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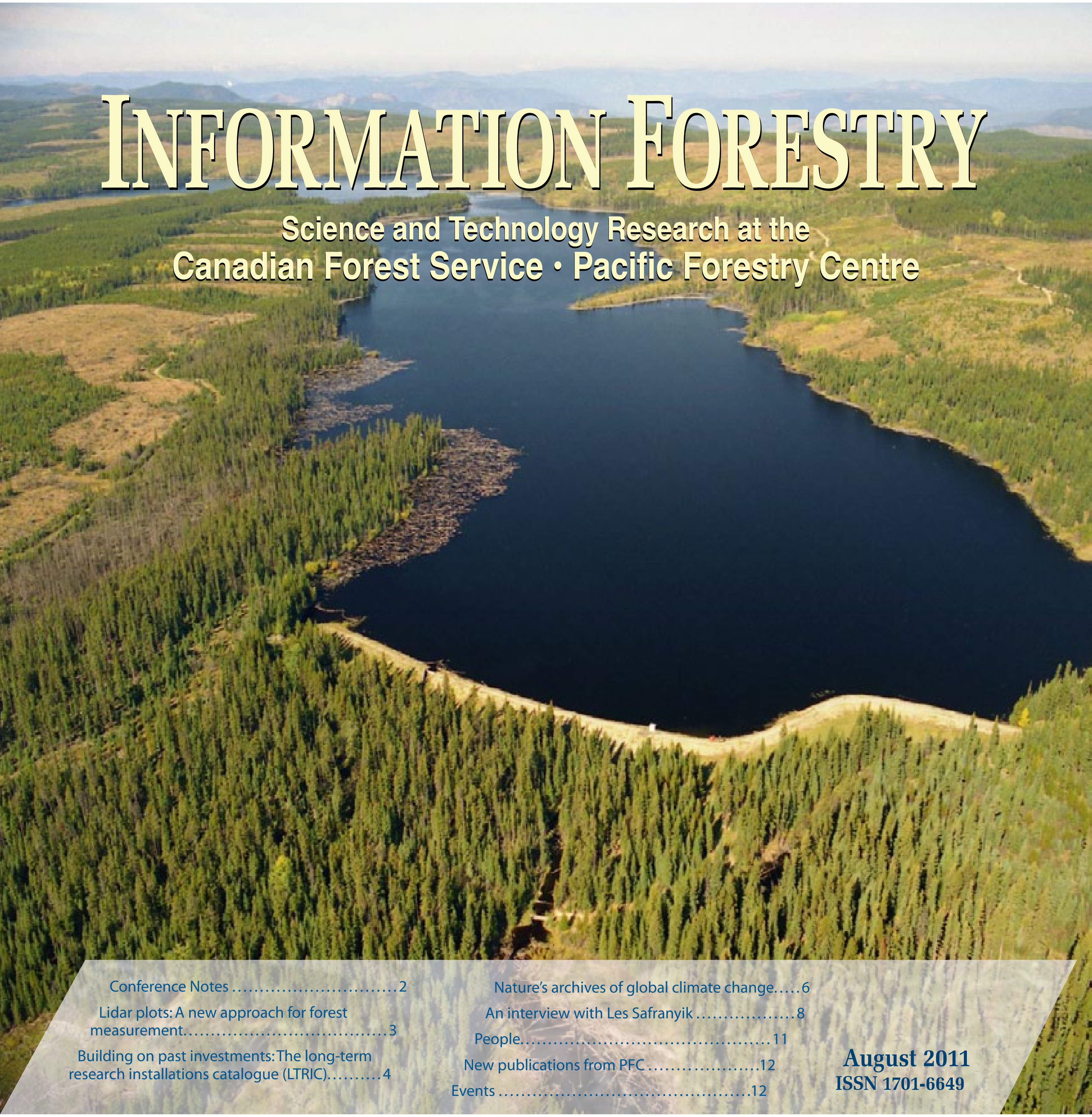
INFORMATION FORESTRY

Science and Technology Research at the Canadian Forest Service • Pacific Forestry Centre



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Canada

Conference Notes

Wildland fire management: Co-operation begins with relationships

Steve Taylor, CFS

Graduation ceremony for Working on Fire firefighters; 35% of WOF firefighters are female.

Canada has built a strong international presence in wildland fire management over the past several decades. Canada transfers fire science (such as the Canadian Forest Fire Danger Rating System) to other countries, exchanges fire management resources in crisis situations, and exports fire management equipment, material, and services. All of these roles, whether in science, fire management, or business, begin with relationships.

Since 1989, four international wildfire conferences held in Boston, Vancouver, Sydney, and Seville have helped further these relationships. They have resulted in a number of international agreements, such as adoption of the Incident Command System (a standardized organizational system for the command, control, and co-ordination of emergency response) in most countries.

During the week of May 9–13, 2011, **Steve Taylor** (steve.taylor@nrcan.gc.ca), a fire scientist with Pacific Forestry Centre, and about 20 other Canadians travelled to South Africa to participate in the 5th International Wildfire Conference, held under the auspices of the United Nations' International Strategy for Disaster Reduction, and sponsored in part by the Canadian Interagency Forest Fire Centre (CIFFC) and the Canadian company Wildfire.

Canadian delegates and exhibitors, including staff from CIFFC, the Canadian Forest Service, Parks Canada, provincial and municipal governments, FPInnovations, and equipment suppliers, presented seven plenary and session papers to the 700 delegates, and hosted a number of exhibits. Topics included a global fire early warning system, climate change and fire, a national resource sharing system to fuels management, and FireSmart community programs.

Taylor also participated in a study tour for members of the North American Forestry Commission Fire Management Study Group and the Australasian Fire Management Group hosted by Working on Fire South Africa. Within the Working on Fire initiative, South Africa is training wildland fire fighters to a very high standard as part of a poverty relief program, Africanizing the US FireWise program (similar to the Canadian FireSmart program), and developing infrastructure for fire detection with video cameras. They are also acquiring and distributing hotspots from MODIS and the European geostationary Meteosat for southern Africa (which can detect fires at about 2 ha with a 15-minute refresh rate). Another initiative is helping to develop fire management in other countries in sub-Saharan Africa.

"The information exchanged, experiences gained, and relationships developed in South Africa will help to further Canada's position in global wildland fire management," said Taylor. *–S.T.*

Steve Taylor, CFS

Working on Fire helicopters bucketing water in the Pilanesberg Game Reserve with bambi buckets manufactured by SEI Industries, Richmond, BC.

Resources

Conference photos, recommendations, and papers available online at:

http://www.wildfire2011.org/gallery.php?lnk=5

http://www.wildfire2011.org/recommendations.php?lnk=5

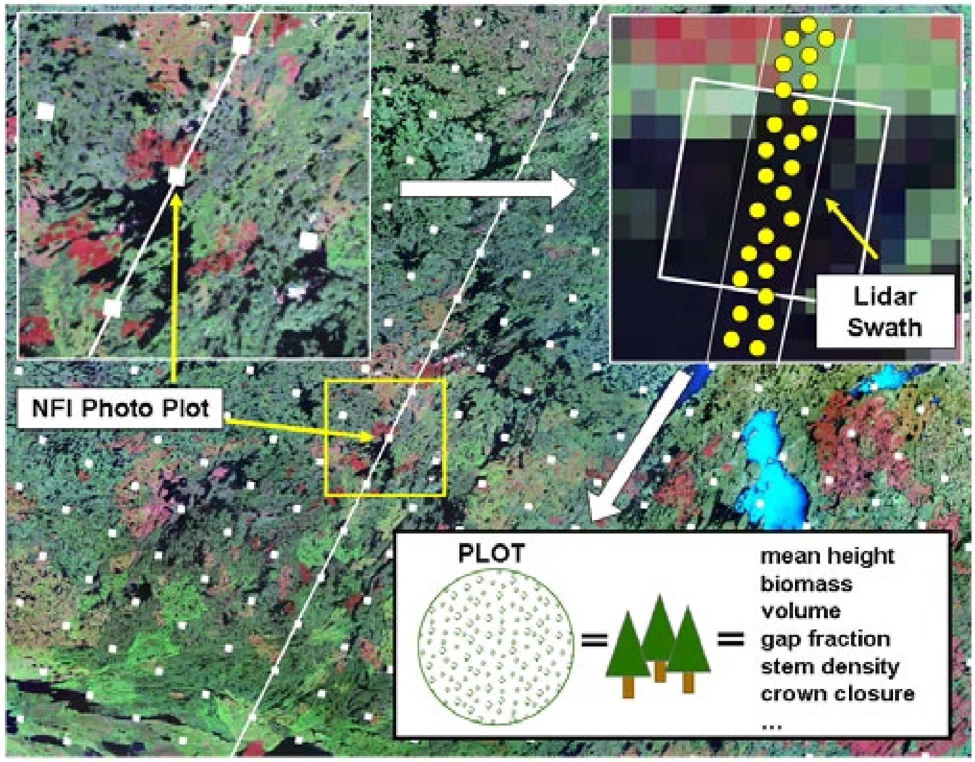
Lidar plots: A new approach for forest measurement

Forests are an important global resource: they play key environmental and economic roles and are managed for a suite of economic, social, and environmental values. Canada, as steward to 10% of the world's forests, is actively involved in developing tools to help manage these forests responsibly. A range of national programs have been developed to assess and monitor forests across Canada, including a National Forest Inventory, satellite-driven land cover and change, and a forest Carbon Accounting Program. Common to these programs is a need for field calibration and validation information. However, much of Canada's forests are remote and lack road access, which limits the ability to collect field data.

Monitoring and reporting programs with sampling based on air photo plots have been developed to mitigate some of the difficulties and limitations of ground plot-based programs. Increasingly, satellite data are being used to produce reliable statistics on forest characteristics and change over large areas. But there's a catch: photo- and satellite-based programs still require ground measurements to calibrate models or assess accuracy of attribution.

To offer a source of detailed data for calibration and validation of large area mapping and monitoring programs, **Mike Wulder** (mike.wulder@nrcan.gc.ca) and his team of researchers at Pacific Forestry Centre proposed the collection and integration of light detection and ranging (lidar)-based plot data. Lidar is a proven data source offering accurate measures of vertical forest structure, canopy height, and biomass. Working with researchers from the University of British Columbia and Nova Scotia Community College, Wulder's team collected lidar data from June to August 2010, over a period of approximately 67 days. The lidar data was acquired using the Optech ALTM 3100 airborne lidar instrument. Following processing of the transects of lidar point data, over 10 million 25 x 25 m grid cells, or "lidar plots," were generated from over 24 000 km of transects flown.

Rather than using lidar to produce a wall-to-wall coverage, Wulder's team suggests placing transects from coast to coast to characterize conditions over large areas (see figure above). "Given an appropriate sampling framework, statistics can be generated from the lidar plots collected over the transects," says Wulder. In other instances, the lidar plots may be treated as ground plots, providing locally relevant information that can be used independently or integrated with other data sources. In many areas, ground plots are in short supply due to cost and access limitations. Lidar plots may mitigate these limitations by producing information to aid and augment monitoring programs and support science activities.



Possible sampling scenario, with a flight line intersecting NFI photo plots and their arrangement along the lidar swath. Combined data from lidar points in each plot generates attributes indicated in lower inset.

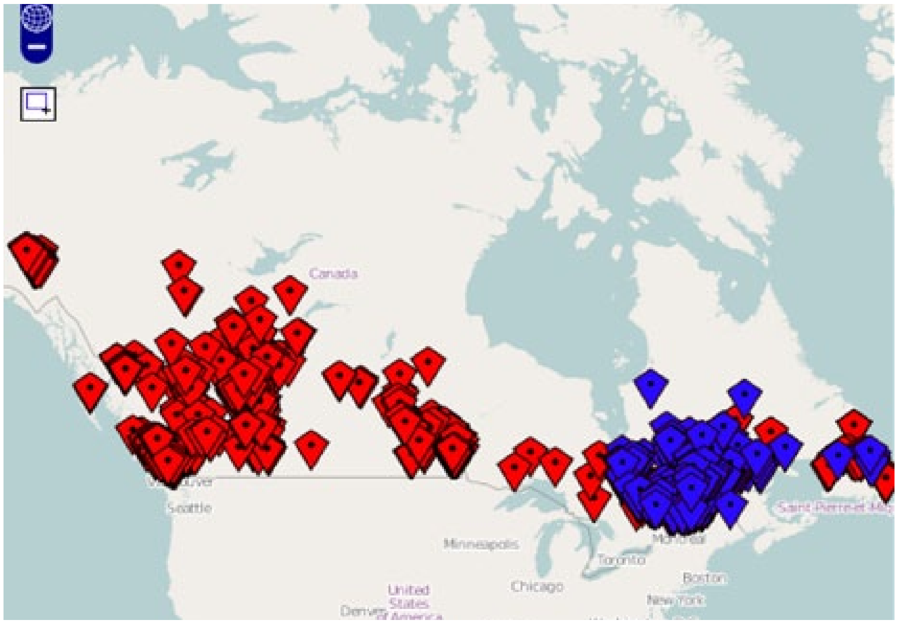
Because of considerations like small populations, slow forest growth rates, and long distances to markets, most northern areas of Canada are not subject to management-driven forest inventories. Some locations, such as British Columbia, are subject to management-level inventories, and were therefore of lesser priority for coverage by lidar transects, as evident in the graphic (next page). A key goal of this research is to inform on the use of new technologies in monitoring Canada's forests and to support scientific investigations.

This project presents a unique opportunity to apply Canadian Forest Service methods and expertise to a comprehensive national data set. In doing so, this application will also enable improved integration with international studies of circumboreal ecosystems. "Thematically, there are many broad application areas that can make use of this information such as climate change, biodiversity, and sustainable forest management," says Wulder.

The lidar plots will provide data that has previously been unavailable, with broad applicability to a multitude of Natural Resources Canada programs. This Canada-wide lidar transect survey has the largest scope undertaken internationally

continued on page 4...

Building on past investments: The long-term research installa



Map showing typical search results. Each icon when clicked will access a record for that LTRI.

Trees grow slowly compared to research careers and annual budgets. This makes it difficult to reconcile traditional research methods with the rapidly evolving demands of the forestry sector. Today, forest researchers need to provide timely solutions for an ever-expanding array of silvicultural, biological, social, climate, and economic questions, yet their subjects take decades or even centuries to mature.

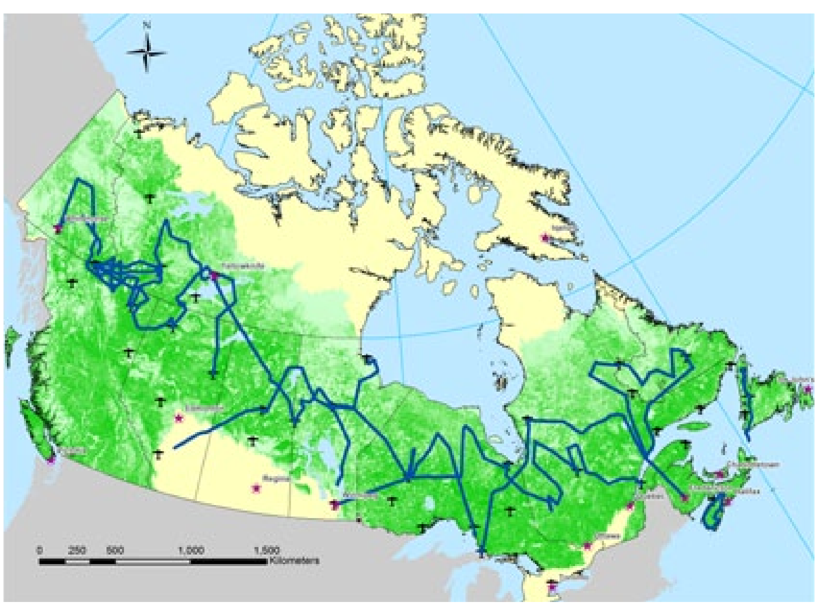
One possible solution is to "buy time" and capitalize on past research investments. Since its inception in 1899, the Canadian Forest Service (CFS) has established thousands of research installations across Canada. Many are well known, maintained, and monitored as long-term research installations, but some are known only to the original researchers. Every CFS facility has files filled with unpublished data, establishment and progress reports, field notes, and "gray literature" on past research sites. People with knowledge of these sites are also retiring at an increasing rate.

Art Robinson and **Linda Bown,** archivists at Pacific Forestry Centre (PFC), view this information much like an iceberg, and have coined this challenge "the infoberg." Most of an iceberg's mass is unseen below the ocean's surface. This provides a convenient analogy to the information held at many research facilities: the tip of the "infoberg" that you see is the published literature and information, but the data that remains unseen represents a tremendous volume of research and investment that, when discovered and organized, becomes a very valuable asset in our research toolbox.

The Canadian Wood Fibre Centre (CWFC) was created in 2006, and one of its main goals is to better understand the influences of silviculture and the environment on the fibre quality of Canadian tree species. Almost any past forest research site is a candidate to provide this type of information. After all, nature continues the experiment even if researchers are not watching. Drawing knowledge from long-term observations of the environment is really nothing new, and has formed the basis of the "traditional knowledge" of Indigenous peoples around the world for generations.

Lidar Plots *...continued from page 3*

to date. The collection of data from these lidar-based plots is intended to support the improved monitoring of Canada's forests, contributing to forecasting and managing of ecosystem risks, forest tracking, and climate change. Now, with the processed lidar plots available, research and applications activities are ongoing. *–M.W.*



A national survey of transects for generation of lidar-plots. Transects are denoted in blue, and increasing proportion of forests is denoted in green shading. The ground density of lidar hits was specified to be a minimum of $3/m^2$. For the minimum 500-m swath width of the lidar data, 25 × 25 m cells are created for the generalization of the lidar data to enable the generation of plot-like inventory information. Over 10 million lidar plots have been created.

tions catalogue (LTRIC)

Two CWFC researchers, Dr. Al Mitchell (at PFC until his retirement in 2010) and Richard Krygier at Northern Forestry Centre (NoFC), had a vision to create a database of all long-term research installations (LTRIs) across the country. Programmer Jon Elofson, also from NoFC, accepted the challenge to build a working prototype of the LTRIC program. CWFC managers recognized the value of LTRIs for fibre quality research, and were quick to lend support. Input for the project came from many sectors, including the CFS, FPInnovations, and Natural Resources Canada Libraries. "CWFC staff started populating the database almost immediately, and we quickly learned there were not hundreds but thousands of LTRIs that can be added to the database," said Tom Bown (tbown@nrcan.gc.ca), a CWFC researcher at PFC. "Currently, the database holds about two thousand records."

The CWFC collaborated with **Brian Low** and the National Forest Information System (NFIS)/CFSNet group at PFC, and Joanne Frappier, Director of the Forest Knowledge and Information Management Division of the CFS in Ottawa. What began as a vision has become a major piece in the overall knowledge management strategy of the CFS. As a co-operative venture, with funding from both CFS and CWFC, programmers **Ryan Bluemell** and **Michael Colynuck** at PFC created LTRIC Version 2 from the prototype. Version 2 is compatible with other CFS information management applications and incorporates feedback suggestions based on the first version.

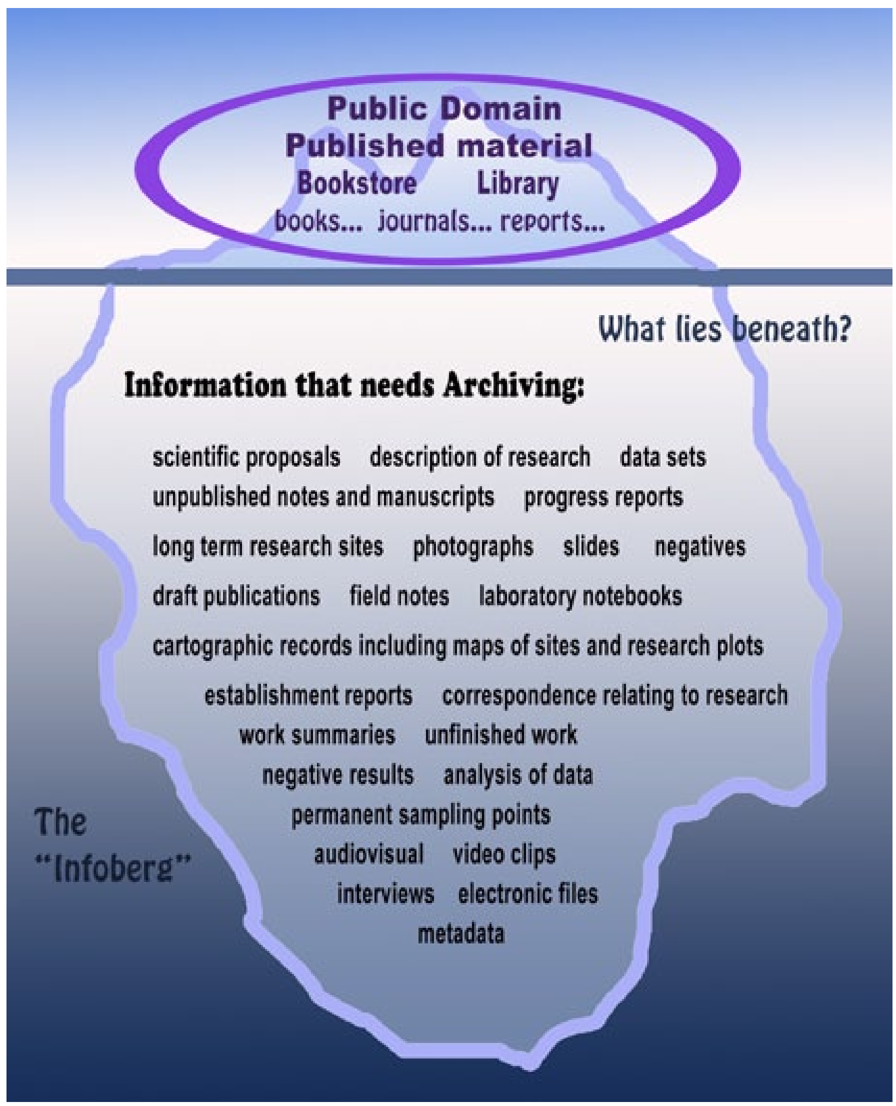
Rather than providing a detailed database, the goal of LTRIC is to provide researchers with just enough information to decide if a particular site would be of value to their research. Researchers can search by a number of different parameters or by map, and the resulting records provide a brief description of the site, links to related studies, and indicate where to find additional information (see figure at right). The LTRIC program also assigns a permanent number to each record that can be used for archiving.

LTRIC Version 2 is a stand-alone product that will be available to CFS researchers as well as to CFS collaborators via a password-protected website. Future goals for LTRIC Version 3 include integration with the CFS "Foogle" project, an all-encompassing CFS information management package (named after the popular Google search engine with a forestry twist), and inclusion of provincial LTRI databases. Some provincial data for Québec is already searchable in LTRIC, and the Ontario Research Sites database is being prepared for inclusion. The Newfoundland provincial government, through collaboration with Bruce Pike of the CFS Corner Brook Research Division, has also made a significant contribution to LTRIC, and LTRIs from this province are currently being added to the database.

"As for the LTRIC in the CFS, the "infoberg" is bigger than we thought, and we have much more work to do to populate and upgrade the database," said Bown. To meet this challenge, today's talent is coming together and working with LTRIC to extend and enlarge the value of our long history of excellence in field-based research. *–T.B.*

Link

CFSNet
https://cfsnet.nfis.org/data/index_e.shtml



Nature's archives of global climate change

BC Ministry of Forests, Lands, and Natural Resource Operations.

Forest fires with smoke plumes, illustrating how charcoal can be transported to lake depositional environments.

Global climate change has the potential to affect plant community dynamics and ecosystem processes worldwide. Changes in climate are now affecting ecosystem configurations in disparate regions around the globe, resulting in new species groupings, canopy structures, and ecosystem functions. Consequently, plant community dynamics, species interactions, and processes are being transformed, including wildfire. Scientists anticipate that vegetation response to climate forcing will alter fire regimes, which describe the pattern of fire frequency, size, intensity, severity, type, and seasonality in an ecosystem. Climate-driven changes to the fire regime will further modulate forest response to climate change, resulting in a potential feedback linking climate, vegetation, and fire. Given that Canada has a vast forest cover of ecologic and economic importance, it is in the public interest to understand the drivers and dynamics of fire disturbance. Such knowledge is especially paramount given the potential consequences of climate change.

Fire is a complex combustion process that rapidly oxidizes fuel, releasing energy in the form of heat as well as greenhouse gases. These gases directly connect fire disturbance to climate. Post-fire dynamics are also important because additional CO_2 is released at a slow rate as dead organic matter decomposes. Carbon dioxide is also sequestered as the site regenerates. Critically, the combustion reaction is rarely complete during a forest fire—incomplete combustion results in the production of a variety of products, including charcoal. Through various transport mechanisms, charcoal fragments enter nearby lake basins where they accumulate. Subsequent fires deliver additional charcoal to the basins over time, forming a long-term record of disturbance history that is preserved in the lake sediment.

In addition to charcoal, pollen grains and plant macrofossils are also well preserved in lake sediment deposits. These records not only document how forest composition and structure change through time, but can also be used to reconstruct climate history. Using these various proxies, it is possible to assess the interaction between climate, fuel, and fire disturbance, providing a long-term perspective that has relevance in both ecological theory and management.

Given that recent land management practices and fire suppression initiatives have dramatically altered the natural fire regime in parts of Canada and in other regions of the world, long-term records help place the modern fire regime in better perspective. Scientists, forest managers, policymakers, and other officials can use these records to establish baseline conditions, generate analogues, assess ecosystem sensitivity and resilience, identify key processes, and examine rates and magnitudes of change. Furthermore, the records can also be used to calibrate and validate models that are being used to generate ecosystem forecasts for a variety of future scenarios.

"Fortunately, we can use a variety of sampling approaches to recover nature's incredible archives, and in so doing, we open a portal into the past with a view towards the future," says **Kendrick Brown** (Kendrick.Brown@nrcan.gc.ca), a research scientist with the Canadian Forest Service.

For example, in a recent collaborative investigation, vegetation and fire disturbance histories were examined for the southern boreal forest of Scandinavia. Lake cores were collected from two sites near the boreal–temperate forest ecotone. During the early Holocene (ca. 10 000–8000 years ago), pine- and birch-dominated forest typified the region, and both sites exhibited comparable patterns of fire disturbance. However, in the warmer-than-present mid-Holocene (ca. 8000–4000 years ago), temperate forest expanded northward, as evidenced by an increase in thermophilous (warmth-requiring) pollen at the more southern site. At the same time as this change in vegetation occurred, there was a decrease in fire disturbance. Given their proximity to each other, the sites would have experienced a comparable change in climate. This suggests that the change in fire disturbance at the southern site was in response to the climate-induced change in vegetation.

It is possible that increased summer leafing shaded the understorey, facilitating a relatively moist microclimate that reduced fire disturbance. Other potential factors that may have contributed to the decline in fire disturbance include changes in the moisture content of the foliage, alteration of the fuel structure, and a reduction in volatiles (pitch, wax, resin) available for combustion. A similar decrease in fire disturbance could recur in the southern boreal zone in the future, as vegetation responds to climate forcing. For example, in Canada, the southern boreal fire regime will change in response to a climate-induced expansion of either eastern temperate forest or western aspen parkland.

During the late-Holocene interval (ca. 4000 years ago to present day) climate has cooled and become wetter, and spruce has expanded regionally in Scandinavia, marking the establishment of the modern boreal forest. Notably, both Scandinavian sites experienced an increase in fire disturbance even though climate was deteriorating; another result that highlights the important role of forest composition in regulating the fire regime.

Several similar projects are currently being initiated at the CFS to investigate the various factors that influence the Canadian fire regime and to examine how the fire regime may change in the future. Records of fire disturbance are being collected from fire-prone regions, particularly in the boreal forest, across both lightning strike and precipitation gradients. In addition, charcoal records from the boreal–prairie ecotone are being analyzed to assess the role of fire disturbance at this dynamic vegetation boundary, particularly during times of climate change. *–K.B.*

Kendrick Brown, CFS

Extracting a core in a fire prone region of central British Columbia (left) yielded a 7-m long sediment core that contained laminated sections (right). The core likely spans several millennia, and will be used to examine the various factors that affect fire disturbance through time, including changes in vegetation and climate.

Knowledge gained through a lifetime of experience: An interview


CFS photo

Barb Crawford: Why don't you start by telling me how long you worked here at PFC?

Les Safranyik: I joined the Department of Forestry in 1964 at the Calgary lab. In 1969 a new federal laboratory was built in Edmonton and I moved there for three years. In 1972, I transferred to Victoria with two other scientists. The idea was to have all the federal scientists in Western Canada who worked on bark beetles and associated problems in the same laboratory. So with the federal government, I worked 37 years, plus 10 years as an emeritus scientist. If we only count my work in Victoria it would be 39 years.

BC: Obviously it's something you really enjoy.

LS: Yes, obviously if one didn't enjoy the work one would not have continued after retirement, at least not for a long time as I have.

BC: Can you give us an overview of how you ended up here and working on bark beetle research?

LS: Yes. I came to Canada in 1957 as a consequence of a failed uprising against communism in Hungary. I started forest engineering at the University of Sopron in early September 1956 and the revolution had started in October. Then about 150 students and teaching staff emigrated to Canada, to UBC, at the invitation of the Canadian government and the president of UBC.

"The most satisfactory solution to a problem comes from a detailed understanding of the biotic and abiotic factors that affect the establishment and abundance of an organism."

We established the Sopron Division of the faculty of forestry at UBC. Our education was conducted by our own professors and mostly in Hungarian, especially in the first two years. We took biological subjects as well as engineering subjects such as road construction, engineering mechanics, and strength of materials. The curriculum in the old country was five years long. When we came to UBC the decision was made to follow the four-year curriculum, so we had extra subjects; our school day was much longer. Anyway we were young and flexible and we survived, and it was actually a great time. I graduated in 1961 with a degree in forest engineering.

It is interesting how fate or random circumstance can change your career. Back in high school, in the old country, I was interested in the natural sciences as well as mathematics, and joined the math club. Each member was assigned a topic to research and present, and my topic was the mathematical description of human population growth.

As an undergraduate I had a very good professor of entomology, and when he started describing the numeric changes that an insect population can go through in a few generations, I realized that probably the same mathematical treatment could apply to insects as for human populations. And that got my interest in pursuing entomology, especially population dynamics.

I was still doing my PhD at UBC when the director of the Calgary laboratory contacted my major professor at UBC to see if there were any candidates interested in pursuing work on bark beetle populations. They interviewed me and I must have impressed them because they hired me. The position that I occupied was vacated by the most famous bark beetle entomologist at the time, Mr. George Hopping. Prior to his retirement, Mr. Hopping was the director of the Calgary laboratory.

BC: I bet those felt like big shoes to fill.

LS: Very much so. I joined a young and dynamic group of scientists in Calgary, which made my work very enjoyable.

BC: Even if the way you fell into entomology was chance, you grew really passionate about it.

LS: Yes.

BC: What is it that has fuelled this passion for so long?

LS: Well, I really tried to look into the fundamental aspects of whatever problem I had to tackle. I found it very stimulating, the process of thinking through the whole problem. Of course it required first being very familiar with the literature. I was very thankful to my predecessors, Dr. Shepherd especially but also Dr. Reid, because when I arrived in Calgary, Dr. Shepherd came into my office with a huge stack of literature on the mountain pine beetle and said, "it would probably be a very good idea if you studied this literature so you have a good background of what has been done." That turned out to be a very wise move.

There are two aspects to being able to work at the level that achieves some significant goals. One is sheer personal ability, and the other is staying power. It's very easy in research to get discouraged. You have to be persistent, confident, and prepared to accept small incremental increases in new information. A lot of it is very hard slogging, and you just keep at it.

BC: So you have to have the inner motivation–

with bark beetle entomologist Les Safranyik

LS: It is the motivation. And why we are motivated is a hard question to answer. Personally, I like the mental exercise involved in thinking through a problem and the development of experimental procedures, and especially finding out what the results are. There is this responsibility that if you have a result, you have to communicate that result to other scientists as well as the outside world so that society as a whole can benefit from it.

One of the reasons I decided to stay on as an emeritus scientist was to try to publish most of the information we have collected through years of field and lab experiments. I know from experience it is extremely hard to analyze other people's data. I pretty well published most of the salient features of results from my research, as well as the synthesis of information or knowledge of what, not only we here at PFC, but all researchers from across North America, have accomplished in relation to mountain pine beetle. The synthesis was published in a book (see sidebar).

BC: What do you think we have learned, or could even still learn, from the most recent mountain pine beetle outbreak?

LS: One of the very important things that I have learned from my career is this: The most satisfactory solution to a problem comes from a detailed understanding of the biotic and abiotic factors that affect the establishment and abundance of an organism. Based on that fundamental knowledge, there is a chance that, through a combination of direct control and preventive forestry practices, we can devise management practices to reduce the probability of establishment and survival of these insects and the probability of outbreaks.

Direct control methods—cutting down the trees, burning or peeling the bark, or using chemicals that we spray onto the bark or inject into the tree—are necessary but short-term solutions. Those methods don't deal with the underlying problem: tree and stand susceptibility. If trees and stands are susceptible, under favourable conditions for the beetle only a very small proportion of the brood has to survive for the population to explode in a few generations.

Our understanding is inadequate in describing the change from the endemic state to the epidemic state. All you need is a relatively small change in factors that control insect abundance, with the proviso that the change stays more or less constant for a number of generations. And because such a small change in brood survival is required for population increase, the relaxation of the adverse effects of many factors, even those caused by a relatively innocuous parasite or predator, could induce an increase in population levels. To detect such small change in brood survival is extremely difficult.

For relative success in applying direct control methods, you have to start when beetle populations are small. When the problem is small, it's relatively cheaper and easier to have the greatest impact on reducing beetle numbers. Once the problem grows, and usually it grows exponentially, and it spreads exponentially in space as well, the time and motion and resources required for suppression also increase exponentially and the probability of success declines.

For effective direct control we need an approach similar to what is being done for fire control. We need a system whereby there is permanent funding in place for surveillance, and intervention shortly after a problem is detected. Unless we can act early, it is very likely we won't be successful. At a later stage during the epidemic we usually apply great effort to salvage and control, but because of the usual exponential increase in the scale of the problem, it overwhelms us.

BC: It progresses much faster than we can react.

LS: Exactly. Or we have the resources to spend.

BC: So, what do you think are the "hot issues" that bark beetle scientists are going to be facing from now forward?

LS: I've already mentioned the change from the endemic to the epidemic state: Much more work needs to be done on that area. The role of the host in establishment and survival is, again, a fairly difficult area of research. We should maintain fundamental and long-standing efforts in looking at host resistance, because that understanding would increase our ability to create forest conditions that would make trees and stands as resistant as possible to this insect.

It's very important to understand the variability in stand climate as affecting insect establishment and survival. Because of microclimatic differences, even within a stand, there can be substantial changes in survival. A good understanding of that would be essential for our ability to appraise with confidence the overall impact of each year's climatic conditions on population success.

There is a lot of work needed still on the nature and effect of insect dispersal. Mountain pine beetle has two kinds of dispersal: one is a

"It's very easy in research to get discouraged. A lot of it is very hard slogging, and you just keep at it."

Resources

The Mountain Pine Beetle: A synthesis of biology, management, and impacts on lodgepole pine. 2006. Safranyik, L. and B. Wilson, eds. 304 pp.

Available from the CFS online bookstore: http://cfs.nrcan.gc.ca/pubwarehouse/pdfs/26116.pdf short-term, mainly host-seeking kind of activity. The other type is long-term dispersal whereby the insect will rise above the canopy and drift on the wind, and then where there is cooling, cold fronts, or a downdraft, these insects shower out and establish satellite infestations. They are very difficult to detect, other than by accident, until we see the foliage discolouration of successfully attacked trees. So this area of long-term dispersal would be a very important area of research.

With Canada being a very large country that spreads from sea to sea, we are in an interesting situation in that, as far as I am aware, we do not have any internal quarantine for native forest insects. Canada is a little bigger than Europe, which has many countries and each has a quarantine that restricts the possible importation of certain things, not just insects. Because of this lack of internal quarantine in Canada, there is the possibility of accidental movement of beetles, in infested bark or logs or bolts, and firewood.

"The more versatile your background is, the better it allows you to look at a problem from various angles, and that helps in arriving at a solution. Of course, you don't find this out until later in life."

The other important activity, as more knowledge is accumulated on insect dynamics, is to revise the existing population models. Through modelling you can gain additional insights into not only the nitty gritty of beetle biology but also what kind of management practices might be more efficient in reducing losses.

BC: What do you think are the things that these scientists will find the most challenging? What are the problems they are going to be facing in trying to fill these research gaps, and how can they tackle those?
LS: Some of the challenges relate to the resources available to do field experiments. They are getting more and more expensive and I'm hoping that we do not get into a situation whereby relatively limited new information can be obtained through field experimentation. That would be a real problem, because you can only do so much with existing data.

BC: So if you were going to tell someone just starting out in their career one thing, what would you tell them?
LS: If you're in the area of population ecology, you have to have a very good background in ecological theory. In addition, population work deals with numbers, and it helps if you are fairly conversant with mathematics—enough to know how you would develop fragmental equations that would effectively describe the phenomenon you are trying to model but also relate to established ecological theory. At least a basic knowledge of experimental design and sample surveys are highly desirable. And certainly versatility in computer use and programming: If you knew at least one good programming language it would be very helpful. And other than that, it is very useful to be conversant with bark beetle biology and biology of commonly associated organisms. Of course you have to start with reading up on what is known in the field.

BC: The same good advice that was given to you at the beginning of your career.
LS: I always felt lucky that somebody did that.

BC: Absolutely. You mentioned that when you came to UBC, doing the five-year program in four years made for a more rigorous academic schedule. How do you think having that background changed your approach to your research?
LS: Well the more versatile your background is, it allows you to look at a problem from various angles, and that helps in arriving at a satisfactory solution. Of course, you don't find this out until later in your life. I took so many exams, over 90 by the time I finished my PhD. I sometimes thought, "gosh, why do I need to take all these courses, I will never use them," and then later you find out that even though you might have forgotten a lot of the salient details, it actually helped you in looking at the problem in a different light.

BC: For sure.
LS: I remember taking biochemistry in the department of medicine because I late registered and it was a real killer. But nevertheless I appreciated it very much when, in the mid 60s, the synthesis of pheromones, chemical attractants by insects, became important in bark beetle research. The evolution of attractants by insects is almost unbelievable. For example, one of the primary components of resin in a pine tree is alpha-pinene, which is part of the tree's defense system against invading organisms. The mountain pine beetle converts alpha-pinene into a chemical called trans-verbenol, a population aggregating pheromone. This pheromone is produced by female beetles upon entering a pine tree and attracts beetles of both sexes, and mediates mass attack that is normally successful in overcoming host resistance. So the beetle uses part of the tree's defence system to enhance brood establishment. It's an incredible system.

BC: Remarkable. Is there anything else you want to say about mountain pine beetle?
LS: Mountain pine beetle is native, but it's also an eruptive insect, so from time to time it can develop devastating outbreaks. Since records have been kept in British Columbia, we have seen five or six major outbreaks. Even if the climate hadn't changed significantly, the probability of these outbreaks occurring within 10–15 years is pretty high. Therefore, it is very important that we

maintain a well thought out and oriented research program on beetle population biology, as well as develop practices that are effective in acting on developing infestations in the shortest period of time. If we don't do that, we'll just repeat the past. And the results from the past haven't been very encouraging.

In terms of preventive management, this research program I alluded to will hopefully further increase our ability to develop stands that are more resistant to mountain pine beetle and grow stands on short rotation, as well as, in very high hazard areas, perhaps avoid growing lodgepole pine altogether.

We should try to learn from the past. We know that these outbreaks will occur again, and we should be able to react more quickly in the future. When it comes to the longer-term effective management, we have to gather as much information as possible on the nature and the effect of the interaction of this insect with its host. So based on that knowledge, we could advise management agencies with confidence on how to grow and manage that resource so that future outbreaks have less of an impact.

BC: Great advice. Now that the mountain pine beetle has crossed the Rockies and is into the boreal forest, what are the implications for Canadian forests? A lot of people speculate that the recent outbreak is going to get worse because of climate change.

LS: Climatic factors are considered the most important factors in determining the historical range of this insect. Therefore, as climate changes in a way that is favourable for insect survival and establishment, it would certainly increase the probability of territorial spread; permanent establishment in new areas.

In the short-term, certainly, in areas like north-central Alberta and north-eastern BC where mountain pine beetle populations are currently active, my feeling is that the beetle will be permanently established, and the worry is that these might serve as jump-off points for spread further north toward the Yukon and the Territories, and further east in the boreal region.

In the longer term it might be possible, through natural factors such as favourable climatic conditions, that the beetle would spread to the east, but in the near term the probability of that is relatively low, other than in Alberta and Saskatchewan.

BC: One last question: Now what? Now that your emeritus stint has come to an end, what are you going to do?

LS: We have a little farm, and there is no shortage of physical activity there. I plan to spend more time with my four grandchildren, and take some trips with my wife. From high school days, I was interested in astronomy so I'll probably acquire my scope now, and since we have a little farm away from the lights hopefully the viewing will be relatively decent. I might take a course at UVic in mathematics, probably number theory.

BC: Sounds like a good plan.

LS: I had a great run with my research activities here and I have fond memories of the place, of colleagues and friends.

"It is very important that we maintain a well thought out and oriented research program on beetle population ecology."

People

Accolades

Pacific Forestry Centre recognized employees who went above and beyond job expectations during National Public Service week. **Andrew Dyk, Melissa Lee, Katja Power, Dominique Lejour, Erich Moerman, Heather O'Leary, Elaine Zamardi,** and **Holly Williams** were presented with **Spirit Awards** for their contributions. Award recipients were recognized for leading, initiating, or providing crucial support for activities that contribute to building a strong community, whether within PFC or the broader community.

Long Service Awards were awarded to:

10 Years– **Morgan Cranny, Bryan Bogdanski, Werner Kurz, Jun-Jun Liu**

15 Years– **Heather O'Leary**

20 Years– **Kevin Pellow, Gary Roke**

25 Years– **Anne Dickinson, Nello Cataldo, Lee Humble, Kami Ramcharan, Art Robinson, Rona Sturrock, Steve Taylor, Brian Titus**

30 Years– **René Alfaro, Ross Benton, Steve Gray, Brad Hawkes, Don Leckie, Bill Wilson, Nita Wilson, Jim Wood**

New Publications from Pacific Forestry Centre

Assessment of *Colletotrichum gloeosporioides* as a biological control agent for hemlock dwarf mistletoe *(Arceuthobium tsugense)*. 2011. Askew, S.E.; Shamoun, S.F.; van der Kamp, B.J. Forest Pathology: In press.

Further studies on zoospore germination inhibition of three lineages of *Phytophthora ramorum* by chemical fungicides, and identification of a potential bacterial biocontrol agent. 2010 Pacific Division Meeting Abstracts. 2011. Elliott, M.; Shamoun, S.F.; Sumampong, G.; James, D.; Masri, S.; Varga, A. Phytopathology 101(6) Supplement: S248.

Recent rates of forest harvest and conversion in North America. 2011. Masek, J.G.; Cohen, W.B.; Leckie, D.G.; Wulder, M.A.; Vargas, R.; de Jong, B.; Healey, S.P.; Law, B.; Birdsey, R.A.; Houghton, R.A.; Mildrexler, D.; Goward, S.N.; Smith, W.B. Journal of Geophysical Research 116: G00K03.

Estimating change in species richness from repeated sampling of incidence data. 2011. Magnussen, S. Journal of Environment and Ecology 2(1): 1–21.

A modified bootstrap procedure for cluster sampling variance estimation of species richness. 2011. Magnussen, S.; McRoberts, R.E. Journal of Applied Statistics 38(6): 1223–1238.

Characteristics of wood wastes in British Columbia and their potential suitability as soil amendments and seedling growth media. 2011. Venner, K.H.; Preston, C.M.; Prescott, C.E. Agricultural Institute of Canada 91(1): 95–106.

Design and installation of a phenological camera network across an elevation gradient for habitat assessment. 2011. Bater, C.W.; Coops, N.C.; Wulder, M.A.; Nielsen, S.E.; McDermid, G.J.; Stenhouse, G.B. Instrumentation Science & Technology 39(3): 231–247.

A Comprehensive DNA Barcode Library for the Looper Moths (Lepidoptera: Geometridae) of British Columbia, Canada. 2011. deWaard, J.R.; Hebert, P.D.N.; Humble, L.M. PLoS ONE 6(3): e18290.

Site, plot, and individual tree yield reduction of interior Douglas-fir associated with non-lethal infection by *Armillaria* root disease in southern British Columbia. 2011. Cruickshank, M.G.; Morrison, D.J.; Lalumière, A. Forest Ecology and Management 261(2): 297–307.

Mapping wildfire and clearcut harvest disturbances in boreal forests with Landsat time series data. 2011. Schroeder, T.A.; Wulder, M.A.; Healey, S.P.; Moisen, G.G. Remote Sensing of Environment 115(6): 1421–1433.

Assessing the impact of N-fertilization on biochemical composition and biomass of a Douglas-fir canopy—A remote sensing approach. 2011. Hilker, T.; Lepine, L.; Coops, N.C.; Jassal, R.S.; Black, T.A.; Wulder, M.A.; Ollinger, S.; Tsui, O.; Day, M. Agricultural and Forest Meteorology: In Press.

Characterizing the state and processes of change in a dynamic forest environment using hierarchical spatio-temporal segmentation. 2011. Gómez, C.; White, J.C.; Wulder, M.A. Remote Sensing of Environment 115(7): 1665–1679.

Assessment of standing wood and fiber quality using ground and airborne laser scanning: A review. 2011. van Leeuwen, M.; Hilker, T.; Coops, N.C.; Frazer, G.W.; Wulder, M.A.; Newnham, G.J.; Culvenor, D.S. Forest Ecology and Management 261(9): 1467–1478.

From laboratory bench to marketplace—the 'Chontrol®' story—a legacy to government-academia-industry partnership. Abstracts, Annual Meeting, 2010: The Canadian Phytopathological Society. 2011. Shamoun, S.F. Canadian Journal of Plant Pathology 33(2): 291–292.

Events

Forest Biodiversity in a Changing Climate: Understanding Conservation Strategies and Policies
September 22–23, 2011 • Freiburg, Germany
www.freiburgconference2011.de/

European Forest Institute Annual Conference and Seminar 2011: Active Forestry with Responsibility
September 28–29, 2011 • Uppsala, Sweden
www.efi.int/portal/shortcuts/efi__2011_annual_conference_

National Electronic Lecture Series
Canadian Institute of Forestry
September–November 2011
Research from Pacific Forestry Centre
www.cif-ifc.org/site/electure

Carrefour Forêt Innovations Ministère des Ressources naturelles et de la Faune
October 4–6, 2011 • Québec City, Québec
http://www.carrefourforetinnovations.gouv.qc.ca/english/index.asp

22nd Meeting of the Montréal Process Working Group
International Tropical Timber Organization and Forest Europe
October 16–21, 2011 • Victoria, BC
www.rinya.maff.go.jp/mpci/meetings_e.html#other

Restoring the West Conference: Sustaining Forests, Woodlands, and Communities Through Biomass Use
October 18–19, 2011 • Logan, Utah
www.restoringthewest.org/

2011 Society of American Foresters National Convention
November 2–6, 2011 • Honolulu, Hawai'i
www.safnet.org/natcon11/index.cfm

The Future Role of Bioenergy from Tree Biomass in Europe
November 6–11, 2011 • Vienna, Austria
www.esf.org/index.php?id=8196

Joint Annual Meeting of the Entomological Society of Canada and the Acadian Entomological Society
November 6–9, 2011 • Halifax, Nova Scotia
www.esc-sec.ca/annmeet.html

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