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INFORMATION FORESTRY

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

Forest biomass as a source of bioenergy p.2

An interview with Caroline Preston: The power of perseverance p.4

Conference Notes p.6

People p.7

New publications from PFC p.8

Events p.8

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Canada

Forest biomass as a source of bioenergy: Another step toward



CFS photo

Wood pellets.

Worldwide concern that increased atmospheric concentrations of carbon dioxide are linked to climate change has led Canada, along with many other nations, to commit to reducing its carbon dioxide emissions. A wide range of tools are needed to achieve our national goals, including increased use of renewable energy to offset burning of non-renewable fossil fuels. Canada's vast forests go through continuous cycles of regeneration, growth, senescence, and death. Of all forests restarting this cycle in Canada in an average year, more die from natural disturbance (such as insects, disease, fire, and windthrow) than through harvesting for forest products. These disturbances cause an initial net release of carbon to the atmosphere, which later becomes net capture of carbon as the forest regrows and the amount of carbon taken up by the ecosystem becomes greater than that released. Outside of forests, traditional forest products also store carbon for different amounts of time and thus, contribute to mitigating rising atmospheric carbon dioxide concentrations.

As world leaders in production of bioenergy, 32% of Sweden's energy and 25% of Finland's energy currently comes from bioenergy, largely from biofuels made of biomass taken directly from forests, or from by-products of the forest industry. (Biofuels are solid or liquid fuels made of any biological material.) In Sweden, the vast majority of these biofuels are generated from residues or waste products of industrial processes, such as black liquor from pulping or chips from sawmilling. Only a small proportion (about 10%) comes from biomass (any biological material, but usually harvesting residues, i.e., slash) that is removed

directly from forest sites. By comparison, only about 6% of the energy used in Canada comes from bioenergy; as in Sweden and Finland, the vast majority is from the forestry sector, which makes and uses about 55% of this energy themselves.

Bioenergy production therefore benefits Canada by helping us meet our carbon objectives. Although removing biomass directly from forest sites will likely be a minor component of forest bioenergy production in Canada, the production of bioenergy as a new commodity will also help our forestry sector to be more efficient and competitive. Indeed, the Future Bio-pathways Project, a collaboration of the Forest Products Association of Canada with partners including Natural Resources Canada and FPInnovations, recently did a study which concluded that integration of traditional and bioproducts (including bioenergy) within the forestry sector would be the most cost-competitive way forward (see sidebar).

Canadian Forest Service (CFS) research scientist **Brian Titus** (brian.titus@nrcan.gc.ca) was recently involved in a study showing that some 40 million tonnes per hectare of slash is produced by logging every year. As one of the largest potential sources of biomass in Canada, if 50% of this slash was left on site for ecological sustainability, the remainder could generate about 6% of Canada's current energy needs.

However, unlike industrial processes, there is no such thing as "waste" in ecology. The biomass removed contains nutrients, as well as carbon—an energy source for some organisms—and can provide habitat for a variety of other organisms if left in place. Researchers are asking: Can slash be removed without compromising ecological processes? If so, how much can be removed, and from what kinds of sites?

The CFS has a long history of research in this area. A rising interest in slash as feedstock for bioenergy in the mid-2000s prompted CFS researchers to form a nationwide Sustainable Biomass team to rejuvenate this research, in collaboration with provincial, university, industrial, and community colleagues. Their objective is to ensure that biomass procurement from forests is environmentally sustainable, thereby ensuring market access for Canadian forest biofuels and bioenergy as well as competitiveness of the Canadian forestry sector. There are three general themes in the CFS research strategy: collating and synthesizing existing knowledge, generating new knowledge, and applying that knowledge spatially.

Resources

Future quantities and spatial distribution of harvesting residues and dead wood from natural disturbances in Canada. 2010. Dymond, C.C.; Titus, B.D.; Stinson, G.; Kurz, W.A. *Forest Ecology and Management* 26(2): 181–192.

Future Bio-pathways Project
<http://www.fpac.ca/index.php/en/bio-revolution/>

reducing Canada's carbon footprint

To this end, the CFS is developing a "nutrient calculator" for estimating nutrient removals from sites across the country with different levels of intensive harvesting. A literature review on impacts of intensive harvesting (i.e., slash removal) has recently been completed (see sidebar), and data is currently being gathered from around the world for a major meta-analysis of global results.

To generate new knowledge, the CFS is re-measuring old field trials, which are a priceless asset: several decades of data is needed to understand site productivity issues. At the same time, researchers are establishing new "second-generation" field trials that will better elucidate slash removal thresholds; the larger trials now include key biodiversity studies. Because the cost of major field trials is substantial, the CFS has also developed a network of operational monitoring plots that can be easily installed by industry as part of normal operations; targeting key site types makes this efficient, and data will eventually be generated that would otherwise be too expensive to collect using large-scale trials.

Indicators of site suitability for intensive

harvesting are being developed by synthesising the knowledge gained from both old and new studies. This information can feed into slash removal guidelines to ensure sustainable practices, such as exist for New Brunswick, and are being developed in some other provinces. Current studies are also testing how these indicators can be applied spatially. Results can then be overlain with forest inventory data to predict long-term slash availability, and used with operational models to predict an economically accessible supply. "This information is foundational for building bioenergy business plans and formulating government policies," says Titus.

Research results generated by the CFS, combined with those from other agencies, feeds into the knowledge base necessary to ensure the continued sustainable management of Canada's forests. While bioenergy generated from biomass removed directly from our forests is no panacea, every environmentally sustainable energy source that reduces our long-term carbon footprint is needed to counterbalance our changing climate.

-B.T.

Resources

Effects of forest biomass harvesting on soil productivity in boreal and temperate forests: A review. 2011. Thiffault, E.; Hannam, K.D.; Paré, D.; Titus, B.D.; Hazlett, P.W.; Maynard, D.G.; Brais, S. *Environmental Review* 19:278–309.

Guidelines: Establishing permanent plots for monitoring the effects of forest biomass harvesting. 2011. Thiffault, E.; Paré, D.; Dagnault, S.; Morissette, J. Canadian Forest Service, Laurentian Forestry Centre, Québec, QC.



Harvesting residue in Québec stacked at roadside in preparation for processing into biofuel.

An interview with soil chemist Caroline Preston: The power of



Andrew Dyk, CFS

Caroline trussed up in full field gear for the United Way talent show fundraiser in 2010.

Barb Crawford: How long have you been at PFC?

Caroline Preston: 25 years. I arrived in 1986.

BC: Can you give us a brief overview of your career and how you ended up here?

CP: It was sort-of by accident, which doesn't happen much now. I did my PhD in pure chemistry, but I was very interested in environmental issues. I had a couple of temporary jobs in Ottawa, and then I did a two-year post-doc with the Department of the Environment in glaciology. I got to go on some interesting local field trips, measuring light penetration through ice and snow on lakes. Then I got a job with Agriculture Canada in 1978, in soils. I'd never taken

a soil or biology course in my life, but they were looking for someone who could bring some more modern chemistry to bear on characteristics of soil organic matter and soil nitrogen and nutrient cycling.

I came out here on a secondment because they needed someone with some expertise in ^{15}N analysis and interpretation for a project, and I had been doing that at Agriculture Canada.

"Some of this stuff doesn't seem urgent right now, but when you look at what other countries are doing and what the effects of soil warming could be in the long term, it's important."

BC: You're very passionate about your work and I was wondering what fuels that passion for you.

CP: Curiosity. The nice thing is, I've channelled that curiosity into really applied things. I have a different approach than most people here, because as a chemist I'm a generalist and I use a lot of different chemistry techniques. I've been able to work with a lot of people on very applied projects, big field projects, and I bring that extra dimension of chemistry. So I get to do something useful, which is also a main motivation. When you help with fertilization problems, and you help make trees grow faster and you overcome some of the growth inhibition in clearcuts, you can help underpin some of the assumptions in carbon models.

I have a lot of fun both in the lab and the field. Going out in the field is a really big motivator. That's where you get a lot of ideas, just seeing what the sites are like, what the variability is going to be, what you can bring back to analyze.

I've had a lot of adventures—Siberia, Australia, New Zealand. In the last few years, because I've been involved in carbon cycle work and boreal forests, I worked in northern Saskatchewan and Manitoba. I've been as far as Churchill and Inuvik, which was spectacular. Even working up in Port MacNeil has been really interesting.

BC: What do you think are the greatest challenges that researchers face in soil chemistry and forestry?

CP: It's really hard to sell soil science, and I don't mean just traditional soil science of particle size and nutrients, but soil organic matter science and processes. That's what Les [Safranyik] was talking about too: understanding the mechanisms (see previous issue).

In the carbon cycle work and carbon budget and modelling they have a lot of conceptual pools—you know the boxes and the arrows—like slow soil carbon. We don't know very much about what controls the amounts and turnover of this carbon. We don't know its personality. It literally is a black box—it's a box in the model. Some of this stuff doesn't seem that urgent right now, but when you look at what other countries are doing and what the effects of soil warming could be in the long term, it's important. We have huge amounts of carbon in the North—Canada, Russia, Alaska—that we don't know very much about, stuck in permafrost, in semi-forested peatlands.

So all the way through in our carbon research for soils we need to know more about how stable it is, what's going to control its stability, and how much of it is going to turn into CO_2 as we upset the balance. Is the changing climate going to result in a loss of soil carbon? Or a gain? We haven't really done anything on mechanisms of carbon stabilization, even in southern Canada. What keeps carbon stuck in the soil? What's the carbon saturation? How much more can you store in there? A lot of that research has been done in other systems that don't really apply. A lot of our forest soils are not very complex; they're very shallow, and the potential for deep carbon storage may not be as high. I think there are a lot of challenges out there if people want to pursue that. Some of those answers are going to be needed eventually.

Black carbon, too, that's another huge issue. It's just basically charcoal from fires. And someone here is starting to work on that, too, **Kendrick Brown**. I've got a list of things I'd like to see. I think the nutrient question has been a bit overlooked too. I think that forest fertilization is going to

perseverance

become much more necessary and important. What are nutrient limitations going to be if the soil warms up? We might not get that increasing productivity expected in the North, because there might not be enough nitrogen and phosphorus and other nutrients.

BC: Some of your fellow researchers mentioned that you have a really dynamic approach to your work.

CP: Yes, because I come from the outside, from chemistry and agriculture, and I've done a lot of international work. I think there's a mindset here that you have to plan this huge project, you can't start until you see the funding, and there's a bit of over-planning. We're not encouraging enough of the 10% of your research that should be a little bit exploratory. In most cases that is the 10% that people are doing anyway; it's not really costing anything. It's partly a biological sciences thing too: you work out your three expected answers in advance, and you design your project around that. Chemists and physicists have a different way of looking at things. It's very good to work together. When I get together with somebody who has a good ecology project, the interdisciplinary stuff can be really, really good.

BC: What's the most important advice you can give new researchers?

CP: You have to really push. If someone says no, go back with a better case. Stay on the leading edge. International exposure is really important. I think you have to have something that makes you unique, something that makes you stand out: this will attract collaborators. You need to do those things that the other institutes aren't doing, you need to add value, so pick something and really be known for it: mine was the use of a highly specialized piece of equipment, the NMR spectrometer. Get involved in a wide range of projects. People always have some little exploratory side project that may or may not go anywhere. I think you have to push those things too, so you're not just doing safe stuff that you think you already know the answer to. And have fun. Go out in the field, enjoy your colleagues. Be interdisciplinary.

BC: Some of the other researchers I've spoken with talk about how international collaboration enriches their work and perspective. Have you seen how that's influenced your work?

CP: Oh, huge. Huge. It gives you new ideas. If you email those people that have some fantastic piece

of equipment, they are often more than happy to run your samples. It gives us more standing on the international stage when all the papers aren't just from within CFS or within Canada. You really have to have that international credibility. Going to international conferences is wonderful, but that's just one level. The other thing is actual collaborative projects. Often they aren't difficult to arrange: they're all done by email and sending a few samples around. They bring in a technique that you wouldn't be using.

BC: Relationships sort-of snowball from there.

CP: Exactly.

BC: What contribution or achievement do you feel most proud of?

CP: I think I've actually done a lot for increasing our fundamental understanding of the organic matter aspects of nutrient cycling. It's been a more generalized contribution, pushing the knowledge forward in a pretty wide area. I'm happy with that. When I look at the increases in understanding that have happened in soil and plant chemistry since I started my PhD in 1970, it's staggering. I see papers of mine that are still cited from 1983, so I hope people will still be able to make use of this knowledge. I also want to make a contribution to the understanding of the role of black carbon.

I see a lot of work that's influenced by our work. Like, the paper we wrote on lignin in litter (see sidebar)—I couldn't have done it without people like **Tony Trofymow** and Jag Bhatti at Northern Forestry Centre, because if it was just me going and getting a leaf, a soil sample here and there, it wouldn't be very effective. It would be nice chemistry, but what we have here is the strength of the interdisciplinary group. I can work with someone who's got a big set of field plots, take a subset of those samples, and do stuff that actually has statistical significance and is much more relevant to the field projects than just going, "Oh, I found a few fallen leaves and analyzed them." Getting involved with the big projects like CIDET is very important.

BC: Sounds like those connections are very important in a researcher's career.

CP: Very much. But that's true no matter what field you're in. The other thing we're doing is getting involved in archiving: it is really important. There's more that can be done with these data. I've just done the easiest, quickest analysis in a lot of cases because there wasn't time to do more.

"Stay on the leading edge.... Get involved in a wide range of projects."

Resources

Decomposition, delta 13C, and the "lignin paradox." 2006. Preston, C.M.; Trofymow, J.A.; Flanigan, L.B. *Soil Science* 86:235–245.

Chemical changes during 6 years of decomposition of 11 litters in some Canadian forest sites. Part 2: 13C abundance, solid-state 13C NMR spectroscopy and the meaning of "lignin." 2009. Preston, C.M.; Nault, J.R.; Trofymow, J.A. *Ecosystems* 12(7): 1078–1102.

Conference Notes

Global change and forest diseases: How do we prepare?

Rona Sturrock, CFS



A distant view of the Montesclaros Monastery.

Resources

Climate change and forest diseases. 2011. Sturrock et al. *Plant Pathology* 60:133–149. Available online at: <http://onlinelibrary.wiley.com/doi/10.1111/j.1365-3059.2010.02406.x/abstract>

Abstracts available online at: <http://files.iufro2011.com/200000783-0ab5d0bafb/Abstracts%20IUFRO%202011.pdf>

Other resources from the IUFRO meeting available online at: <http://www.iufro2011.com>

Plant diseases are strongly affected by environmental conditions so it makes sense to expect that climate change will result in changes in the impact of diseases in the world's forests. Climate change is, in fact, just one example of "global change," defined by some as "any consistent trend in the environment—past, present, or projected—that affects a substantial part of the globe."

"Global change and forest diseases: New threats, new strategies" was the theme of the latest meeting of the IUFRO Working Party 7.02.02 on Foliage, Shoot, and Stem Diseases, which took place at the Montesclaros Monastery near Palencia, in northern Spain, from May 23–27, 2011. The meeting began with a thought-provoking address from Dr. Mike Wingfield, Vice-President Responsible for IUFRO Divisions and Director of the Forestry and Agricultural Biotechnology Institute at the University of Pretoria, South Africa. Dr. Wingfield proposed that acknowledgement of five key truths could guide us in managing forest health into the future:

1. new forest diseases and insect epidemics will continue to occur;
2. novel associations between tree species and pathogens are emerging;
3. climate change is dramatically influencing the behaviour of tree pathogens;

4. plantation forestry of non-native species is negatively impacting the health of native forests; and
5. new technologies will have substantial impact on the future of forest protection.

Rona Sturrock (rona.sturrock@nrcan.gc.ca), a forest pathology research scientist at the Pacific Forestry Centre, gave the meeting's final presentation, entitled "Climate change and forest diseases: Using today's knowledge to address future challenges." Sturrock discussed how forest diseases will interact with changing global climate and described possible outcomes. She also outlined four approaches—monitoring, forecasting, planning, and mitigation—for managing forest health into the future. "This was an invaluable opportunity to forge new working relationships with dozens of forest pathologists and students," said Sturrock of her first attendance at the meeting.

A total of 73 delegates from 17 countries were present at the rustic and remote Montesclaros Monastery, making for intimate exchanges of forest pathology and cultural knowledge among the global attendees. Participants were able to discuss and see first-hand recurring issues that included significant economic and ecological damage caused by introduced pathogens, which can often traced back to "plants for planting," and the risks associated with planting non-native, genetically uniform hosts. Diseases causing significant damage in the Cantabria region of Spain include Pitch canker, caused by the fungus *Fusarium circinatum*, affecting *Pinus radiata* plantations, and Mycosphaerella Leaf Disease, caused by *Mycosphaerella* spp., affecting plantations of *Eucalyptus* spp.

—R.S.



Rona Sturrock, CFS

Pitch canker caused by *Fusarium circinatum* on *Pinus radiata* in Cantabria, Spain.

People

Arrivals

Dr. Eliot McIntire recently joined PFC as a Research Scientist in Natural Disturbance and Modelling. Eliot received his PhD from the University of British Columbia in 2003 in Forest Ecology, working on spatial patterns of natural disturbances. Prior to joining PFC, Eliot was a Canada Research Chair in Conservation Biology at Laval University, where he developed new approaches to working with spatial data and explored a wide range of topics from wildlife management to climate effects on mountain ecosystems, whitebark pine conservation, and spatial modelling and forecasting. Dr. McIntire's interests lie in forecasting complex spatial systems to help decision support systems.

PFC welcomes **Dr. Céline Boisvenue**, a new Research Scientist in Climate Change and Forest Dynamics. Prior to joining the Canadian Forest Service, Dr. Boisvenue was a researcher in climate change and carbon modelling at the Forest Research Branch of the Québec Ministry of Natural

Resources (DRF-MRNF). Dr. Boisvenue obtained her PhD from the University of Montana in 2008, where she worked in the Numerical Terradynamic Simulation Group. At PFC, she is joining the Carbon Accounting Team and Dr. Werner Kurz, and will be contributing to better quantifying the carbon balance of our forests.

Dr. Brian Van Hezewijk recently joined PFC as a Research Scientist (Insect Ecology). Brian's previous research focused on the spatial dynamics of insect populations and their interaction with higher and lower trophic levels. During PhD at the University of Alberta he examined the interaction between landscape structure and insect dispersal, and its effect on the dynamics of a model host-parasitoid community in aspen parklands. His most recent work at Agriculture & Agri-Food Canada in Lethbridge, AB has focused on the spatial ecology and impact of herbivorous insects and their use in the biological

control of invasive plants. He is excited about working in forestry again and studying the interactions between insects and their environment.

Margaret Gracie joined Natural Resources Canada in August as a Writer/Editor for Communications. At PFC, Margaret's main duties will be writing and editing content for regional publications and online newsletters. Margaret spent the last 10 years working for Service Canada here in Victoria, as a Communications Consultant and Business Expertise Consultant, and was Senior Editor at Hansard for the BC Legislative Assembly for 7 years. Before that, Margaret worked for Statistics Canada in Vancouver on the 2001 Census as a bilingual Communications Officer.

Accolades

Montreal Process Working Group Meeting: International organizations meet in Canada to streamline global forest reporting

In October 2011, Natural Resources Canada's Canadian Forest Service hosted a workshop for experts in criteria and indicators (C&I) of sustainable forest management from the Montreal Process Working Group, Forest Europe, the International Tropical Timber Organization, and the Food and Agriculture Organization (FAO) in Victoria, BC.

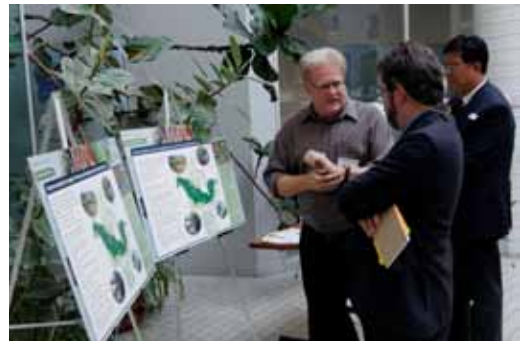
Delegates looked at how international C&I processes and the FAO teams could work together to improve reporting on the world's forests and reduce the reporting burden on countries. A joint statement of collaboration and associated recommendations was prepared and will be shared by December 2011. The recommended actions will improve the way forest information is collected and shared for international reporting, and will enhance

the ability of C&I processes to inform the development of the FAO's 2015 Global Forest Resource Assessment.

Jim Wood, Director of Pacific Forestry Centre's Policy, Planning, and Operations Division, welcomed delegates at the Royal British Columbia museum on Monday, October 17, 2011. Pacific Forestry Centre (PFC) staff hosted a science showcase and a field day to tour southern Vancouver Island research sites.

After the Working Group meeting on Tuesday, PFC researchers showcased their science at a poster session. Wednesday's field trip, led by PFC research scientist **Tony Trofymow**, included stops at China Beach, the Harris Creek Spruce, Cowichan Lake Research Station, and a tour of North Cowichan Community Forest.

"Our delegates were mesmerized by our extraordinary forests and our hospitality. Many commented on the useful and enlightened discussions they had with our staff and stakeholders," said Joanne Frappier, Director of Natural Resources Canada's Forest Knowledge and Information Management Division.



New Publications from Pacific Forestry Centre

Fine root density distribution and biomass in second- and third-growth Douglas-fir stands on Vancouver Island, British Columbia. 2011. Lalumière, A.; Trofymow, J.A. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. Information Report BC-X-428.

Phytophthora ramorum (sudden oak death) – recent studies in Canada. Abstract. 2011. Shamoun, S.F.; Rioux, D. Pages 57–58 in Proceedings of the Forest Pest Management Forum 2010, November 30–December 2, 2010, Gatineau, QC. Natural Resources Canada, Canadian Forest Service, Ottawa.

Comparison of the Activities of Three LdMNPV Isolates in the Laboratory Against the Chinese Strain of Asian Gypsy Moth. 2011. Duan, L.; Otvos, I.S.; Xu, L.B.; Conder, N.; Wang, Y. The Open Entomology Journal 5:24–30.

Genetic diversity and population structure of 151 *Cymbidium sinense* cultivars. 2011. Lu, J.-J.; Hu, X.; Liu, J.-J.; Wang, H.-Z. Journal of Horticulture and Forestry 3(4):104–114.

Phenotypic differences among three clonal lineages of *Phytophthora ramorum*. 2011. Elliott, M.; Sumampong, G.; Varga, A.; Shamoun, S.F.; James, D.; Masri, S.; Grünwald, N.J. Forest Pathology 41:7–14.

Phragmidium violaceum on *Rubus armeniacus* and *R. laciniatus* in British Columbia. 2011. Callan,

B.E.; Wall, R.; Dale, P.L.; Joshi, V. North American Fungi 6(14):1–5.

In Silico Mining and PCR-Based Approaches to Transcription Factor Discovery in Non-model Plants: Gene Discovery of the WRKY Transcription Factors in Conifers. 2011. Liu, J.-J.; Xiang, Y. Pages 21–43 (Chapter 2) in L. Yuan and S.E. Perry, editors. Plant Transcription Factors: Methods and Protocols, Methods in Molecular Biology 754. Humana Press, c/o Springer Science+Business Media, LLC, New York, NY.

Carbon Budget Model of the Canadian Forest Sector (CBM-CFS3). Experiences in implementing a Tier 3 approach. 2011. Kurz, W.A. Pages 39–47 in H.S. Eggleston, N. Srivastava, K. Tanabe, J. Baasansuren, and M. Fukuda, editors. IPCC 2011, Use of Models and Facility-Level Data in Greenhouse Gas Inventories, Proceedings: Report of IPCC Expert Meeting on Use of Models and Measurements in Greenhouse Gas Inventories. August 9–11, 2010, Sydney, Australia. Institute for Global Environmental Strategies (IGES), Hayama, Japan.

Assessing the impact of N-fertilization on biochemical composition and biomass of a Facilitation in bark beetles: endemic mountain pine beetle gets a helping hand. 2011. Smith, G.D.; Carroll, A.L.; Lindgren, B.S. Agricultural and Forest Entomology 13(1):37–43.

Mountain pine beetle survey in the Peace Region of British Columbia and adjacent areas in Alberta. 2011. Pellow, K.W.; Thandi, G.; Unger, L.S. Natural Resources Canada, Canadian Forest Service, Pacific Forestry Centre, Victoria, BC. Mountain Pine Beetle Working Paper 2010-05.

Fragmentation regimes of Canada's forests. 2011. Wulder, M.A.; White, J.C.; Coops, N.C. Canadian Geographer 55(3):288–300.

An adaptive composite density estimator for k-tree sampling. 2011. Magnussen, S.; Fehrman, L.; Platt, W.J. European Journal of Forest Research : (not yet paginated).

Simulated impact of sample plot size and co-registration error on the accuracy and uncertainty of LiDAR-derived estimates of forest stand biomass. 2011. Frazer, G.W.; Magnussen, S.; Wulder, M.A.; Niemann, K.O. Remote Sensing of Environment 115(2):636–649.

Conifer Chitinases. In: Al-Mughrabi K (Ed) Plant science and biotechnology in North America: Focus on Canada II. 2011. Islam, M.A.; Sturrock, R.N.; Ekramoddoullah, A.K.M. The Americas Journal of Plant Science and Biotechnology Volume 5 Special Issue 1:22–36.

Events

Pacific West Biomass Conference and Trade Show

January 16–18, 2012 • San Francisco, CA
<http://pacificwest.biomassconference.com/>

Association of BC Forestry Professionals (ABCFP) Forestry Conference and AGM

February 22–24, 2012 • Victoria, BC
<http://www.expofor.ca/>

Forest Models for Research and Decision Support in Sustainable Forest Management

European Forest Institute, Atlantic European Regional Office
March 1–2, 2012 • Pierroton, France
http://www.efiatlantic.efi.int/portal/events/cost_fp0603_final_meeting/

Cumulative Effects of Insect Outbreaks: Western Forest Insect Work Conference

March 26–29, 2012 • Penticton, BC
<http://www.fsl.orst.edu/wfiwc>

IUFRO IRG 43 International Research Group on Wood Protection Annual Meeting

May 6–10, 2012 • Kuala Lumpur, Malaysia
<http://irg43.my/index.html>

World Bioenergy: Conference and Exhibition on Biomass for Energy

May 29–31, 2012 • Jönköping, Sweden
<http://www.elmia.se/en/worldbioenergy/>

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