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Forest Health & Biodiversity News

Canadian Forest Service

Ice Storm 1998 Forest Research Conference

Ice storms are common events in the forests of eastern North America. Ice storms develop when a warm front occurs during the winter and releases rain. This precipitation fails to be cooled sufficiently to fall in a solid state as it travels earthward. If ground level conditions are below freezing, then ice will form upon impact. If sufficient ice forms on tree canopies, their weight can be increased up to 100 times, resulting in bending of stems, breakage of branches, and sometimes mortality due to excessive branch loss or stem breakage.

In January of 1998, a major ice storm affected northeastern North America. Ice accumulation of up to 80 mm was reported and accumulations of 30-60 mm were common across eastern Ontario, Quebec, New York, and the New England states. In Canada, damage to forests occurred from eastern Ontario through to western New Brunswick. The most significant forest damage was reported in western Quebec and eastern Ontario, where approximately 2 400 000 ha of damaged forest was mapped. This storm resulted in a state of emergency: thousands of people were left without electricity for days to weeks, power and transmission lines were downed, and extensive damage was caused to forests in the region. Following the storm, many questions arose about the state of these forests, and the long-term impact to forest health.

Ice storm damage.

A conference was held in Ottawa in October 2000 to bring together researchers who had been working on assessing how the ice storm impacted forest ecosystems. The three-day conference was co-hosted by the Canadian Forest Service (CFS) and the Ontario Ministry of Natural Resources (OMNR), and attracted over 100 researchers from Ontario, Quebec, and northeastern United States. The forty-six presentations covered a range of topics, beginning with a history of ice storm damage in North America, and the potential for increased frequency in a changing climate. Other presentations included: the results of ice damage surveys; the response of forest vegetation; the effects of ice damage on insect and bird populations; monitoring techniques for assessing damage; the impact on sap production; economic modeling of ice storm damage in Ontario; and, the results of experiments to accelerate recovery. Some of the

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Exotic species risk modelling at the Great Lakes Forestry Centre

Most people probably do not realize that many economically damaging insects and diseases are not native. These species have become a fact of life. It has been suggested that the spread of exotics is the single greatest threat to biodiversity after habitat loss. The presence of the Asian and brown spruce long-horned beetles (*Anoplophora glabripennis* and *Tetropium fuscum*) in North America has rekindled interest in the problem of exotic species in Canadian forests. Introduced insects and diseases have, in fact, been a scourge of Canadian forests for a long time. Some non-native species have caused tremendous economic damage (e.g. chestnut blight, white pine blister rust, Dutch elm disease, zebra mussels, sea lampreys, purple loosestrife).

As we enter the 21st century, global trade and the prospects of rapid climate change mean the planet is developing new patterns of plant and animal distribution. The redistribution of the earth's biota is a very complicated issue, not only because of the ecological implications but also because of the potential for countries to impose trade restrictions over concerns about non-native species. This may have important economic impacts. Countries that undertake trade-related measures for sanitary or phytosanitary reasons must base them on scientific principles and risk assessments. For certain exotic species, there is unfortunately uncertainty and a lack of quantitative data on their distribution and impact in their new, non-indigenous environment.

The Canadian Forest Service at the Great Lakes Forestry Centre in Sault Ste. Marie has been building a spatial modelling capacity for improved exotic species' risk assessments. The framework makes use of geographic information system technology, new continental climate models, bioclimatic analysis of the likely distributions of species, forecasts of future climates and integration with the National Forest Inventory to help broadly assess economic and ecological risks. The development of such predictions based on sound science is a key component when formulating policy.

Asian long-horned beetle; Scleroderris, European race, on red pine; European larch canker

On a broad scale, climate is an important driver of the distribution of many plants and animals. Thus, so-called "bioclimatic" analysis can help provide spatial assessments of possible distributions and impacts now and under a changing climate. In these examples, observations of the species are entered into a computer program that generates a climatic profile. The profile is then mapped, providing a so-called "climatic domain" for the species. The map provides an indication of areas that are climatically suitable for the species even though it may not be present currently. The maps can be quickly updated as new data become available. It is possible to define "core" and "peripheral" ranges. Core ranges identify the areas where the climate matches, say, 80% of the observations. The remaining 20% may be considered as outliers. Such issues need to be considered in consultation with experts on the species. The exploratory spatial analysis illustrated here is aimed at synthesizing and visualizing relevant data and thus supporting rational debate on possible impacts and monitoring strategies.

Examples studied include beech bark disease, European larch canker, scleroderris and Asian long-horned beetle. For more information on this work and to view the maps, visit the Landscape Analysis and Applications Section Web page at http://www.glfc.cfs.nrcan.gc.ca/index-en/research-e/irm-e/landscape_management.html under the Species Modeling section. Our hope is that an improved capacity for spatial risk assessments will help research, mitigation, and monitoring efforts.

For more information, please contact: Dan McKenney (dmckenne@nrcan.gc.ca), Anthony Hopkin (ahopkin@nrcan.gc.ca) or Kathy Campbell (kcampbel@nrcan.gc.ca).

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Management for Acadian mixedwoods in New Brunswick

The Acadian mixedwood forest is gradually disappearing. Many of the stands currently classified as tolerant hardwood pure (THP) in New Brunswick were formerly tolerant mixedwoods (THSW), but more than a century of high-grade logging has decimated the softwood component of these stands. As a result of clearcutting, late-successional species (such as red spruce, white cedar, eastern hemlock, sugar maple and white ash) that require protection to regenerate are being replaced by lower value, short-lived species, such as balsam fir, tamarack, red maple, white birch, and trembling aspen. Valuable white pine and yellow birch also regenerate well after clearcutting, but the high quality veneer logs and saw timber of these species are usually produced in gaps that are a small fraction of the area left open by conventional clearcutting. Moreover, increased harvest frequency means that small-sized softwood seed from conifer remnants in these stands has less access to the raised, rotten-wood nursery microsites which allow them to avoid burial by deciduous leaf litter. Although most of the beech, which thrives in small openings, is destined to be severely cankered by beech bark disease, there are resistant clones that can be encouraged to replace the diseased trees.

Considerable success in restoring 'protection-requiring' species has been achieved by extensive planting in strip-cut corridors, because the air flow from uncut leave strips offers the humid microclimate that is essential for their establishment. Such extensive reintroductions, often at spacings ≥5 m, are intended to produce a future seed rain that will allow these species to reestablish the complex assemblages that existed historically. Containerized seedlings (small-seeded species) or seeds (large-seeded species) are planted from inside the uncut leave strip on one side, across the open clearcut corridor, and into the uncut strip on the other side. This increases the chances of meeting the particular microclimate requirements of the various species. Severe browsing by deer and hare, in the season following strip harvesting, has proved to be a problem. Repellents have not prevented browsing, but planting very small seedlings (short-keep, unfertilized germinants) has helped to alleviate the problem. Planting seedlings or seeds in the second growing season, when candidate microsites among ferns and to the south of large sprouting stumps are more easily identified, also helps to avoid the severe browsing pressure that occurs after strip harvesting. The considerable regrowth on the strips in the second year is not so much of a problem for these shade-tolerant and intermediate species as is the case with boreal pioneer species like jack pine, white spruce, and black spruce, which are commonly planted in large clearcuts.

Although late-successional Acadian species do not establish well when they are exposed to desiccating summer and winter winds in large clearcuts, most of them grow more rapidly when exposed to increasing sunlight in the protected environment of the strip-cut corridors where the humidity of the air drawn from the uncut surroundings depends on the width of the leave strips.

As successful reestablishment methods were being developed, it was clear that the historical attrition pattern was continuing on both Crown and private lands, because the regeneration microclimate requirements of these high-value, long-lived species were not being met. If the Acadian mixedwood forest type is to be retained and restored, easy-to-implement alternatives to clearcutting must be developed for sites that will support them.

Approval for clearcut harvesting in stands with a component of valuable late-successional species is made on the basis of the sawlog potential of the trees occupying the site and the percentage of tolerant hardwoods plus red maple that is present (Province of New Brunswick, " Goals and Objectives for Crown Land Management, March 10, 2000). After repeated episodes of high-grade harvesting, many of the trees in these stands have no sawlog potential because of poor form and harvesting damage. However, the advance regeneration on the forest floor, that results from the seed rain produced by these trees probably retains the genetic characteristics capable of producing high quality veneer and saw timber if appropriate silviculture is employed.

The proportion of intolerant hardwood-softwood (IHSW) community types in New Brunswick increases after human disturbance (*ibid.*). The tolerant softwood and hardwood remnants in these stands indicates the potential to reverse the incremental replacement of valuable Acadian species by intolerant opportunists with appropriate silviculture.

New Brunswick Crown lands policy (*ibid.*) specifies that the equivalent of 12% of each of eight major forest community types must be present on the landscape in the old and/or large stage. An easily organized strip-cutting method has been developed that fosters a more mature forest structure. This harvesting technique approximates the gap replacement disturbance pattern that existed before settlement, and which is necessary

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Biodiversity and Forest Health Connections - On the International Scene

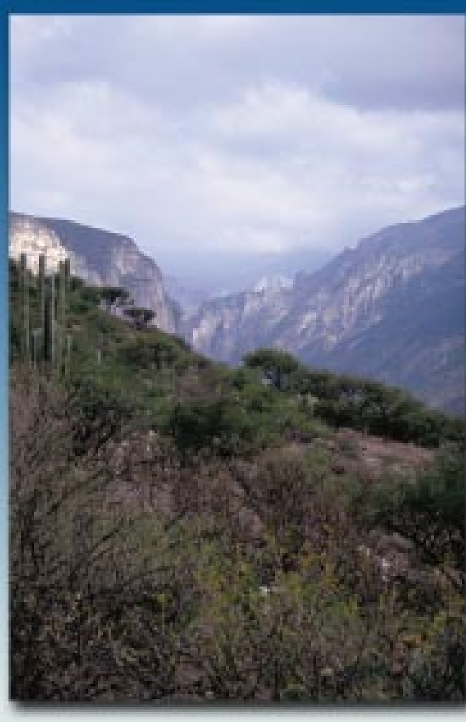
Canadians increasingly understand that we live in one large global ecosystem, where healthy, naturally diverse forests improve the quality of life everywhere. This is exemplified by discussions of global carbon cycles, global climate models and a wide-spread concern for the global rate of deforestation.

Canadians are fortunate to live in a country with abundant forests, where natural ecosystems are relatively healthy compared with many other areas of the world. The Biodiversity Convention, to which Canada is a signatory, defines our responsibility to share our expertise with nations that are less fortunate, where the natural forest is threatened and declining. Canadian scientists' involvement in other areas of the world is much more than simple charity. Ultimately, the well-being of our own ecosystems will depend upon the health of distant ecosystems that influence water, oxygen, and carbon cycles, as well as provide wintering sites for our migratory birds, bats, moths, and insects.

Biodiversity and forest health scientists within the Canadian Forest Service (CFS) are involved in research or technological transfer to other countries: they participate in working groups, deliver short courses, and organize conferences. As well, they collaborate in international research programs. Their involvement has been primarily in Latin America and Asia.

Dr. Tannis Beardmore of the Atlantic Forestry Centre (AFC), in her capacity as co-chair of the International Union of Forest Research Organizations (IUFRO) working group on Tree Seed Technology, Physiology and Tropical Silviculture, recently helped organize a conference in the Philippines. The conference focused on issues related to seed storage, viability, and quality. Development of appropriate seed storage technology is important for conserving tree species at risk both in Canada and elsewhere.

CFS/UNB graduate student Weiming Wang inspecting Canadian seedlings in China with scientists from Jilin and Liaoning Provinces.



A typical pine forest in Mexico.

Several other biodiversity and forest health scientists chair or co-chair IUFRO working groups or task forces, for example the Biodiversity Working Group, and the Forest Genetic Resources Task Force. Dr. Ian Thompson, at Great Lakes Forestry Centre, plays a different role on the international scene as a member of an expert advisory body to the Biodiversity Convention. In addition, a number of scientists are actively involved in working groups of the North American Forestry Commission (NAFC). This group focuses on issues of interest to Canada, Mexico, and the United States, and includes Dr. Eric Allen at Pacific Forestry Centre (PFC) who participates in the NAFC sub-committee on forest insects and diseases, with an emphasis on alien species.

Several researchers have developed connections with scientists in China. Dr. Lee Humble and others at PFC, who recently alerted the CFS community to the dangers of introducing new insects and fungal organisms to Canada's forests, have implemented tests of quarantine detection tools in China. Working with Chinese scientists and a Canadian company, PheroTech, Inc., they are testing systems used to detect insects that could pose a threat to our forest tree species. The technology can also be used by the Chinese to detect and monitor pests of their forest tree species. During the spring and summer of 2001, various lures for the European pine shoot beetle, Tomicus piniperda, a pest recently introduced into North America, and engraver beetles (Ips spp.) were tested in northeastern China. The development of better detection tools will enhance exotic pest detection in Canada and forest pest detection and management in China.

Dr. Yill Sung Park and Bruce Pendrel at AFC are collaborating on quite a different project in China. Chinese researchers have asked for help in reforesting and restoring degraded forest land. The Chinese

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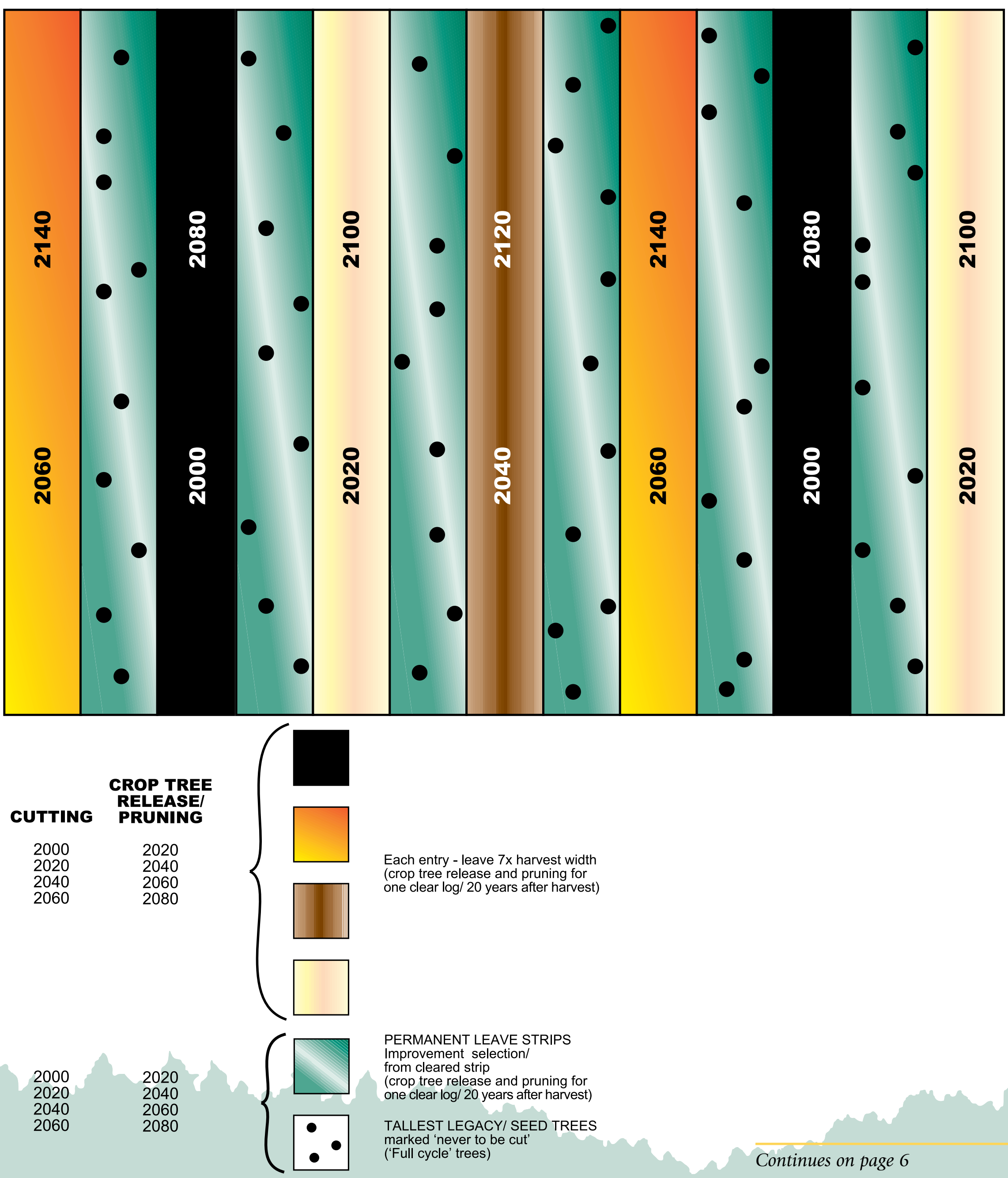
for the regeneration of Acadian late successional mixedwood species. It specifies that future stand composition must include a significant component of large trees that will die in place. Given that harvesting is now largely conducted by machines, these standing dead trees do not pose much of a safety hazard. While mechanical harvester operators consider strip cuts to be long narrow clearcuts, the microclimate in these strips, when oriented to avoid drying winds, favors the regeneration of protection-requiring species because of the humid replacement airflow that is drawn from the adjacent uncut forest.

Using this technique, the first entry clearfells 10- to 25-m strips, separated by wide leave strips. A second entry (10-40 years later) and subsequent, regular entries clearcut intervening strips so as to set up a system of machine-accessible strips that are interspersed with 'permanent leave strips' of equal width. Over time, half the ground surface is available for direct access with machinery, with as little as a tenth of the ground surface undergoing clear cutting at each entry.

The remaining half of the area is given over to 'permanent leave strips' which are not entered by machinery, but do undergo improvement selection harvesting by reaching in from the clearcut operating strips. Within the 'permanent leave strips', the tallest trees (up to 100/ha,

Natural Disturbance Approximation/ Microclimate Maintenance With Strip Cutting



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representing all the species in the stand) are marked never to be cut. These 'life-cycle' trees will produce a constant seed rain while they are alive. As they die, they will function as cavity nesting trees, before falling to the ground to provide the important rotten wood microtopography required for small-seeded species regeneration and habitat for ground-dwelling animals whose importance to forest health and ecosystem integrity is largely unknown. At each harvest entry into specific strips (60 to 100 year return intervals), new 'life-cycle' trees have to be marked in the 'permanent leave strips' to replace those that have died since the last stand entry. When saplings have become well established (5-20 years after harvest), a crown release can be conducted to decrease the competition by neighboring trees on up to 700 candidate quality crop trees per hectare. This is the time for these trees that are being groomed for veneer and sawlog production to receive the first of several stem prunings. The diagram shows a version of the method that clearcuts one eighth of the total stand every 20 years, with an interval of 80 years between harvests on any particular strip and crop tree release and first pruning 20 years after harvest.

The resulting uneven-aged stand is composed of preselected quality stems, a considerable volume of untended general-run fiber, some very-large-dimension timber resulting from a history of improvement selection during former harvests, and a number of very old trees that will never be cut, as well as a component of large, standing dead trees that result from the 'life-cycle' program.

Over time, the quality of the timber from the low-grade selection in the permanent leave strips improves, while the amount of large rotten wood, necessary for the regeneration and survival of small-seeded species, is increased.

There are many possible modifications of this strip-cutting method. Such modifications must not erode the humid microclimate required for natural regeneration, the machine-operational feasibility, the maintenance of old-growth approximating structures or the ability to meet criteria and indicators of sustainability that will ensure certification under any of the current schemes. Its attraction for New Brunswick Crown lands management lies in its ease of implementation, the minimal requirement for tree marking, and the fact that as little as 2% of the entire ground surface is required for permanent access roads.

This methodology could foster the combination of a quality oriented silviculture with an 'ecosystem management credo' that measures success by the value of selected production and what condition the forest is left in as opposed to how much low-grade product can be removed. Its adoption would move management at least one step away from the large canopy opening harvest methods that are now the norm in Acadian mixedwoods on New Brunswick Crown lands.

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presented work will be published in an upcoming issue of the Forestry Chronicle.

Conference results

Results from a joint CFS-OMNR survey showed that conifer tree species were less affected by ice damage than were hardwoods. Those most affected were poplar (*Populus* spp.), white birch (*Betula papyrifera*), and basswood (*Tilia americana*), while sugar maple (*Acer saccharum*) and red oak (*Quercus rubra*) showed moderate levels of damage. Surveys conducted by the Ministère des Ressources naturelles in Quebec showed low levels of mortality in trees with less than 80% crown loss. Similar results were observed in studies from New York. Monitoring of ice-damaged forests has shown that most stands are recovering. Within the United States, New York was the most severely affected state, followed by New Hampshire, Vermont, and Maine.

The ice storm was also reported to affect forest fauna and flora. Work presented by the Canadian Wildlife Service showed songbird abundance was reduced in ice-damaged forests. Studies conducted on wood-boring insects showed no significant increase in populations of these beetles in either hardwood or conifer stands. Other studies noted the beneficial effects of increased woody debris in forests on some insect and salamander populations and the potential for changes in stream environments in the ice-damaged forests. Understorey vegetation changes were also observed. Existing seedlings grew rapidly due to the increased light levels, as did other woody and herbaceous plants that existed prior to the storm. Generally, species richness did not change although the composition of the understorey did change with increasing damage levels.

The complete list of abstracts and titles is available at http://www.glfc.cfs.nrcan.gc.ca/index-en/research-e/forest_health-e/forest_health-e.html

Much of the information presented was of a preliminary nature; however, conference participants benefited from the exchange of information and ideas. A common topic of conversation was the need for collaborative studies and data sharing in order to document the full extent of this natural disturbance. The knowledge gained from this conference will benefit the forest science community and assist forest managers in dealing with similar events in the future.

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researchers are very interested in using Canadian tree species in their restoration efforts. The Canadian scientists are encouraging them to place equal emphasis on tree species native to China in their species tests. The hope is that after reclaiming the seriously degraded land using whatever tree species have sufficient tolerance for the arid and saline soil conditions, native species may be reintroduced.

Mexico and Central America are the sites of a variety of collaborative efforts. For example, both Dr. Roger Cox and Dr. Judy Loo from AFC have spent time at a graduate school near Mexico City teaching and advising students on ozone monitoring and conservation genetics. Dr. Cox has a collaborative research project underway to monitor air quality in relation to forest health near Mexico City. Dr. Loo is participating in a test of Criteria and Indicators of Sustainable Forest Management in Mexico. This test aims to determine whether a particular forestry operation in a Mexican temperate forest region is ecologically and economically sustainable. Dr. Loo is also mentoring interns who are working on forest conservation issues with two Guatemalan organizations.

The primary focus of the CFS will always be on Canada's forests but, by fostering relations with other countries, we meet commitments made in international agreements such as the Biodiversity Convention, and learn new ways to approach problems. Perhaps most significantly, we contribute to the long-term ecological sustainability of the global ecosystem.

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Correction

In our last issue, Vol. 5, No.1 Winter 2001, page 6, the correct references at the end of the article "Climate and pest interactions" are Dr. Ted Hogg, Research Scientist at thogg@nrcan.gc.ca or Mr. James Brandt, Forest Health Unit Leader at jbrandt@nrcan.gc.ca.

FYI

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