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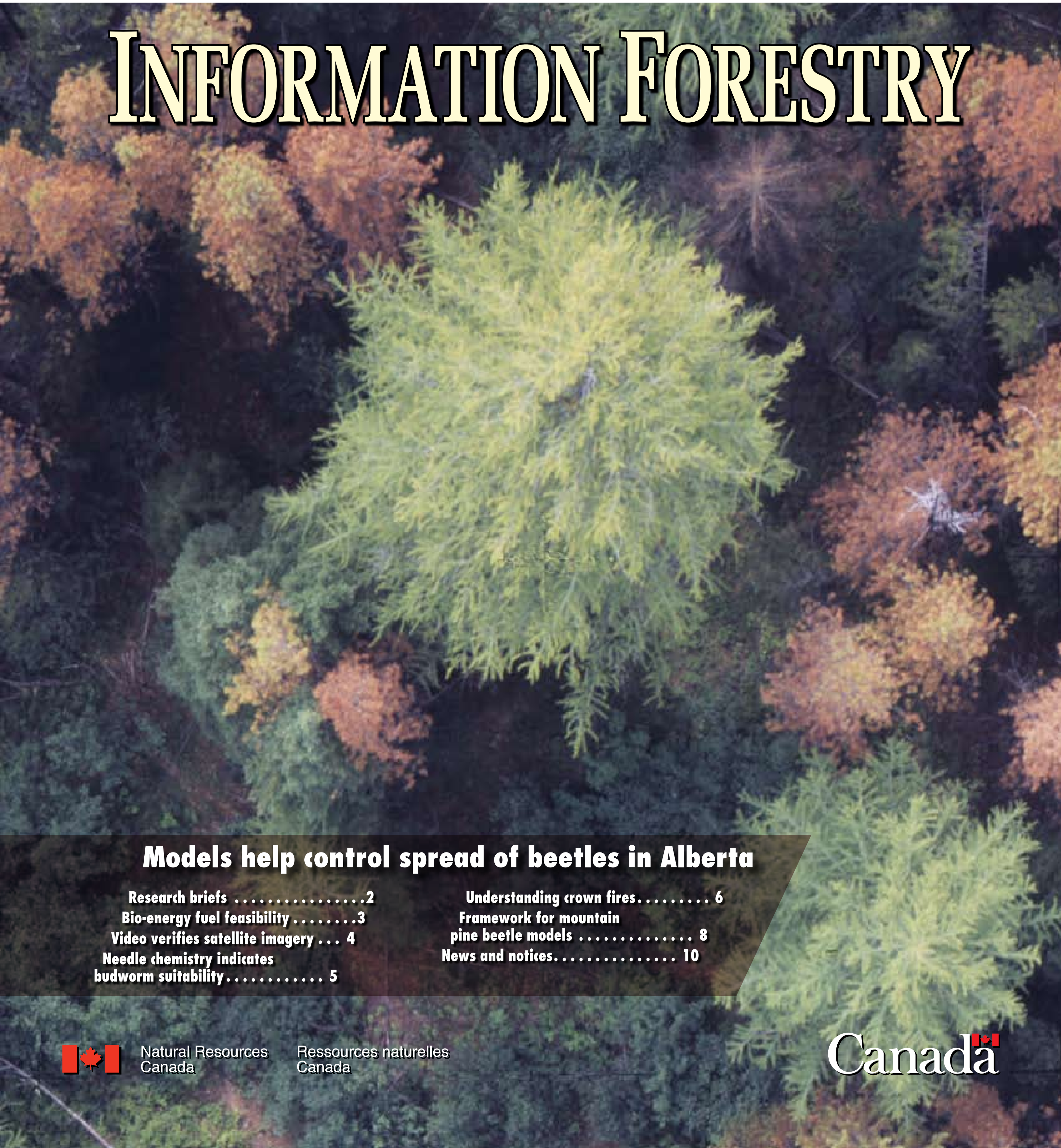

Models help control spread of beetles in Alberta

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Beetle numbers drop with exposure, study shows

Debarking logs full of Douglas-fir beetle larvae can reduce the insect's populations—especially if logs are stripped in early summer. Working with staff from British Columbia's Kootenay Lake Forest District, where a Douglas-fir beetle infestation has been turning forested slopes around the city of Nelson brown for almost a decade, Canadian Forest Service researchers recently tested the treatment's effectiveness.

"Debarking is sometimes done to control infestations where felling and burning is restricted because of weather conditions or a nearby community," says Research Scientist Terry Shore, who headed the study. "However, it's labour intensive and costly, so companies are reluctant to do it. We wanted to determine how worthwhile the effort might be."

Douglas-fir beetles prefer to feed and lay their eggs under the bark of freshly downed trees, and attack live trees only during outbreaks when downed-wood supplies are insufficient. Shore and his colleagues cut bolts from freshly attacked Douglas-fir in the Nelson infestation area following spring flight. In July, the researchers peeled some of the trap bolts, then placed the bark in a mesh bag on the ground near the log. At the end of August, they collected the bags and counted survivors: none of the more than 700 beetles and larvae found in the bark peeled in July had survived exposure over the summer.

The researchers repeated the experiment at the end of August. The following spring, they collected those bags of bark. The beetle survival rate was somewhat higher in the bolts peeled in August: only three or four beetles remained per square metre of bark.

"Not only did we find debarking is very effective if timed right," says Shore, "we found that it is actually much easier to do than expected. The bark came off the logs in large pieces."

In a concurrent experiment in which stumps were monitored, the researchers counted an average of 70 beetles emerging from each stump in the spring, with some stumps producing as many as 220 adult beetles.

"If there's just a stump here and there, it's probably not much of a problem," says Shore. "But if there are a lot of stumps, forest managers may want to consider debarking them.

Pest tests pinpoint insect-resistant trees

Wise investors protect their investments. The Canadian Forest Service and the British Columbia Ministry of Forests are no exception. Integral to their long-term goal of regenerating the province's forests with spruce trees selectively bred to resist white pine weevil are tests to determine if those trees are irresistible buffets for other pests.

"We wanted to determine whether genetic resistance to weevil provides resistance to other pests," says Canadian Forest Service Forest Research Officer Lara vanAkker. "The flip side of that was to see if weevil-resistant trees were actually more susceptible to other insects."

VanAkker and her colleagues tested weevil-resistant and -susceptible families of Sitka, white, Engelmann and interior spruce trees. The results: weevil resistance does not make the trees resistant to other insects. However, researchers did identify specific tree families and clones—including both weevil-resistant and -susceptible genetic types—which performed better against the pests than others.

The insect pests that had greatest impact on tested trees were gall aphids, spruce bud moth and spruce cone worm. Compared to the impact of white pine weevil on regenerating spruce forests, however, the impacts of these three pests are relatively minor. White pine weevil, named for its preferred eastern North American host tree, is almost solely responsible for the lack of spruce regeneration in many parts of British Columbia.

However, says vanAkker, "It's important to know if, by breeding spruce families with weevil-resistance mechanisms, we are increasing risk for damage by other insects."

The British Columbia Ministry of Forests' Coastal Tree Breeding Program will use the test results, including information on which spruce families performed best against other pests, to select material for weevil-resistance breeding programs and seed orchards.

The research is funded by the Forest Investment Initiative of the British Columbia Ministry of Forests' Forest Science Program (research project #Y051225).

White pine weevil is one of the most destructive pests of spruce in British Columbia, and is almost solely responsible for the lack of spruce regeneration in many parts of the province.

Options for using wood for energy examined

High energy prices, international greenhouse gas reduction commitments and governments' desire to lessen their nations' dependency on fossil fuels are creating worldwide demand for renewable energy including wood-fibre fuel.

With more than 8.7 million hectares of forest affected by the current mountain pine beetle infestation, British Columbia has a surplus of beetle-killed wood that could fuel biomass-energy development. Even with increased production at mills and processing plants, there's too much wood for the forest industry to process into traditional products, or to export without negatively affecting our traditional export markets. Developing an industry to produce energy and energy commodities from the surplus could solve many problems created by the beetle epidemic, and provide new economic opportunities for the province's communities.

But, caution Canadian Forest Service economists, not all aspects of the energy-from-wood solution are feasible. For instance, says Forest Economist Brad Stennes (**bstennes@pfc.cfs.nrcan.gc.ca**), who recently completed a study on the economics of bioenergy options for woody feedstocks, "The current surplus is the result of the beetle infestation, and eventually the amount of available wood will fall as the volume of commercial salvage timber declines. Given that, you don't want to build a massive facility which depends on this surplus for feedstock and takes 20 or 30 years to recover your investment."

British Columbia already produces half of the wood-based energy in Canada. Most occurs through self-generation within the forest industry: primarily in pulp and paper mills and to a lesser degree in sawmills using waste wood from their regular processing operations. The energy provides both heat and electricity, freeing up energy that would otherwise be supplied by BC Hydro or Terasen, the province's main energy suppliers. As energy prices rise, many forest companies are expanding capacity to produce energy from wood waste.

Because their fuel is already on site, their costs are low—a benefit operations that harvest wood specifically for energy production lack. "The trees may be dead," says Stennes, "but you still have to go cut them down, gather them, ship them, store them, chip them…. In the current economic climate, you can't get those costs low enough to compete with traditional energy sources." If energy prices continue to rise, however, direct harvesting of trees for energy may become economically feasible.

Smaller scale, well-placed wood-fired energy plants may be more economical—not just to supply, as local sources of woody feedstock could be used, but to build—and would have added benefit of creating employment in smaller communities. One such plant operates in Williams Lake. It collects waste wood from a number of sawmills in the area, burns it and sells the electricity to BC Hydro. Although successful, it is, to date, the province's only such stand-alone plant.

Stennes and co-researcher Alec McBeath also examined the feasibility of producing value-added commodities such as wood fuel pellets from wood. Being more easily transportable than unprocessed wood, these would help meet demand for renewable energy sources in Europe, where use of such energy is highly subsidized. Several British Columbia plants produce wood-fuel pellets for export, but again their operations' viability is based on being able to obtain inexpensive wood waste from nearby mills.

"There is definitely room for greater biomass energy production in British Columbia," says Stennes. "The point of our study was to identify and examine which options best take into account long-term wood availability and costs, as well as best serve communities."

Stennes and McBeath conclude:

The current, very large pool of potential biomass feedstock in British Columbia is a result of the mountain pine beetle epidemic, and is temporary.

Aside from increased processing of industrial wood waste, biomass energy cannot compete with fossil fuel energy—given current prices.

Climate change, range expansion and introduction of exotic forest pests over the long term may create conditions that support development of bio-energy production technologies.

Beehive burners were once the standard method of dealing with logyard and mill wood waste in British Columbia. As pulp and paper mills, saw mills and renewable-energy plants maximize capacity to produce energy from wood, the few burners still in existence will disappear.

Airborne video technology helps assess land cover maps

The Earth Observation for Sustainable Development of Forests initiative, working with the provinces, territories, universities and industry, has produced a national map of the forested land cover of Canada. A long-term goal is to also produce maps of forest land cover change over time and biomass.

Those who produce land cover maps from satellite imagery have always faced the challenge of determining the maps' accuracy.

The challenge increases when the maps represent large areas, such as Canada; it is further increased when the map includes areas lacking in ground-sampled data against which to compare the mapped information. In Canada, much of the forested land cover has never been ground sampled—because of inaccessibility, remoteness and cost.

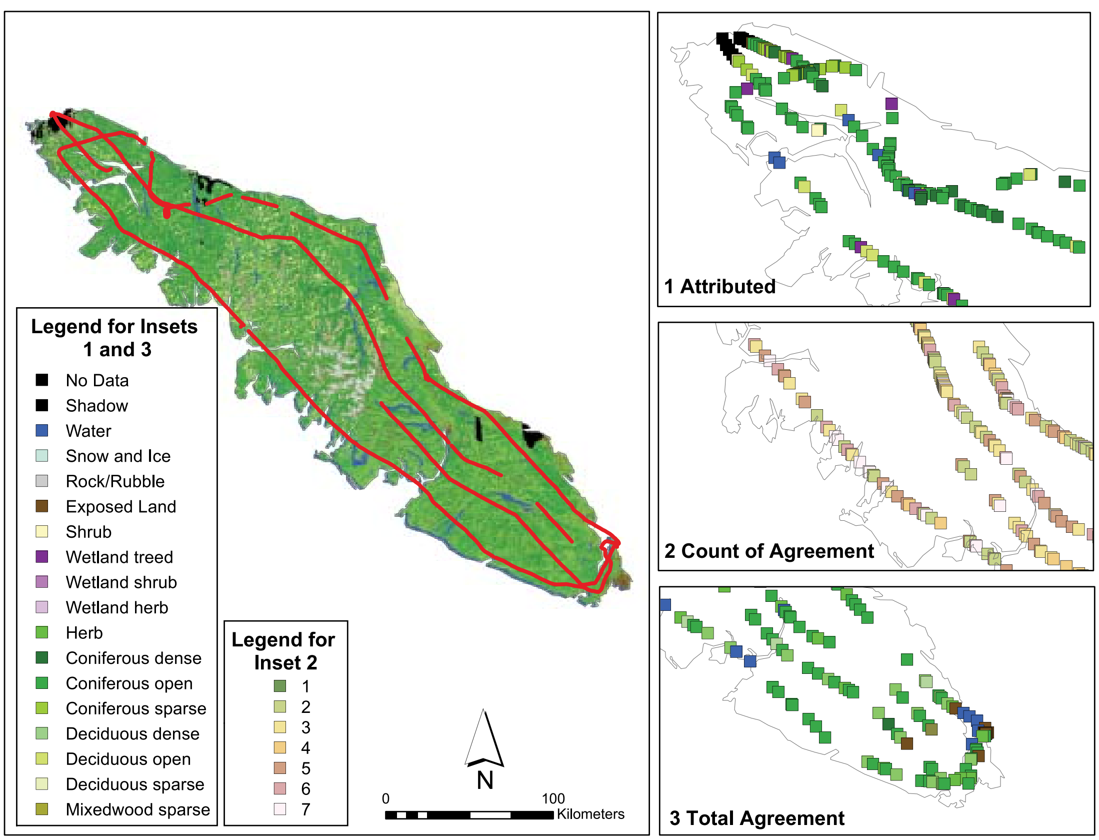
Canadian Forest Service researchers have recently found a way to verify accuracy for these data-poor regions: they adapted new digital–video-interfacing technology to collect verification data. By augmenting a standard-issue video camera with technology developed by private, spatial multimedia company, researchers flew over Vancouver Island's rugged interior and videotaped the landscape. Each image frame is geo-referenced as to its precise location, providing cost-effective data that can be used to validate, or air-truth, land cover classes of videotaped areas.

The imagery and data, says Canadian Forest Service Forest Geomatics Research Scientist Mike Wulder (**mwulder@pfc.cfs.nrcan.gc.ca**), are easily integrated into the geographic information systems used by the Canadian Forest Service, which is producing the map. "The system also provides a permanent record of the survey. All these points are geo-located—they are known positions in space—and the class identifications and the photography are archived as well. If somebody doesn't like what we've done, they can go back in, and re-class the map point, for instance, or verify the class."

The map for which the technology was tested is of Canada's forested land cover—one of the products created by the Earth Observation for Sustainable Development of Forests program (EOSD), a partnership between the Canadian Forest Service and the Canadian Space Agency. The map consists of more than 475 Landsat images, and covers an area of over 400 million hectares: accuracy over 400 assessment on a scene-by-scene basis is not feasible or cost-effective, but air-truthing of remote, unsampled areas is.

The map, to be released later this year, includes ratings not just for overall accuracy. "We're publishing the overall accuracy with an error bar, and each individual class has an average accuracy and an error bar," says Wulder. "People using the maps can look at accuracy reports and have an understanding of the quality of the products we developed. Users can look at the accuracy reports and adjust their applications and expectations accordingly."

Inputs from EOSD are important data sources in the National Forest Inventory, as well as the National Forest Carbon Accounting Framework. The data are integrated and synthesized within the National Forest Information System, which is where the data can be accessed via the web.



Scientists can verify land-cover classifications of remote, unsurveyed regions maps made from satellite imagery. Each line indicates a flight path taken during land-cover verification of Earth Observation for Sustainable Development of Forests (EOSD) map data, with square points representing air-truthed classifications.

Chemistry profiling predicts budworm outbreak potential

Budworms are among the most destructive forest insects in North America. During outbreaks, eastern spruce budworm, western spruce budworm, jack pine budworm and their relatives strip foliage from tens of thousands of hectares of susceptible conifers across the continent.

Now, thanks to indicators identified by Canadian Forest Service scientists, forest managers may be able to use simple chemical analyses to identify areas at particular risk to budworm outbreaks. Insect Ecologist Vince Nealis (**vnealis@pfc.cfs.nrcan.gc.ca**) and Research Scientist Jason Nault (**jnault@pfc.cfs.nrcan.gc.ca**) plotted changing chemistry within developing Douglas-fir needles against the ability of western spruce budworms to feed successfully on the trees' buds. From that, they determined that the same molecular compounds that give evergreens their distinctive smell also indicate the potential success of budworms in a given year.

"An important part of the life history of the budworm has to do with how well it is synchronized with the flush of new buds in the spring," says Nealis. "We wanted to quantify the relationship between emergence of western spruce budworm and development of the insect's preferred food, Douglas-fir buds."

Key to the prediction method is a mixture of complex, aromatic hydrocarbon molecules called terpenes, found in all evergreen needles. The proportions of different terpenes in the mixture within buds change rapidly, but predictably, as buds develop in the spring. The rate of progression from one dominant terpene to another is closely tied to site temperature. In cooler places or during cooler years, the progression—and bud development—occurs more slowly. This can upset the timing of budworm emergence to bud suitability, with consequences to outbreak risk.

According to retired, now-volunteer U.S. Forest Service Research Entomologist Karen Clancy, who studies resistance in Douglas-fir to western spruce budworm, budworm population success depends on that timing. "Phenology of bud break is probably the most important factor driving resistance in individual trees to western spruce budworm damage, and driving budworm population dynamics."

Western spruce budworm emerges from its winter shelters in early spring and subsists on older Douglas-fir needles and pollen cones until its preferred food—tender, developing buds—comes into season. If larvae emerge too early or if bud development is delayed, greater numbers of budworms die, and that particular forest stand may benefit from a year without an outbreak.

By using gas chromatography to measure the terpene profiles of developing buds, Nealis and Nault found they can pinpoint where and when host trees would be most suitable for budworm outbreak in a given year and where the risk of damage is greatest. Knowing this allows forest managers to better plan and implement pest management options, and better manage forests in their care.

"They appear to have found a good, reliable, relatively easy way to measure the bud break phenology of individual trees and populations of trees," says Clancy. "Measuring bud break phenology with other methods like going out and collecting samples and visually assessing each of the buds is very time consuming. If you can clip just one branch from a tree and analyze its foliar terpenes, that's a phenomenal result."

Although Nealis and Nault identified the correlation between terpene profile and bud suitability for budworm by performing linked biological and chemical assays on western spruce budworm and its host, Douglas-fir, Nealis suspects "the method can be applied to jack pine budworm or eastern spruce budworm or any of the other budworms."

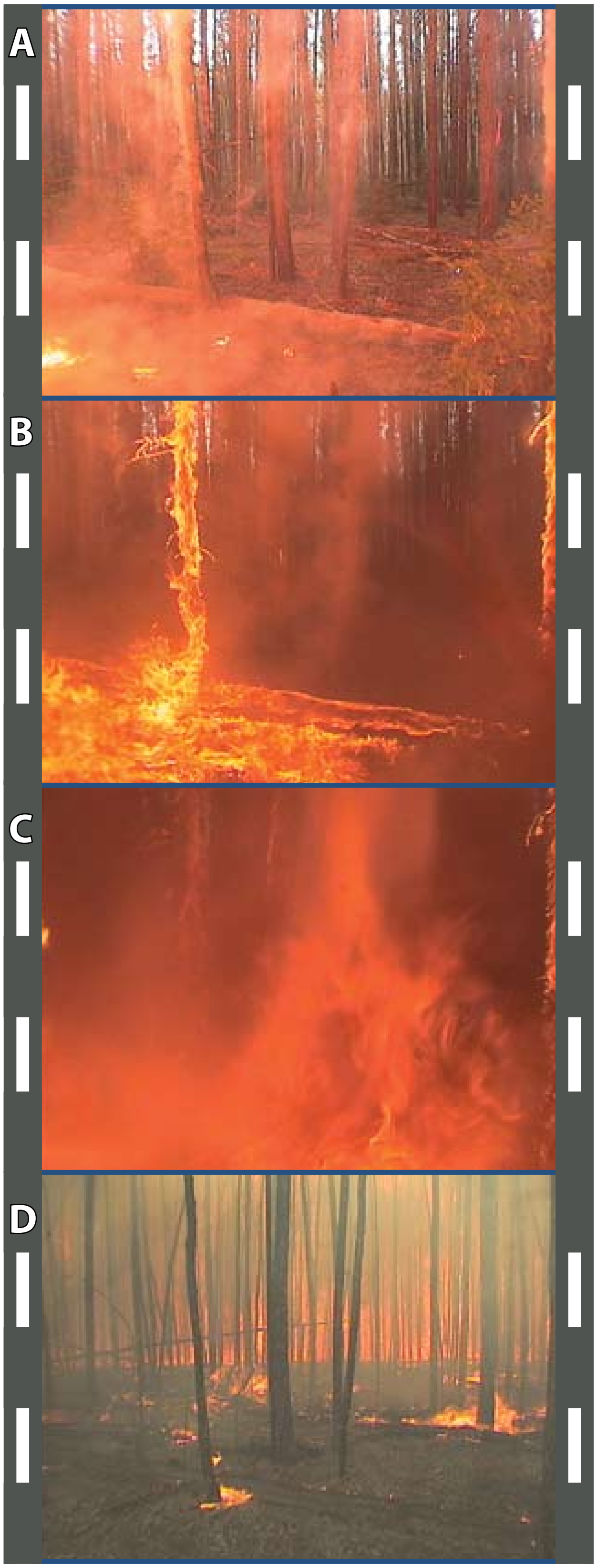
For more information on budworms, visit the Canadian Forest Service Conifer Defoliators website, at **www.pfc.cfs.nrcan.gc.ca/entomology/defoliators/index_e.html**

Scents of suitability

Terpenes, the molecules that give conifers their distinct smell, indicate tree-bud suitability to budworm attack. In linked chemical and biological assays of foliage from test trees at eight sites in British Columbia's interior, Canadian Forest Service researchers identified terpene profiles that can be used to predict host suitability for the insect, severity of defoliation, and identify tree resistance to budworm damage.

Western spruce budworm, one of British Columbia's most destructive forest insects, feeds on developing Douglas-fir buds and young needles. By midsummer, heavily infested trees appear scorched and have defoliated upper crowns and branch tips.

International experiment provides baseline data for u



Two minutes, 31 seconds: Embers dropping ahead of the fire front start pilot fires on the forest floor; the trees glow red with reflected light; they steam and smoke as the radiant heat ahead of the fire front drives off moisture, then bark flakes on the trees and the forest floor bursts into flame. Fire fills the screen, then passes, leaving smoky, charred trees, ash-covered ground, and residual flames.

This video sequence, the first in-fire record of a crown fire sweeping through a northern forest, was shot by a camera placed within a flame-proof, heat-resistant box fitted with an oven-glass window.

"As well as providing insights into mechanisms of fire spread, the video effectively informs people about the power of fire" says Canadian Forest Service Research Scientist Steve Taylor, who led the study during which the video was recorded. "They're using it to help train fire fighters about fire behaviour, and show just how quickly a fire like this spreads and changes."

Providing training materials is only one outcome of that study and its larger research project. When researchers from around the world ignited forest plots north of Fort Providence, Northwest Territories, they were interested in gathering data to test models of the most damaging forest fires: crown fires.

The International Crown Fire Modelling Experiment

Taylor's study analyzed effects of wind-speed variations on crown fire behaviour, one of more than a dozen studies conducted simultaneously as part of the International Crown Fire Modelling Experiment. Canadian Forest Service fire researchers, in collaboration with scientists from the U.S. Forest Service and a dozen other countries, and fire control crews from the Northwest Territories, ignited and tracked 18 high-intensity crown fires in jack pine forests near Fort Providence between 1997 and 2000. A network of ground, tower and airborne instruments tracked fire behaviour characteristics within, around and above each plot. The instruments recorded fire spread rates and patterns, flame structure, thermal radiation, temperature, smoke chemistry, wind dynamics, fuel moisture and consumption, and numerous other variables.

The primary goal of the experiment was to test and calibrate a model of the physical processes that generate and sustain crown fires. A crown fire is a blaze that has leapt up into the forest canopy, where needles, branches and wind feed its sudden explosion from a relatively slow-moving, controllable surface fire into an unpredictable, fast-moving inferno.

"Crown fires are extremely complex events, in terms of the science and physical processes involved," says retired Canadian Forest Service Senior Forest Fire Scientist Brian Stocks, one of the project's primary organizers. "Better understanding of fire behaviour—especially crown fire behaviour and the transition from surface to crown fire threshold—in different fuel types is critical. And it's going to become more critical, because there are probably going to be more crown fires more often in the future, given potential impacts of climate change."

Because fuel availability, moisture content, weather, and other conditions must be right for fires to crown; because such conditions tend to coincide with greater numbers of natural wildfires that require attention from otherwise-available fire crews; because igniting experimental fires, even with utmost care and planning, involves some risk; because trust needs to be developed among and resources committed by different agencies involved in crown fire experiments, it took Stocks and colleagues almost eight years to plan and organize the International Crown Fire Modelling Experiment.

A video taped within a fire during the International Crown Fire Modelling Experiment demonstrates how quickly a high-intensity fire can sweep through a forest stand: (A) 14 seconds after the first spot fires arrive, tree trunks start steaming ahead of the flame front; (B) forest floor and tree trunks ignite eight seconds later; (C) continuous flame front follows four seconds later; (D) the flame front passes, leaving residual flaming on forest floor, downed woody debris and tree trunks, 2 minutes, 31 seconds after the first spot fires ignite.

understanding extreme fires in northern forests

But, as he says, if you light a fire, people come. "Word got out through the fire-research community that we were planning this experiment, and they wanted to participate—they brought in studies we had never thought about."

In the end, more than 100 scientists representing 30 organizations in 14 countries took part. Researchers tested the model and examined other aspects and implications of crown fires, including how intense fires affect fire shelters and forest regeneration, the effectiveness of fuel management treatments and the impact of crown fire on built structures such as houses—subjects becoming more and more important in Canada as more and more people build homes in or near forested environments.

Canadian Wildland Fire Strategy

In October 2005, the federal, provincial and territorial ministers responsible for forests in Canada signed the Canadian Wildland Fire Strategy Declaration. The strategy, developed through intergovernmental cooperation and the joint leadership of the Canadian Forest Service and British Columbia government, commits jurisdictions across the country to work together to enhance forest fire management by expanding hazard mitigation, preparedness, and recovery activities while maintaining an efficient fire suppression program.

"The strategy calls for innovative approaches to fire management that will increase public safety, maintain healthy and productive forests, and foster implementation of new business practices," says Research Manager Kelvin Hirsch, of the Canadian Forest Service's Northern Forestry Centre. "Research, such as that conducted in Fort Providence, provides key insights necessary for the development of new policies and practices." Challenges facing Canadian fire management agencies include increasing numbers of people living in or near forests, more frequent and more severe fires resulting from major insect infestations and changes in climate, aging fire-fighting equipment and retiring personnel, and increasing costs.

Canada is a world leader in forest fire suppression. Ninety-seven percent of forest fires in Canada are extinguished before they consume 200 hectares.

"We're not going to improve much beyond that, no matter how many resources we put into it," says Taylor. "However, the three percent that get away are the ones that cause the most damage and threaten communities." Some escaped fires burn more than 90 percent of total area burned—usually in remote unpopulated regions where fires often are allowed to burn without interference. Some, however, endanger communities and areas with high recreation or industrial values—as the 2003 Okanagan Mountain Park fire did Kelowna, British Columbia. These high-risk blazes can consume more than three-quarters of the nearly $1 billion spent annually on firefighting in Canada.

These fires are usually crown fires.

"Information on crown fire behaviour and their ability to ignite structures will help fire managers make informed decisions about how to reduce risk to life and property through proactive hazard mitigation," says Hirsch.

Modelling crown fires

Understanding the physical processes that cause fires to crown and spread is critical to being able to predict high-risk fires—and preventing them. Canadian forest fire researchers, with decades of field data, are working with scientists from the U.S. and Europe to develop reliable, physics-based crown fire models.

"Current fire behaviour models were developed to answer fire suppression-related questions—such as will a particular fire transition from a surface to a crown fire? how fast will it spread? how quickly will it grow?" says Taylor. "These help fire managers plan control strategies and keep crews safe. New questions—can we mitigate fire behavior potential and damage by manipulating fuels? or by allowing fires to burn in areas where they don't threaten communities, timber resources or other values?—require more sophisticated understanding of extreme fires." A model that allows fire managers to forecast fire behaviour in all states, based on physical processes and characteristics of the forest fuel complex and atmospheric weather conditions is, he says, "the holy grail in fire research."

And like a holy grail, the goal remains elusive. The model that the International Crown Fire Modelling Experiment tested showed gaps in scientists' understanding of crown fire physical processes. Citing how it took U.S. fire scientists 25 years to develop a physical model for creeping surface fires, Stocks says developing a similar model for crown fires requires long-term commitment.

"We've brought together some of the brightest people on the planet to look at the problem. Because the science is so complex, it's going to take time before we get something that works."

Infestation models project beetle spread and impact a

Needles of beetle-attacked lodgepole pine trees turn red during the year after being infested. To date, more than eight million hectares of British Columbia's forests include green, red or grey attack pine.

"Alberta is in a similar position today as British Columbia was 10 years ago in regards to mountain pine beetle," says Director of Natural Resources Canada's Mountain Pine Beetle Initiative Bill Wilson (**bwilson@pfc.cfs.nrcan.gc.ca**). "It has large tracts of mature lodgepole pine forests, difficult forest access and moderating winter temperatures—prime conditions for endemic populations of the beetle to break out into an epidemic."

Adding pressure to the local beetle populations is an epidemic of beetles infesting 8.7 million hectares of British Columbia forests on the other side of the Rocky Mountains and upwind of the provincial border. In recent years, increased incidence of beetle 'hotspots' have emerged in timber stands along Alberta's pine-rich eastern slopes.

To better understand the threat facing Alberta's forests, Canadian Forest Service researchers and other scientists collaborating under Natural Resources Canada's Mountain Pine Beetle Initiative are developing a suite of interdependent models that look at different spatial events within a strategic framework of information, research and policy regarding the beetle epidemic. When completed, models within the suite will fall into one of two main categories: they will project how beetle epidemics develop—how infestations kill trees and kill stands, or; they will project how beetle epidemics spread—across stands, across landscapes, and across regions and from province to province.

"With this suite of science-based models," says Mountain Pine Beetle Initiative Chief Implementation Officer Dave Harrison (**daharris@pfc.cfs.nrcan.gc.ca**), "we will be able to predict how mountain pine beetle might spread across Canada."

That threat, according to Wilson, is a major concern among Canadian forest managers, researchers and provincial and federal policy makers. "With the beetle's range expanding as winters moderate, there is risk that the beetle will infest the lodgepole pine–jack pine hybrid zone in Alberta, make the jump to jack pine as a host, which is a major component of Canada's boreal forest, and then spread through the boreal forest pine and across the country."

In response to requests by officials from Alberta Sustainable Resource Development for information on what lessons learned from the beetle epidemic in British Columbia could be applied to Alberta's situation, Natural Resources Canada and the University of Alberta hosted a June forum in Edmonton where model-building researchers presented recommendations and preliminary findings to government and industry representatives.

Currently, the beetle's natural range in Canada is limited by winter temperatures to British Columbia and western Alberta, and its preferred host is lodgepole pine. However, mountain pine beetle attacks other pine species, including ponderosa and white pine, and studies indicate it would find jack pine suitable as a host. Work by the Canadian Forest Service—still in the preliminary stage—indicates the bluestain fungi that colonize and help kill beetle-attacked trees is "at least as virulent in jack pine as it is in lodgepole pine… if not more so," says Wilson. "If the beetle reaches and gets established in jack pine and winters continue to moderate, eastern and northern expansions of the beetle range are expected."

Some beetle models were developed years ago, but Natural Resources Canada is funding researchers from the Canadian Forest Service and a network of universities across Canada to develop models to fill gaps among existing decision-support systems to complete the suite, as part of the Mountain Pine Beetle Initiative's Value-Added and Risk-Reduction Research and Development Program.

Taken on its own, each model is designed to provide answers for specific kinds of questions that forest managers are asking about the infestation. "Which model you should use depends on what your questions are," says Forest Entomology Research Scientist Terry Shore (**tshore@pfc.cfs.nrcan.gc.ca**), who was and continues to be involved in developing some of the models. "It depends on what your problems are, how much data you have available, how much money you have for beetle management … that sort of thing."

One model, for instance, measures a forest stand's susceptibility to beetle attack, a rating of how attractive a beetle would find the species, age and density of trees within a stand; building on that is a model by University of Calgary researchers that pinpoints exactly what features a beetle keys into when dispersing during summer beetle flight. Another model determines likelihood of attack within a stand, based on present or nearby beetle populations; other models track the biology and population dynamics of mountain pine beetle, how it kills individual trees, and how beetle infestations proceed through stands, leaving some trees untouched for several years. These models provide information that can be used to plan and prioritize stand-susceptibility reduction and direct control activities.

Larger-scale, spatially explicit models are being built for key regions, including the Peace Forest District, Jasper National Park, and the Willmore Wilderness Area regions flanking the British Columbia–Alberta border. They integrate

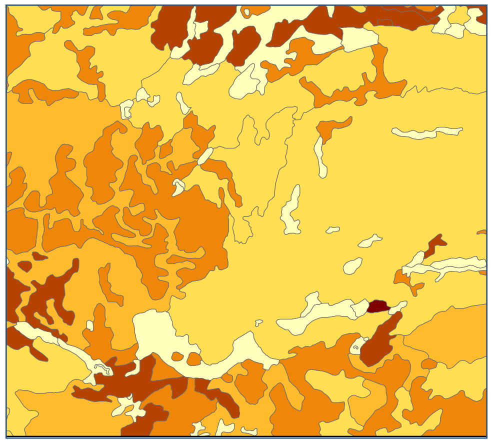
across Alberta, and evaluate management strategies

topographical and climate data, forest inventories and timber supply models specific to a region, as well as interface with other beetle models, and can be used to project how, for example, different beetle-control measures may influence infestation development, as well as how an infestation might spread within the region. Each of these models is specific to a region but researchers at the University of Alberta are working on Mountain Pine Beetle Initiative projects to convert these complex models into an off-the-shelf version of reduced complexity that forest managers could use elsewhere.

Other pieces of the modeling framework being developed under the Mountain Pine Beetle Initiative include contributions by researchers from the University of Northern British Columbia, the University of Victoria, Wilfred Laurier University and the University of British Columbia.

The integrated suite of models will provide a better understanding of what to expect from the current epidemic and decision-support systems to improve the effective control of the beetle.

For more information on modeling research being funded by the Mountain Pine Beetle Initiative and to download research publications issued by the Initiative, including The Mountain Pine Beetle: *A Synthesis of Biology, Management, and Impacts on Lodgepole Pine*, visit **mpb.cfs.nrcan.gc.ca/research/index_e.html**



One of the models used under the Mountain Pine Beetle Initiative's modelling framework generates maps of forest stand susceptibility—rating stands according to characteristics that would attract beetles.

At the University of British Columbia, researchers have developed new computing techniques that convert statistical data into images of landscape management alternatives.

Agreement ensures opportunities for First Nation members

A recent agreement between Natural Resources Canada, the province of British Columbia and a First Nations organization paves the way for jobs and increased economic opportunities for First Nation members, and it ensures sustainable management of forests on two federally owned British Columbia properties.

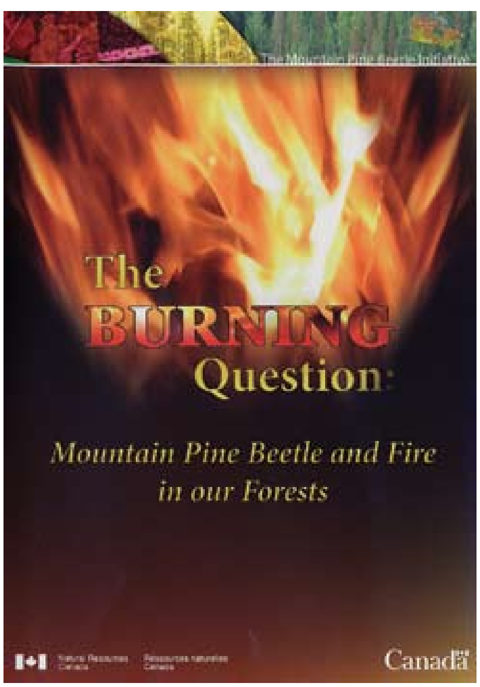
The agreement sets out arrangements for a cooperative, multi-party model for management of forestlands on the Dominion Coal Blocks, two properties totalling about 20,000 hectares, located near Fernie, British Columbia.

"This memorandum of understanding is the result of many years of discussions and negotiations," says Canadian Forest Service Collaborative Forestry Program Manager Nello Cataldo, "and formalizes the three-way relationship between Natural Resources Canada, the British Columbia Ministry of Forests and Range and the Ktunaxa Nation with regards to forest management on Dominion Coal Block Lands."

The Ktunaxa Nation comprises four southeastern British Columbia First Nations bands and approximately 950 members. Under the Dominion Coal Blocks Forest Management Program, the Ktunaxa Kinbasket Development Corporation, owned by the bands of the Nation, prepares annual business and forest management plans for the properties, as well as carries out day-to-day operations. The Canadian Forest Service and the British Columbia Ministry of Forests and Range provide scientific and technical advice and support, and identify activities to enhance opportunities for the Ktunaxa Nation.

According to Ktunaxa Forest Tenures Coordinator Norm Fraser, the Ktunaxa Kinbasket Development Corporation's immediate focus is on timber harvesting and dealing with rampant mountain pine beetle infestations on the lands. However, he says, "we're also hoping to develop commercial tourism, and are planning inventories of non-timber forest products to see how viable developing those resources would be." Sustainable management of the properties' timber and non-timber forest resources, wildlife and ecosystems, integration of traditional ecological and scientific knowledge, and increasing capacity among the Ktunaxa Nation to manage forest resources are key to the Dominion Coal Blocks agreement. "We hope it provides greater understanding of forest resource management within the Ktunaxa community. Of course, employment is its biggest benefit to the community," says Fraser. In addition to the use of Ktunaxa harvesting contractors, the corporation employs four Nation members who are involved in the planning and implementation of forestry operations on the Dominion Coal Blocks.

Under the jurisdiction and authority of Natural Resources Canada, the Dominion Coal Blocks are reserved primarily for their coal resources, but since 1983 the British Columbia Ministry of Forests has had an agreement with the federal department to manage the properties' forest resources; as part of an economic measures agreement with the Ktunaxa Nation, the provincial government awarded the Nation a Community Forest Pilot Agreement License tenure covering the Dominion Coal Blocks in 2003. Under that agreement, the Ktunaxa Nation has begun managing the forest, conducting mountain pine beetle infestation control, and is collaborating with Tembec Inc., the forest company that owns surrounding lands, to harvest and process beetle-infested trees.



The Burning Question: Mountain Pine Beetle and Fire in Our Forests

A mini-documentary exploring how humans have contributed to unhealthy forests, including the recent mountain pine beetle population explosion in British Columbia, has been developed by Natural Resources Canada. *The Burning Question: Mountain Pine Beetle and Fire in our Forests* discusses the important role fire plays in the forest and how fire suppression and climate change have led to North America's largest recorded insect infestation. The production looks at the ecology of the mountain pine beetle and explores how humans can successfully protect people and wildlife living in forests by actually using fire—by setting controlled fires in forests to ensure forest health and long-term sustainability.

The Burning Question: Mountain Pine Beetle and Fire in our Forests premiered on Canadian Learning Television across Canada and on the Knowledge Network in British Columbia in early May. The program has also been distributed to public libraries in British Columbia and Alberta.

A five-minute "sneak peek" is available on the web at mpb.cfs.nrcan.gc.ca/publications/fire-video_e.html.

Learn more about Canada's Mountain Pine Beetle Initiative at mpb.cfs.nrcan.gc.ca/index_e.html.

Events

National Forest Week
Canada's Forests: From Sea to Sea
September 24–30
For details, see www.nrcan-rncan.gc.ca/cfs-scf/NFW/index_e.html

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

Dynamic Forests; Dynamic Thinking
Boreal Conference 2006
October 2–5
Cochrane, Ontario
hosted by the Lake Abitibi Model Forest and the Canadian Institute of Forestry
for information contact :
P. K. (Wally) Bidwell, wally@lamf.net
www.borealconference2006.ca

The Tree at the Centre of Urban Development
Seventh Canadian Urban Forestry Conference
October 11–13
Quebec City
Contact: Michael Rosen at mrosen@treecanada.ca

Diversity
Joint meeting of the Entomological Society of Canada and the Société d'entomologie du Québec
November 18–22
Montreal
Information:
www.seq.qc.ca/accueil_fr.htm

Next Issue

Fungal diversity in variable retention stands

and

Non-timber forest products and communities

Sources

For more information on research featured in this issue, search the Canadian Forest Service Online Bookstore, bookstore.cfs.nrcan.gc.ca, for these and other journal articles:

Seasonal changes in foliar terpenes indicate suitability of Douglas-fir buds for western spruce budworm. 2005.

Site temperatures influence seasonal changes in terpene composition in Douglas-fir vegetative buds and current-year foliage. 2003.

Survival of the Douglas-Fir Beetle in Peeled and UnPeeled Logs and in Stumps. 2005.

Weevil resistance of progeny derived from putatively resistant and susceptible interior spruce parents. 2004.

The International Crown Fire Modelling Experiment

Variation in wind and crown fire behaviour in a northern jack pine–black spruce forest. 2004.

Characterizing the jack pine-black spruce fuel complex of the International Crown Fire Modelling Experiment (ICFME) 2004.

Jack pine regeneration and crown fires. 2004.

Crown fire behaviour in a northern jack pine–black spruce forest. 2004.

Overview of the International Crown Fire Modelling Experiment (ICFME).

Combustion aerosol from experimental crown fires in a boreal forest jack pine stand. 2004.

Predicting the ignition of crown fuels above a spreading surface fire. Part I: model idealization, and Part II: model evaluation. 2006.

Development and testing of models for predicting crown fire rate of spread in conifer forest stands. 2005.

Mountain pine beetle models

The mountain pine beetle: a synthesis of biology, management, and impacts on lodgepole pine. 2006.

Mountain Pine Beetle Symposium: Challenges and Solutions. 2004.

The balance of complexity in mechanistic modeling: Risk analysis in the mountain pine beetle. 2006.

New from the bookstore

The mountain pine beetle: a synthesis of biology, management, and impacts on lodgepole pine 2006. Safranyik, L.; Wilson, W.R.

Publications Digest. (L'Abrégé des publications). 2006. Vol. 15, 2005.

A Procedure for Mapping and Monitoring Mountain Pine Beetle Red Attack Forest Damage using Landsat Imagery. 2006. Wulder, M.A.; White, J.C.; Coops, N.C.; Han, T.; Alvarez, M.F.; Butson, C.; Yuan, X. Information Report BC-X 404.

Prescribed burning impacts on some coastal British Columbia ecosystems. 2006. Beese, W.J.; Blackwell, B.A.; Green, R.N.; Hawkes, B.C. Information Report BC-X-403.

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Assessment of Quickbird high spatial resolution imagery to detect red attack damage due to mountain pine beetle infestation. 2006. Coops, N.C.; Johnson, M.; Wulder, M.A.; White, J.C. Mountain Pine Beetle Initiative Working Paper 2005-19.

Effects of fire return rates on traversability of lodgepole pine forests for mountain pine beetle and the use of patch metrics to estimate traversability. 2006. Barclay, H.J.; Li, C.; Benson, L.; Taylor, S.W.; Shore, T.L. Mountain Pine Beetle Initiative Working Paper 2006-01.

Large-area mountain pine beetle infestations: spatial data representation and accuracy. 2006. Nelson, T.; Boots, B.; Wulder, M. Mountain Pine Beetle Initiative Working Paper 2006–02.

The balance of complexity in mechanistic modeling: Risk analysis in the mountain pine beetle. 2006. Nelson, W.A.; Potapov, A.; Lewis, M.A.; Hundsdörfer, A.E.; He, F. Mountain Pine Beetle Initiative Working Paper 2006-03.

Determining fungal diversity on Dendroctonus ponderosae and Ips pini affecting lodgepole pine using cultural and molecular methods. 2006. Lim, Y.W.; Kim, J-J; Lu, M.; Breuil, C. Mountain Pine Beetle Initiative Working Paper 2006–04.

Augmenting the existing survey hierarchy for mountain pine beetle red-attack damage with satellite remotely sensed data. 2006. Wulder, M.A.; White, J.C., Bentz, B.J.; Ebata, T. Mountain Pine Beetle Initiative Working Paper 2006–05.

Diversity of fungi associated with mountain pine beetle, Dendroctonus ponderosae, and infested lodgepole pines in British Columbia. 2006. Lee, S.; Kim, J-J; Breuil, C. Mountain Pine Beetle Initiative Working Paper 2006–06.

Integrating remotely sensed and ancillary data sources to characterize a mountain pine beetle infestation. 2006. Coops, N.C.; Wulder, M.A.; White, J.C. Mountain Pine Beetle Initiative Working Paper 2006–07.

Stream temperature responses to clearcut logging in the central interior of British Columbia: test of the predictive model developed by Mellina et al. (2002). 2006. Mellina, E. Mountain Pine Beetle Initiative Working Paper 2006–08.

Quantifying Lumber Value Recovery from Beetle-killed Trees. 2006. Orbay, L.; Goudie, D. Mountain Pine Beetle Initiative Working Paper 2006–09.

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