

This fall, Addison retires, ending a 30-year career. *Information Forestry* sat down with him to discuss changes he's seen within the CFS, and how he has helped steer PFC through those changes. Following is a part of that conversation.

What would you say is the most significant change in the organization during your career?

Because the nature of my work changed so much, it's difficult to isolate those changes from the changes within the organization. Change occurred within CFS very much like it has in society—at an ever-increasing rate. In 1969, we had over 2,000 employees, whereas today there are under 800. For a long time, there was just a gradual erosion of resources for S&T (science and technology) through small, persistent yearly budgets cuts, but the effects of these were buffered by programs such as the FRDAs (Forest Resources Development agreements) and the Green Plan. In addition, over time we became quite adept at seeking partnerships—a code word for getting others to contribute to the cost of us doing what we thought best. Then in 1995, the FRDAs ended and there were both deep cuts and big changes in government policy. We lost well over 50 percent of the organization's resources.

We remember the cuts, but that's not the main thing that happened. The government changed the way it manages its affairs. Instead of tracking only inputs, funding, etc., it started to judge us on the basis of our outputs.

At that time, the government also made the decision to enhance and support S&T in Canada through support to universities and, in fact, over the past decade has increased S&T spending some $13 to 15 billion. All of a sudden, we had to redefine what it meant to be an S&T organization within the Government of Canada.

Redefine in what way?

We used to do S&T that was tied closely to forest management and forest protection. Provincial and industrial foresters were our primary clients. We still count provinces, territories and industry as clients, but now we focus much more on policy-makers rather than foresters and there is more attention to the federal agenda as the primary driver.

Clearly there have been tremendous changes in the complexity of forest issues in the recent past, making it essential that we act as a catalyst to help bring the re-invigorated universities, forest research institutes and provincial agencies together. Through the efforts of many, we've built, or are players in, cooperative relationships such as Forest Research Opportunity B.C., our graduate student awards, and the forestry cluster at the University of Northern British Columbia. We also have become a significant contributor in dealing with the mountain pine beetle in British Columbia.

All this is part of a shift in focus to issues that have greater social, ecological and economic ramifications. Basically, we are becoming science synthesizers—we've gone from asking, 'How do we solve day-to-day operational problems?' to 'How do we focus on the policy issues or bigger questions affecting future forestry?' During my tenure at PFC, we've moved about 30 percent of our programming to national objectives such as the National Forest Information System, the National Forest Inventory, Carbon Accounting, the space program, and the invasive species–phytosanitary program. An additional 35 percent is currently focused on mountain pine beetle—the most significant forest management issue that the province and perhaps Canada has had to deal with. That's our new niche—using our intellectual capital and spending power to make a difference nationally and globally, while not losing track of provincial needs.

And how well are we succeeding?

Well, of course, I am biased. I believe that we are doing extremely well, judging from the number of requests we get for help and advice. By focussing on both bigger issues and advising policy makers, we provide a unique and valuable service. We are well positioned to advise government on forest issues that affect the futures of government, industry and Canadians. This brings both PFC and the CFS greater recognition from Ottawa, the country and from around the world. It also brings our scientists

greater professional recognition; they are becoming the key specialists that people turn to for advice on these issues.

In fact, by using our intellectual capital in this way, we make a bigger difference nationally and globally than we ever have. We're far more influential than ever before. That bodes well for our long-term future as an organization.

And now that you're retiring, what are your goals for your future?

My goals? I really don't have any specific goals—I don't think that is the objective of retirement. I do want to slow down a bit and get engaged in the social side of society. I have some grapes to grow. The bluegrass–gospel band I sing in (Shady Mountain) is playing more and more gigs; I'd like to master the mandolin well enough to play in public.

Accolades

The Individual Tree Crown software suite has garnered the Canadian Forest Service and two research scientists Federal Partners in Technology Transfer awards. This novel approach to sustainable forest management using remote sensing, developed by Pacific Forestry Centre research scientists **François Gougeon** and **Donald Leckie** delineates, identifies and regroups individual trees through computer analysis of high-resolution, remotely sensed digital images. Coupled with field sampling, the programs can be used to extract information such as crown sizes, formation and content of forest stands, and location of damaged and dead trees. Because of the possible global applications of the technology—including assessment of olive groves, tropical forest biodiversity, urban forestry, park rehabilitation, biomass and carbon accounting for the Kyoto Protocol—the team received its award under the category *Commercialization Leading to Social Benefits.*

François Gougeon and Donald Leckie

Already in use in Quebec, Ontario and the United States, the system has attracted the attention of several European and South American countries and enhanced Canada's reputation as a leader in sustainable forest management.

The Federal Partnerships Technology Transfer initiative is a group of federal government science-based agencies and departments that encourages the transfer research and technologies from government labs to the private sector.

Recently retired Senior Research Scientist **Mike Apps** was honoured recently with a Public Service Award of Excellence for his outstanding career. Recently retired after 25 years with the Canadian Forest Service, Apps's research on the role of forests in global change has earned him an international reputation. He led development of a forest carbon budget model for Canada, which is one of the few and best ways to measure carbon storage in trees, and was involved which in various roles in the Intergovernmental Panel on Climate Change, the International Geosphere–Biosphere Program and other international and national organizations.

Apps was one of 28 individuals and teams of public service employees, representing a range of occupations and services from across the country, recognized by the Public Service of Canada this year for excellence in providing services to Canadians.

Mike Apps

Eveline Stokkink, a student at Royal Roads University, recently received a $5,000 Pacific Forestry Centre Graduate Student Award to assist her in determining the extent introduced ambrosia beetles *Xyleterinus politus* and *Trypodendron domensticum* have become established in British Columbia. She will be working with Research Scientist **Leland Humble.**

New from the bookstore

Mountain Pine Beetle Initiative Interim Report. 2005. Natural Resource Canada, Canadian Forest Service, Pacific Forestry Centre.

"Beetle-proofed" lodgepole pine stands in interior British Columbia have less damage from mountain pine beetle. 2005. Information Report BC-X-402.

The Bridge 14: Newsletter of Natural Resources Canada's First Nations Element of the Mountain Pine Beetle Initiative, and of the British Columbia First Nations Forestry Program. Spring/Summer. 2005.

An annotated bibliography on the effect of bluestain on wood utilization with emphasis on mountain pine beetle vectored bluestain. Mountain Pine Beetle Initiative Working Paper 2005-4.

Performance of posts laminated with blue-stained mountain pine beetle lodgepole pine. 2005. Mountain Pine Beetle Initiative Working Paper 2005-5.

Bleaching treatments for blue-stained mountain pine beetle lodgepole pine. 2005. Mountain Pine Beetle Initiative Working Paper 2005-6.

Alternative wood products from blue-stained mountain pine beetle lumber: non-structural laminated products. 2005. Mountain Pine Beetle Initiative Working Paper 2005-7.

Current knowledge of characteristics and utilization of post-mountain pine beetle wood in solid wood products. Mountain Pine Beetle Initiative Working Paper 2005-8.

Maximizing value recovery from mountain pine beetle-killed pine for veneer products. Mountain Pine Beetle Initiative Working Paper 2005-9.

Forest Health & Biodiversity News (Santé & Biodiversité des forêts Nouvelles). Vol 9, No 1. Spring 2005. Natural Resources Canada, Canadian Forest Service, Atlantic Forestry Centre.

The Boreal Forest: A Global Legacy. National Forestry Week, May 1 to 7, 2005 (Poster) [La forêt boréale: un héritage mondial. La semaine nationale de l'arbre et des forêts, du 1 au 7 mai 2005 (Affiche)]. Natural Resources Canada, Canadian Forest Service / Ressources naturelles Canada, Service canadien des forêts, Headquarters.

Next Issue

Defense against root rot

and

Estimating carbon risk

Coming Up

A Future Beneath the Trees: International symposium on non-timber forest products, community economic development and forest conservation
Centre for Non-Timber Resources, Royal Roads University
August 25 –27, 2005
Victoria, BC
Information: www.ntfpvictoria2005.ca

Look North to the Future
25th Annual Meeting, Forest Nursery Association of BC
September 19–22, 2005
Prince George, BC
Information: resweb.res.unbc.ca/fnabc

Sustainability at the Landscape Scale: Supporting the Process through Multi-Party Stakeholder Participation
National Science Meeting, Ecological Monitoring and Assessment Network
November 20–26, 2005
Penticton, BC
Information: www.eman-rese.ca

Entomology: A Celebration of Life's Little Wonders
Joint annual meeting of the Entomological Society of Canada and the Entomological Society of Alberta
November 2–5, 2005
Canmore, Alberta
Information: people.uleth.ca/~dan.johnson/lac2005/esc-canmore.htm

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