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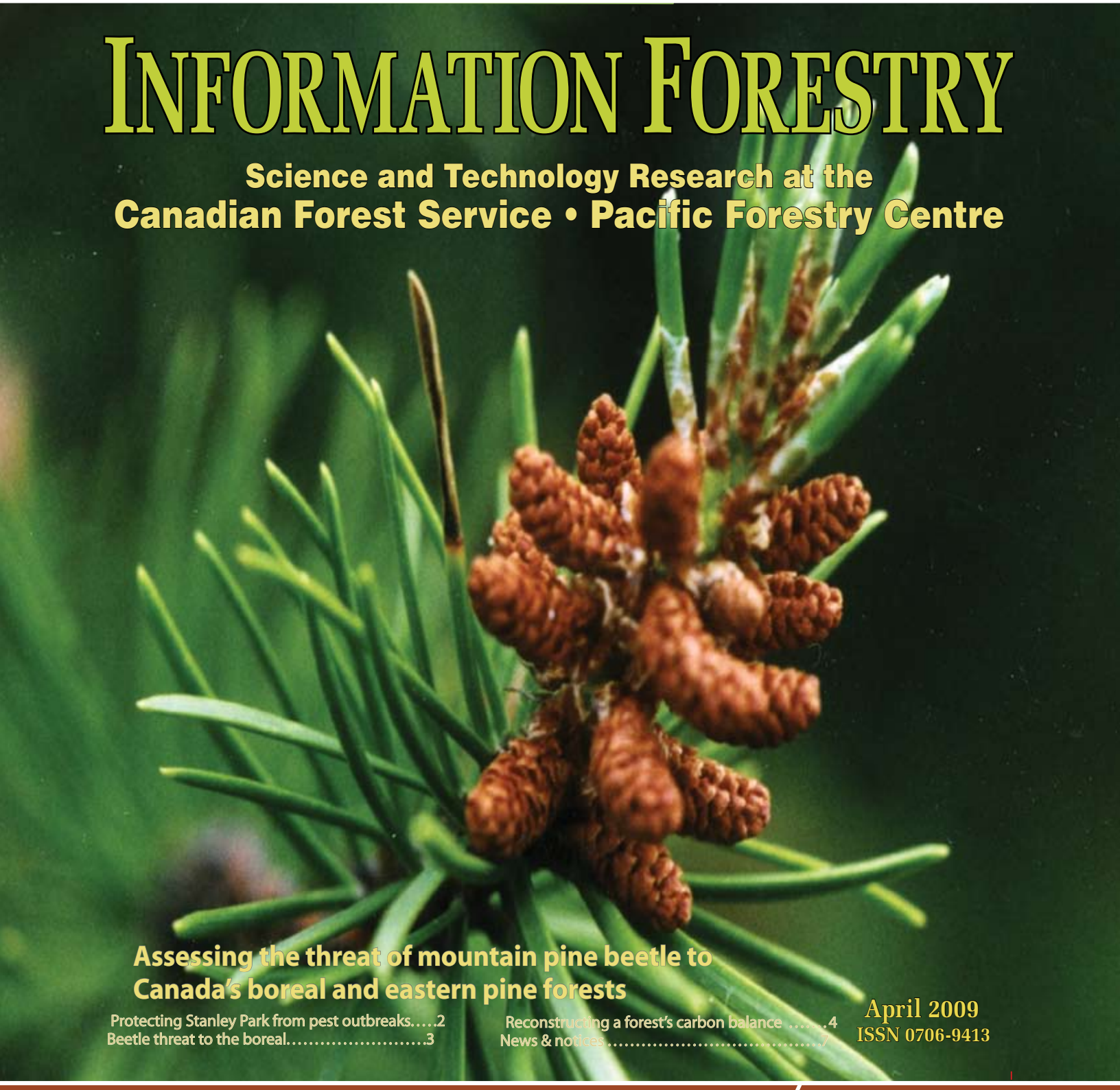

Assessing the threat of mountain pine beetle to Canada's boreal and eastern pine forests

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Canada

Insect inventory to protect Vancouver's Stanley Park

A biological survey in Vancouver, British Columbia's Stanley Park is providing critical information about the insects that live there.

After windstorms toppled entire stands of the park's old-growth forest in 2006, researchers from the University of British Columbia, Natural Resources Canada and other agencies joined together to trap beetles, moths and other insects among the fallen trees. It is the 120-year-old park's first insect inventory.

"We're trying to get some background entomology information on the park," University of British Columbia forestry expert John McLean says. "We haven't had a good handle on what is there."

Natural Resources Canada Research Entomologist **Lee Humble** (leland.humble@nrcan.gc.ca) extended his research on non-native forest pests to the 400-hectare park. For 14 years, he has conducted surveys for alien insects in forested areas throughout the province's lower mainland.

"Urban forests are often the first environments where non-native forest pests gain footholds," he says, "and are usually the first to be damaged, so they can provide early warning about the pests."

Humble supplied light traps and developed protocols for collecting moths using light at locations in Stanley Park. Students working with McLean collected, mounted and labelled the specimens, and Jeremy deWaard, a Ph.D. candidate working with Humble on the Canadian Barcode of Life project, genetically analyzed them. Humble says the barcode libraries will help forest managers identify unknown, mystery or alien species.

Non-native forest pests are usually introduced to new territories aboard trade goods shipped from elsewhere. Ports, rail depots and industrial areas tend to be located on shorelines, in river valleys or near other natural areas that provide refuge for insects.

"With the Port of Vancouver located just two, or three kilometres away," Humble says, "Stanley Park is vulnerable." In fact, Asian gypsy moth was found in the park in 1992; the larvae had ballooned ashore from vessels anchored in English Bay.

The pattern exists across Canada. In 2002, ash trees in southwestern Ontario fell prey to emerald ash borer, an Asian beetle that shipped aboard trade goods into Detroit in the 1990s. In 2003, Asian longhorn beetle was found in an industrial suburb of Toronto. Brown spruce longhorned beetle was discovered in Halifax's Point Pleasant Park, next to the city's main port, in 1999, but had been established in the park since at least 1990. According to Canadian Forest Service Research Scientist **Jon Sweeney** (jon.sweeney@nrcan.gc.ca), the beetle likely arrived in infested wood packing material in containers unpacked at the Halifax container facility.

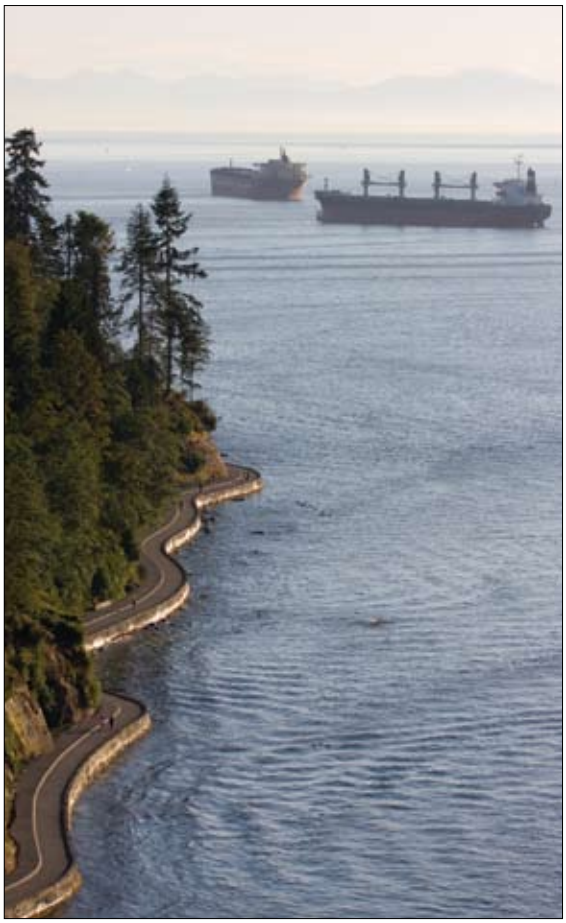
"From spruce mortality observed in 2000, the beetle probably got established in stressed trees, then populations built up enough that it started attacking healthier trees," he says.

McLean says the Stanley Park survey will help managers protect the landmark park from insect outbreaks like that seen in Halifax.

"The goal is to ensure the foresters know what the threats are and keep their eyes open for the appropriate signs and take action before things get out of hand."

That includes removing, for instance, extensive wind-toppled deadfall that might spur an outbreak by the native Douglas-fir beetle or monitoring the forest for sign of gypsy moth and other alien pests.

The 2006 windstorm damage in Stanley Park attracted national attention and prompted a public fundraising campaign to finance repairs and replanting in the park, including a $2 million contribution by the Government of Canada.



In 1992, larvae of the Asian gypsy moth wind-drifted ashore to Stanley Park from container vessels anchored in English Bay. *Photo: Dan Barnes, iStock © 2008*

Sources

Visit the Canadian Forest Service online bookstore to download "Alien Invaders: non-indigenous Species in Urban Forests" and "Invasive Bark and Wood-Boring Beetles in British Columbia, Canada."

For Information on the forest pest-barcoding project, see the December 2007 issue of *Information Forestry*, also available from the online bookstore.

Beetle threat to Canada's boreal forest assessed

Scientists call it the most destructive insect pest in the pine forests of western North America. Since the late 1990s, the mountain pine beetle has attacked more than 10 million hectares of lodgepole pine forests in the British Columbia interior. If the trend continues, 80 percent of the province's mature pine forest is forecast to be dead by 2013.

A key concern is the beetle's advance northward, to higher elevations and eastward in British Columbia and Alberta, beyond its historical range. A recent Natural Resources Canada report on the boreal forest identified the threat of mountain pine beetle to boreal resources and economies as an urgent question requiring attention. And, if the beetle bridges the boreal, it will spread to other pine species in the forests of eastern Canada.

"One of the Canadian Forest Service's research tasks under Canada's new National Forest Pest Strategy is to deploy a standard risk analysis framework to assess the threat from forest pests of multi-regional or national concern," says Pacific Forestry Forest Resources Director Jim Wood, who is working with the Canadian Council of Forest Ministers to implement the national strategy. "Mountain pine beetle is one such pest."

The risk assessment framework is based on the internationally sanctioned standard used for years by the Canadian Food Inspection Agency to analyze threats to Canada by non-native forest insects and diseases.

"Research completed under the federal beetle response programs administered by the Canadian Forest Service provided much of scientific and economic information required to answer the question of threat, or risk, to the boreal and eastern pine forests from continued expansion of the beetle infestation," says Natural Resources Canada Research Director Bill Wilson. "Forest decision makers are using these research findings as the basis from which to plan for and manage the risks of an expanded infestation."

Canada's boreal forests are vulnerable to mountain pine beetle.
Photo: Alexander van Deursen_Fotolia.com © 2008.

Participants drawn from the Canadian Forest Service, provincial forest agencies, and expert consultants identified key factors influencing both the likelihood of range expansion and possible economic, ecological and social consequences. The experts also provided recommendations for response and direction on how to focus management.

Key findings

No biological barriers to expansion. The pine species that dominate boreal and eastern stands are susceptible to beetle attack, and the blue-stain tree-killing fungi that accompany the beetle are at home in boreal pine species.

Climate will play a role. More frequent cold snaps east of the Rocky Mountains will kill overwintering beetles. In the long term, climate change may create more beetle-friendly conditions.

Forest structure may reduce the rate of spread. Pine stands in the boreal are more fragmented, less dense and younger than pine stands in British Columbia's interior—traits that decrease the forests' susceptibility to beetle.

Potential risks

Reduced timber supply. Due to forest structure, average losses to individual stands during outbreaks should not exceed 40–60 percent of standing volume—enough to disrupt fibre flow and make these forests less economically viable for timber supply.

Threats to non-timber benefits. In some regions, threats that the beetle poses to boreal forest non-timber benefits, such as water conservation, carbon storage, recreation and cultural use, may outweigh commercial threats.

Increased fire risks. Stands attacked and killed are more vulnerable to forest fire. When climate change is factored in, the potential for less predictable fire behaviour increases.

On the cover

Studies show that mountain pine beetle attacks and kills jack pine, a component of Canada's boreal forest.
Photo: Bill Cooke, Michigan State University - Bugwood.org

Sources

Risk assessment of the threat of mountain pine beetle to Canada's boreal and eastern pine resources and *Canada's boreal forest economy: economic and socioeconomic issues and research opportunities* are available from the Canadian Forest Service online bookstore.

Analysis of landscape history demonstrates how carbon s

When he reconstructed the landscape history of a 2500-hectare forest research area near Oyster River, British Columbia, soil ecologist **Tony Trofymow** added "history sleuth" to his list of skills and experience as a Natural Resources Canada research scientist.

The task at Oyster River required overlaying current forest inventory maps with information from a 1919 timber cruise, from a decade-by-decade series of digitized air photos from 1931 to 1999, surveys of the area done in the 1930s and '40s, and records and maps of disturbances, including clearcut harvesting begun in 1920, subsequent slash and wild fires, and replanting by World War II conscientious objectors in the 1940s.

In doing so, Trofymow (tony.trofymow@nrcan.gc.ca) traced how the original 300-year-old, Vancouver Island Douglas-fir forest morphed into the landscape that exists there today.

"We wanted to look at an area and determine its carbon budget over a period of time from when it was originally a first-growth forest, through managed forest and onwards," he says. "That meant we had to go back and determine the area's disturbance history. There is a lot of documentation about what was going on in that landscape through the last century … we just had to find it, compile it and analyze it."

Once the historic spatial disturbance and inventory data are compiled, researchers with the Canadian Forest Service's Carbon Accounting Team used them as inputs to the Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3) to derive the area's historic carbon budget. Model values of stock changes confirmed how disturbance in highly productive west coast forests affects local carbon stocks.

"The analysis shows clearly logging old-growth forests significantly reduces carbon stocks. But then, as the forests regrow, they become carbon sinks fairly quickly—within a couple of decades," says Research Scientist **Werner Kurz** (werner.kurz@nrcan.gc.ca), leader of the Canadian Forest Service's Carbon Accounting Team.

Furthermore, when logging begins in second-growth forests, "it is possible to maintain carbon stocks at neutral levels across the landscape while providing society with timber, fibre and energy."

As similar transitions are occurring elsewhere across Vancouver Island and coastal British Columbia, Kurz says forest policy makers and environmental organizations are taking great interest in the Oyster River analysis.

Source

"Derivation of a spatially explicit 86-year retrospective carbon budget for a landscape undergoing conversion from old-growth to managed forests on Vancouver Island, BC" was published in *Forest Ecology and Management* in 2008.

stocks recover after coastal old-growth forest is harvested

The Oyster River-area study is one piece of a multiple-site, multiple–carbon-model comparison project. Researchers with the Canadian Carbon Program's Fluxnet Canada Research Network have established seven forested and wetland stations across Canada. At one or more flux tower sites at each station, sensors mounted on towers detect and measure wind direction and speed, temperature, and precipitation. The sensors also monitor the rate at which the trees and other vegetation take up or release carbon dioxide and water vapour over the forest canopy, and exchange them with the overlying atmosphere.

From 2002 through 2005, the sensors at flux towers set up near Oyster River have taken 20 readings each second, 24 hours each day, 365 days each year.

This detail sets flux tower sites apart from other carbon-monitoring systems, says Kurz. "What flux towers do better than any other measurement system is directly measure both the inter- and intra-annual variability in carbon emissions and removals as an ecosystem responds to fluctuating climate conditions. They provide high-temporal-resolution, localized estimates of carbon

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Models and measurements
Oyster River data improve forest carbon models

The significance of the historic spatial information, the measurement data, and CBM-CFS3–derived historical carbon estimates for the Oyster River research area extends beyond British Columbia. The objective of current research is two-fold: to compare the resulting model estimates with the short-term tower and ground-plot measurements, and to use the CBM-CFS3 estimates for the entire area over the 86-year period as a benchmark against which to compare other carbon models being developed in Canada.

"The historical information that Tony amassed was critical to our part in the project," says carbon modeler **Graham Stinson** (graham.stinson@nrcan.gc.ca). "What we see on the landscape today includes not just what's going on today but the legacy of what's gone on before. If we know the disturbance history,

Continued, next page

Using historical information, ground-plot data, and flux tower measurements for the Oyster River and Buckley Bay areas of British Columbia, researchers determined the carbon budget of the landscape over a period of time from when it was a first-growth forest, though managed forest and into third-growth. Shown: 360° panorama of a flux tower site replanted in 1988.

Ground plots provided information on soil carbon and decomposition.

fluctuations and the environmental drivers that control them."

For the Oyster River study, Trofymow selected a landscape with a progression of disturbance histories that encompassed two flux tower sites of the coastal British Columbia station. The station monitors forests of three different ages on eastern Vancouver Island: an older second-growth stand planted in 1949, and a recent, year-2000 clearcut third-growth stand within the Oyster River area. A tower site near Buckley Bay takes readings from a Douglas-fir stand that was harvested and planted for a second time in 1988.

"Many of the sites in the global network of flux tower sites are in older stands, and those are not necessarily representative of the landscape," he says. "They also tend to look at land that is not being disturbed, so they may not be representative of all the different forest ages, types, and growth conditions found in a larger landscape. It's problematic, as you cannot just take these measurements and extrapolate them to a larger landscape or region."

Trofymow and his team also established in 2002 ground plots at the tower sites. They collected information on soil and nutrient properties, the live trees, understorey vegetation, dead trees, woody debris, forest floor, and mineral soils, in order to calculate the carbon stocks in the live biomass and dead organic matter in each plot.

"These plots were measured again in 2006," said Trofymow. "Once data are compiled and appropriately scaled to each tower site, we will be able to compare the measured changes in ground plot carbon stocks to the cumulative carbon fluxes measured by the towers or estimated by models for the same period."

then our estimates for today's carbon fluxes are less clouded by historical unknowns. This means we can make more meaningful comparisons between our modeling estimates and the towers' measurements."

CBM-CFS3 is the core model of Canada's National Forest Carbon Monitoring, Accounting and Reporting System. It is used by the Government of Canada to prepare estimates of greenhouse gas emissions and removals from the managed forest as part of Canada's Greenhouse Gas Inventory, submitted annually to the United Nations. The model is also used by provinces, industry, environmental organizations, and the research community to meet international reporting requirements, inform policy decisions, support international climate negotiations, and conduct research.

It is one of a number of carbon models used in Canada. Some other models, including the Canadian Integrated Biosphere Simulator being developed out of the Canadian Forest Service's Northern Forestry Centre are process-based models, which attempt to mathematically estimate ecosystem processes such as photosynthesis, tree growth, respiration and decomposition using environmental driver inputs such as incoming sunlight energy and hourly or daily weather data.

Scientists are using the historical spatial and weather data for the Oyster River area, and data from a similar-size study area near Chibougamau, Quebec, as model inputs. The resulting estimates will be compared to each other, to the CBM-CFS3 estimates, and to the localized short-term flux tower and ground plot measurements. This will allow the scientists to identify weaknesses within all the models, as well as their strengths.

"We'll be asking whether the models respond uniformly in magnitude and direction to environmental signals," says Kurz. "Because if the process models are more or less in agreement about how a particular environmental stimulus translates into a greenhouse-gas response, we'll know that science has advanced to the point that we can take one of the process-simulation approaches and incorporate it into the models used in our national carbon accounting system."

Stinson says, "A lot of it will come down to the modeling community learning more about each other's models, and improving their own models based on what they learn."

Out of the experience, greater understanding of the processes that underlie the release, capture and storage of carbon dioxide and other greenhouse gases at forested sites in Canada, like the flux tower sites in the Oyster River-area, will emerge.

People

Arrivals

Welcome to **Judi Beck**, the Pacific Forestry Centre's new Director of Forest Science. Judi brings to the position more than 20 years of forest science and leadership experience, including technical expertise in fire and forest management, stand dynamics, soil sciences and forest meteorology. She has worked with a wide variety of forestry, fire and land management agencies around the world—British Columbia, Australia, Alaska and across Canada—and has worked on science initiatives with Europe, Argentina, Malaysia and Indonesia.

While in Australia and while leader of Fire Sciences for the Province of British Columbia (from 1989 into 2004), Judi conducted research studies in a number of forest-science disciplines. Over a 10-year period, she collaborated with many Canadian Forest Service researchers on projects and studies. These include the International Crown Fire Modeling Experiment, Wildfire Threat Assessment, and the Fire ecology and management chapter in the Forestry handbook for British Columbia.

Departures

Before retiring as Pacific Forestry Centre's GIS and database manager this winter, **Dennis Clarke** helped develop and integrate biological and geographical forest, insect, disease and climate data inventory and related data files, and compiled and analyzed forest pest, bioclimatic and national forest inventory and other related data for regional and national reports. He will be spending more time sailing.

Research Scientist **Hugh Barclay** retired recently. Barclay collaborated on development of many large-scale computer models of bark beetle population dynamics and control, and tree growth. He looks forward to spending more time sailing, playing jazz and Japanese instruments, and looking at the stars.

Rod Garbutt leaves his desk at the Pacific Forestry Centre this spring. During his career as forest health technician for the Canadian Forest Service, he conducted field assessments of forest health in British Columbia and the Yukon. He also monitored outbreaks of major forest pests through ground and aerial surveys. He will continue working as a forest health consultant, between woodworking, hiking, camping and ocean kayaking.

Accolades

Natural Resources Canada, along with eight partners, recently was honoured with a Premier's Award for the British Columbia Parks fuel hazard management program, which received funding from the federal government under the Mountain Pine Beetle Emergency Response: Canada–B.C. Implementation Strategy to address mountain pine beetle issues in the province.

"The federal beetle program worked with the BC Ministry to help remove post-beetle trees from designated recreation sites and trails reducing the risk to public safety from hazardous trees and fires," says **Bill Wilson**, Natural Resources Canada Director of Mountain Pine Beetle Policy and Research. "The project also contributes to local economic activity by encouraging local and visitor use of these recreational sites and trails."

Events

2009 COFI Convention
Council of Forest Industries
April 1-3, 2009
Prince George, BC
www.cofi.org

Envisioning Tomorrow's Forests
Sustainable Forest Management Network
April 21–23, 2009
Gatineau, QC
www.sfmnetwork.ca/html/conference_2009_e.html

Integration: Thinking outside the box
Applied Biology Conference and AGM
Assocation of Professional Biologists of British Columbia
May 5–, 2009
Victoria, BC
www.apbbc.bc.ca

22nd Annual Global Forest & Paper Industry Conference
PricewaterhouseCoopers
May 14, 2009
Vancouver, BC
www.pwc.com/forestconf09

2009 Conference and AGM
British Columbia Community Forest Association
May 29–31
Port Alberni, BC
www.bccfa.ca/conferences.php

2009 AGM and Conference
Canadian Institute of Forestry
September 21–23, 2009
Nanaimo, BC
Contact: Michel Vallee,
vancouver-island@cif.ifc.org

2009 Joint Annual Meeting
Entomological Society of Canada and the Entomological Society of Manitoba
October 18-22, 2009
Winnipeg, MB
www.esc-sec.ca/annmeet

XIII World Forestry Congress
October 18–25, 2009
Buenos Aires, Argentina
www.wfc2009.org

New from the bookstore

Technology Transfer Notes

Determining year of death and nature of stand recovery using a time series analysis of remotely sensed data. 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Technology Transfer Note 37.

Déterminer l'année de la mort et la nature de la récupération des peuplements au moyen d'une analyse des séries chronologiques des données télédétectées. 2009. Ressources naturelles Canada, Service canadien des forêts, Centre de foresterie du Pacifique. Notes de transfert de technologie 37.

Working papers

Source or sink stands - Can stand parameters be used to predict mountain pine beetle brood production with enough precision to be useful for assigning treatment priorities? 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-03.

Effects of overstory mortality on snow accumulation and ablation. 2008. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-13.

Using reconstructed outbreak histories of mountain pine beetle, fire and climate to predict the risk of future outbreaks. 2008. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-16.

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Decision support framework for assessing alternative mountain pine beetle management strategies on sustainable forest management. 2008. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-18.

Factors affecting the ecological legacy of unsalvaged post-mountain pine beetle stands. 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-19.

Working paper: Monitoring tree-level insect population dynamics with multi-scale and multi-source remote sensing. 2008. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-20.

Considering the effectiveness of mountain pine beetle mitigation strategies. 2008. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-21.

A landscape level assessment of post-beetle change in stream riparian function. 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-22.

Temporal composition and structure of post-beetle lodgepole pine stands: Regeneration, growth, economics, and harvest implications. 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-23.

Impact of mountain pine beetle infestation and salvage harvesting on seasonal snow melt and runoff. 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-24.

Pilot mechanical pulping assessment of dry blue-stained and grey-stage wood chips from beetle-killed lodgepole pine. 2009. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-25.

Assessing the influence of time-since-death: Pilot scale kraft and thermomechanical pulping of beetle-killed lodgepole pine. 2008. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre. Mountain Pine Beetle Working Paper 2008-26.

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