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university of british columbia

dean'smessage

The 21st of March marked the International Day of Forests. This year, the theme was forests and climate change. Forests are an integral component of the climate change debate. Their conversion to other forms of land use have resulted in large-scale emissions of carbon dioxide and other greenhouse gases. Conversely, afforestation and the regrowth of cut forests represent significant sinks for atmospheric carbon dioxide. Climate change appears to be responsible, directly or indirectly, for increasing instability of forest ecosystems around the world, and there is mounting evidence for a whole suite of other impacts on the environment.

The UBC Faculty of Forestry celebrated the International Day of Forests by holding what may well have been the largest silver ring ceremony ever held, with 118 rings awarded. Elsewhere in Canada, a number of relatively low-key events were held, and regrettably the day was barely noticed in the general media.

This apparent disinterest is disturbing. According to UN Secretary-General Ban Ki-moon, "To build a sustainable, climate-resilient future for all, we must invest in our world's forests. That will take political commitment at the highest levels, smart policies, effective law enforcement, innovative partnerships and funding." Scientists from our Faculty, including Suzanne Simard, Sally Aitken and George Hoberg have recently played a major part in a report outlining possible solutions: "Acting on Climate Change: Solutions from Canadian Scholars". The report emphasizes how important it is to take a holistic approach. One sector alone cannot solve the problem, but a concerted effort involving energy, transportation, urban planning, the natural resources sector and others might do so.

We are currently living in a period of time that some have dubbed the "Anthropocene". This recognizes that the current geological time period is the first in which the activities of humans have had such a dominant effect on the planet. Climate change is obviously one such effect, but other inter-related effects include the loss of biodiversity, changes in land use, and changes in ocean chemistry. The changes will need novel solutions, and Shannon Hagerman discusses what some of these might look like in this issue. They include re-introducing species to areas where they formerly existed, and assisted migration, whereby humans move other species to locations outside their normal range in anticipation of future climate change.

Sometimes the changes that are being experienced are indirect and quite subtle. Cora Skaien describes how introduced deer populations seem to be driving evolutionary change in some plants, citing how seablush plants growing on some of the Gulf Islands have changed in response to browsing pressure by deer.

The Anthropocene is also marked by changes in a number of natural processes. One such change has been in the frequency and intensity of wildfires in western Canada. Raphaël Chavardès has been using tree rings to reconstruct the incidence of wildfires in Jasper. He found that the fire regime there has changed drastically over the past 350 years, with today's forests being the result of a hundred years of fire suppression. Today's relatively uniform, closed canopy forests have reduced the landscape diversity and made it more susceptible to catastrophic fire.

The problems associated with the Anthropocene period are reflected in the type of research projects being done today, many of which would not have been considered 20 years ago. Jamie Halperin describes a project looking at carbon in the miombo woodlands of Zambia. Ensuring that forests can act as a sink for atmospheric carbon is an important aspect of plans to use forests to reduce atmospheric carbon. Forests all over the world will play a role in this, but regional variations are not as well understood as they should be.

Reducing carbon emissions from transportation may not be a priority for most managers, but reducing transport costs may well be, and so the work described by Fattane Nadimi on the optimization of truck transport has both an immediate economic value and long-term carbon implications. Links between economic optimization and environmental sustainability are also evident in the account of Julie Cool's research into planing and gluing. Reducing the amount of glue needed will not only present cost savings, but will also be more sustainable. Such considerations are becoming increasingly important in the secondary manufacturing and value-added sectors, as revealed by Haris Gilani's work on the adoption of chain of custody certification. This has lagged behind forest management certification, but is becoming more widespread as companies realize the potential benefits associated with the certification (which, unfortunately, still do not generally involve a price premium).

The Anthropocene is throwing up many new challenges for research and these are only likely to intensify over time. Scientists in the Faculty are fully engaged with research on the topic, and teaching students about it. However, they are also suggesting solutions, and ensuring that these solutions are widely disseminated. It remains to be seen whether Canadians and others are listening.

John L Innes
Professor and Dean

forestrynews

2015 Schaffer Lecture a great success

On Tuesday March 3rd **Dr Cecil Konijnendijk** delivered the 19th Schaffer Lecture in Forest Sciences. Dr Konijnendijk is the head of Landscape Architecture, Planning and Management at the Swedish University of Agricultural Sciences. His talk entitled "Urban Forestry for Urban Futures, Biocultural Diversity for Resilient and Healthy Cities" drew a close-to-capacity crowd of over 200 people to the UBC Forest Sciences Centre.

The Schaffer Lectureship was established in 1981 by the late Mrs Kato Schaffer for the purposes of disseminating scientific information among forestry students, professional foresters, scientists and the public. The evening included a poster displays of 30 graduate student research projects and a reception following the lecture.

If you missed Dr Konijnendijk's talk you can watch the video of his full presentation at http://bit.ly/healthycities.

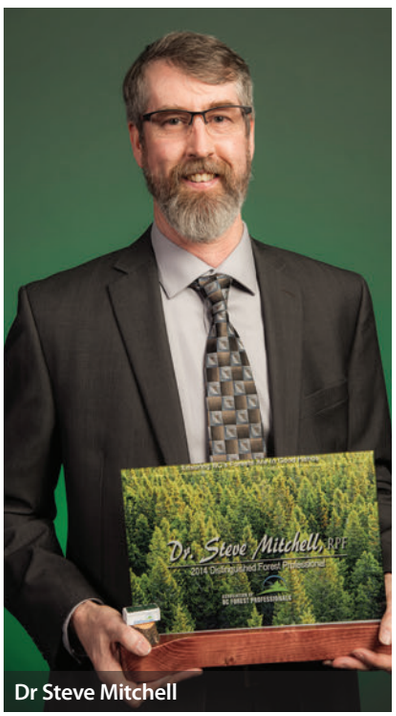
Dr Cecil Konijnendijk

Dr Shawn Mansfield, of UBC's Department of Wood Science, has been named 2014 Forest Biotechnologist of the Year by the Institute of Forest Biosciences. Shawn is the 6th scientist to win this award. His scientific career has focused on understanding the molecular underpinnings of plant cell wall biosynthesis and development. Based, in part, on studies of the molecular biochemistry of tree secondary cell wall metabolism, Shawn generally uses poplar as a model organism to investigate the fundamentals of cell wall development, but with an emphasis on developing solutions to real-world problems.

You can read more about Shawn's award at http://forestbio.org/dr-shawn-mansfield-named-forest-biotechnologist-of-the-year/.

Congratulations Shawn!

Dr Shawn Mansfield



Dr Steve Mitchell

Dr Steve Mitchell, RPF, of UBC's Department of Forest and Conservation Sciences, is this year's recipient of the Association of British Columbia Forest Professional's Distinguished Forest Professional (ABCFP) Award. This award, which is not presented every year, is the ABCFP's top award for a member. It is presented to an individual who has contributed a lifetime of work to the betterment of forestry in BC.

Steve is known around the world for his research into understanding and managing windthrow (wind damage in a forest that can occur naturally and can be made worse by a number of factors such as wet soil, recent fires or human activity). He is the coordinator of the International Union of Forest Research Organization's Wind and Trees section.

Congratulations Steve!

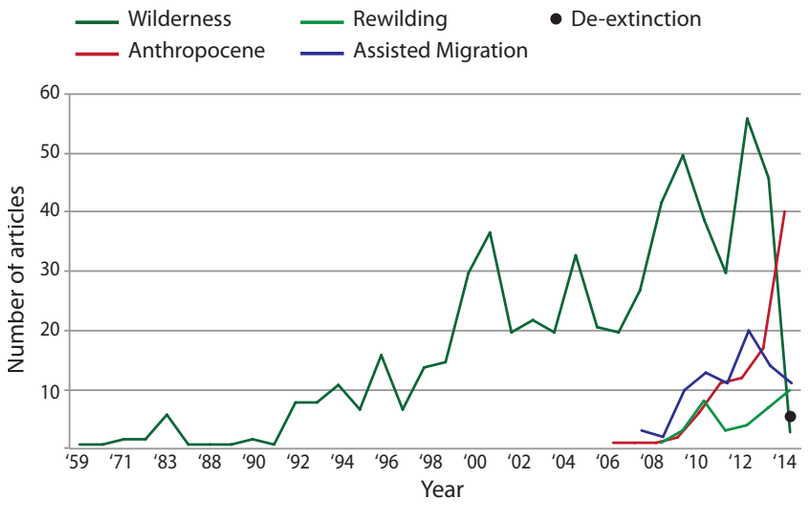
Helmut Gezius, a lecturer in the Department of Sociology at the Anton de Kom University of Suriname, is visiting UBC's Department of Forest Resources Management on a 6-month Canada-CARICOM Faculty Leadership Program Scholarship. Helmut's scholarship is sponsored by the Canadian Bureau for International Education on behalf of the Department of Foreign Affairs, Trade, and Development of Canada. While at UBC, Helmut is continuing his research on the relationships between Indigenous and Traditional Peoples of Suriname and nature conservation and development programs, in collaboration with Dr Janette Bulkan.

A very warm welcome, Helmut!

Conservation in the Anthropocene

From the pages of preeminent scientific journals, to feature articles in national newspapers, to popular non-fiction and TED Talks, to the recent World Economic Forum, we are told at every turn that we are now living in the Anthropocene: that humankind has become an agent of environmental change on planetary scales. The Anthropocene reveals itself in myriad, unsettling ways: the systems upon which humanity's wellbeing depends are being pushed beyond critical thresholds one after another with each passing year; almost every metric of global biodiversity is in precipitous decline, and evidence suggests that the Earth's 6th mass extinction may now be under way. Wildness, even as the tenuous construct that it has always been, does not exist – in the Anthropocene, there is no place on Earth that might be considered "untrammelled by man," so imagined 50 years ago by the authors of the US Wilderness Act.

What role for conservation in this post-wild era? Which objectives should guide management? Which management practices will be effective? Which novel actions and objectives might be considered? Which forms of knowledge should inform these decisions? Which types of governance arrangements should guide decision-making?



Yesterday, Today and Tomorrow: Exploring the shifting terrain of conservation ideas and practice

Yesterday

Responses to these and other questions will ultimately find their roots in value-based ideas about nature and humanity's relationship to it. As history reveals, these ideas have long been in flux. In the mere span of a century, ideas guiding western conservation morphed from a utilitarian philosophy of resource development, to the preservation of presumed pristine wilderness, to biological diversity and related ideas about ecological representation and systematic conservation planning.

Today

The past decades have solidified protected areas as the cornerstone approach to protecting biodiversity. At the same time, at least 3 current trends are worth highlighting. First, the impacts of global climate change are now widely recognized as a major threat to the persistence of species and ecosystems within protected areas.

Term	Definition
Rewilding (Conservation reintroductions)	Intentional reintroduction of species extirpated within historic times and within a species' indigenous range More popularized definitions seek to link potential reintroductions to a vision of permitting ecological processes to resume and allowing nature to "find its own way"
Assisted migration (Assisted colonization, Managed relocation)	Deliberate translocation of imperiled species outside of their current native range in response to expected climate and other threats
Novel ecosystems (Emerging ecosystems, No-analog ecosystems)	Assemblages of species that have not co-occurred historically and that have tendency to self-organize and persist without future human involvement
De-extinction	Reviving species that have been extinct for several decades, centuries, or longer using molecular genetic techniques

Second, the potential for negative impacts of conservation on indigenous and local communities has been established empirically, thus spurring efforts to design governance and benefit sharing arrangements to avoid past inequities and injustices. Third, conservation is no longer the primary purview of state governments. That is, conservation today involves an increasing diversity of non-state actors (eg non-governmental organizations, international science bodies, First Nations, business). This shift has co-occurred with the ascendance of market-based mechanisms to deliver conservation objectives. It is from this vantage point that future trajectories for conservation come into focus.

Tomorrow

Rewilding. Novel ecosystems. Assisted migration. De-extinction. These are just some of the emerging and contentious ideas occupying the attention of conservationists today [Box 1]. Some conservation scientists view these ideas and related proposals as deeply misguided affronts to traditional conservation. They note that the resources and political will for conservation are not only limited, but also tenuous. They worry that unhinging conservation from the guiding light of historical fidelity may predispose the general public to give up on conservation, and provide those in power with an excuse for inaction. Other conservation scientists cite ongoing species declines, the fact of novel ecosystems, the conceptual divide between what is seen as natural and unnatural, and argue for consideration, and scientific inquiry into non-traditional approaches including those oriented towards management targets that depart for historical analogs. These scientists explain that consideration of novel approaches should be considered as additive to protected areas (not at the exclusion of).

Played out between the pages of conservation journals, these debates grow increasingly divisive. Meanwhile, citizen conservation groups like the Torreya Guardians are already experimenting with assisted migration, molecular scientists have already resurrected the recently extinct Pyrenean ibex (albeit for a fleeting few minutes), over 35% percent of the Earth's ecosystems can already be defined as novel, and here in British Columbia, interventions foregoing one species for another are already underway (wolves for caribou; eagles for marmots). Regardless of one's personal or professional views, these examples illustrate the types of dilemmas awaiting the conservation professionals of tomorrow.

These are also the types of dilemmas central to the research agenda of new faculty member Shannon Hagerman (Assistant Professor of Social-Ecological Systems in the Department of Forest Resources Management). Shannon studies these and other policy-relevant topics in conservation and resource management from perspectives in the environmental social sciences and humanities – specifically human behavioral and institutional perspectives including those relating to science/policy interactions. On the topic of controversial conservation approaches, Shannon examines social aspects of risk perception, including the role of value-based logistics on the relative acceptability of proposals such as assisted migration and rewilding. In related conservation governance work, Shannon studies how science and other forms of knowledge are incorporated into policy at key forums for conservation agenda setting (such as within the Convention on Biological Diversity (CBD) and the World Conservation Congress of the International Union for Conservation of Nature). Through an upcoming project focusing on the Aichi Biodiversity Targets, Shannon plans to examine progress towards, and challenges associated with implementing commitments made to multilateral agreements (such as the CBD) across national and sub-national scales. Shannon is keen to bring her expertise on human dimensions of social-ecological systems to bear on interdisciplinary projects aimed at understanding and resolving conservation and resource management dilemmas in their many forms.

Shannon will be discussing emerging challenges for conservation in the Anthropocene at the annual meeting of the Ecological Society of America this summer as an invited speaker on a panel titled: New perspectives for ecology during the Anthropocene: new paradigms, technologies and collaborations." Hope to see some of you there.

Dr Shannon Hagerman is an Assistant Professor in the Department of Forest Resources Management. She can be reached at 604.827.2625 or shannon.hagerman@ubc.ca.

Improving truck transportation of wood chips to a typical BC pulp mill

People have made and used paper since approximately AD 105, but the use of wood to produce pulp for papermaking is a relatively recent innovation, which started in the 1840s. For centuries, paper was made from fibre waste from the textile industry. In the 19th century, the growing demand for paper motivated producers to find new fibre sources; which led to the development of mechanical and chemical approaches for the production of pulp from wood chips that we are still using today.

With a growing global population and the related increase in paper demand, the need for efficient supply chain management in the pulp and paper industry becomes evident. Within the framework of her Master's thesis at UBC, Fattane Nadimi sought to improve the efficiency of truck transportation, by considering 1) the complexity of the problem; 2) fleet sizes; 3) difficulties in finding efficient work schedules for available machinery and drivers; 4) cost of transportation; and 5) limitations in availability of trucks and qualified drivers.

Operational transportation problems are usually represented by mathematical models. Based on the size of the problem and required computing time, different approaches may be applied. Fattane used a solution method called Simulated Annealing – a method used in the fields of mathematics, engineering and computing science to deal with complex and large optimization models. Simulated annealing is a solution method actively used in the fields of mathematics, engineering, computing science, etc. to deal with complex and large optimization models.

In the forest industry, log truck scheduling problems (LTSP), have received significant attention from industry and researchers; but there is not much literature available on wood chip truck transportation. Wood chips required by pulp mills were generally an inexpensive waste product of sawmills and the pulp industry was able to fulfill their demand from local sawmills or by whole log chipping at a relatively low price using procurement methods based on experience and manual planning.

However, fibre sourcing issues for pulp mills have become increasingly critical in recent years. With the market for biofuels growing at a rapid pace, the industry faces new competitors for their raw material. Consequently, the value and demand for wood chips has increased over the past 2 decades. Additionally, the growing international trade of pulp logs limits whole log chipping in domestic pulp mills. As a result, the survival of the pulp and paper industry depends on increasing competitiveness, including wood chip supply, which can be partially accomplished by more efficient transportation planning.

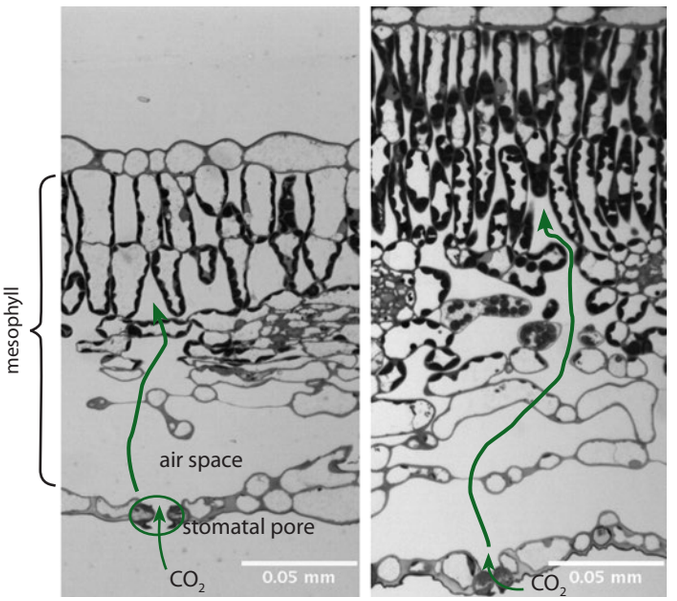
Transporting wood chips to pulp mills is distinct from LTSPs in several ways. Pulp mills have a very high transportation frequency. Wood chip transportation models need to be analyzed weekly in contrast to LTSPs that are studied on a daily basis. The need for a continuous supply of wood chips requires complicated crew scheduling which must account for shift schedules, shift changing times, changeover locations, and rest times. In addition, truck dumpers required at pulp mills have a high capital cost. Considering the production capacity and the transportation volumes; the unloading capacity at many Canadian pulp mills is limited to one truck at a time, which introduces a very strict unloading capacity. Finally, pulp mills usually need to consider transportation priorities for their main suppliers.

The objective of Fattane's research was to model and improve truck transportation of wood chips to a typical BC pulp mill. She looked at a network that transports wood chips from a number of sawmills to a pulp mill with limited truck unloading capacity and developed an optimization model to consider wood chip production at supplier sawmills, its transportation, and unloading at the pulp mill. Fattane adapted a simulated annealing method to solve the model for a case study in BC. Her results show that the truck waiting times could be reduced by 7% and the fleet size could be reduced by one-third.

The simulated annealing model was able to improve the transportation plans and evaluate the effect of changes in the structure of the transportation network. Fattane's findings display the overall benefits that arise from using optimized solutions for wood chip trucking rather than experience based alternatives. Her findings will help to find solutions for some of the province's pressing issues in the pulp and paper sector such as the shortage of experienced drivers, inefficient transportation planning, and the high transportation cost of raw material.

For further information contact Fattane Nadimi at fattane.nadimi@gmail.com.

How form constrains function in balsam poplar



Cross-sections of leaves from 2 different balsam poplar clones, one with thin, loosely packed leaves (left) and the other with thick, densely packed leaves (right). Carbon dioxide moves into the leaf through stomatal pores on the lower leaf surface. From there it travels through intercellular air space towards the various layers of the mesophyll. Most of the chloroplasts (dark, rounded bodies in these figures) are in the cylindrical cells of the palisade layers.

For most plants, and certainly all trees, the carbon dioxide (CO_2) needed for photosynthesis must travel from the atmosphere into leaves, through the mesophyll and into the chloroplasts (see photo). To enter the leaves, CO_2 diffuses through microscopic pores called stomata. These pores open and close in a tightly regulated fashion to control the loss of water from the leaf, while at the same time permitting CO_2 to enter. Consequently, the stomatal conductance (ie, how open or closed the stomata are) is a major limitation on photosynthesis and on plant growth, and so has been a focus of crop and tree production research for many decades. The conductance of the rest of the CO_2 diffusion pathway, through the air spaces, cell walls and cytoplasm, was largely ignored because it was assumed to be non-limiting. Recent work, however, shows that the mesophyll conductance is often just as important as the stomatal conductance. Hence there is now a flurry of activity to better understand this part of the diffusion pathway, and how it varies, in order to breed for rapid growth and improved resource-use efficiencies.

Leaf thickness and anatomical traits such as cell packing, wall thickness and chloroplast distribution are likely to be some of the most important determinants of mesophyll conductance. Unfortunately, like the mesophyll conductance itself, none of these are easy to measure on a routine basis. A much more convenient measure, requiring only a balance and a paper punch, is the leaf mass per unit area (LMA). Variation in LMA could reflect differences in either leaf density and/or leaf thickness. LMA has been associated both positively and negatively with mesophyll conductance in a variety of species. For example, Raju Soolanayakahally, a previous graduate student in UBC's Faculty of Forestry, found that balsam poplars from northern Canada have higher LMA and higher mesophyll conductance (and higher photosynthesis), than balsam poplars from southern Canada. A positive correlation between LMA and mesophyll conductance seems counterintuitive because an increase in leaf thickness should increase the diffusion path length (see photo). On the other hand, a higher tissue density might increase the cell wall area available for absorbing CO_2, thereby improving the conductance. To sort these possibilities out, recent masters graduate Estefania Milla-Moreno, working with Dr Rob Guy in the Department of Forest and Conservation Sciences, investigated the microscopic basis of variation in LMA in 17 balsam poplar clones resulting from a cross between a female tree from northern Quebec and 3 male trees in southern Saskatchewan.

Using light and electron microscopy, Estefania measured leaf thickness, air space volume, cell wall surface area, cell wall thickness and several other traits. Many of these measurements had no relationship to LMA, but both leaf thickness and cell packing did, and with nearly equal effect. Most importantly, both of these dimensional parameters contributed to an increase in cell wall area. Estefania was able to show that leaves with high LMA provide chloroplasts with more cell wall area for the uptake of CO_2 from the intercellular air spaces. This may be what underlies high mesophyll conductance in northern trees, helping to explain their superior photosynthetic rates.

Readers may wonder why northern trees, despite higher photosynthetic rates, do not grow as much as trees from lower latitudes. The answer is simply that they stop growing, each year, well before their southern relatives. Our hope is that crosses produced between geographically disparate parent trees will combine the high photosynthetic rates of the north with the long growing seasons of the south, resulting in productive clones for commercial purposes.

For further information contact Estefania Milla-Moreno at e.milla@forestry.ubc.ca or Dr Rob Guy at rob.guy@ubc.ca.

Using web-based learning and mobile gaming to learn about the forest floor

In an increasingly technology-dependent world, educators are challenged to motivate new generations of students to experience the outdoors as a part of their university education. Mother Nature has long been an exceptional teacher (especially in forest sciences) and is now augmented by online resources and mobile technology to help students understand concepts introduced in the classroom and laboratory. In the changing postsecondary educational environment it is important to develop approaches that do not focus solely on content, but also allow learners to organize and apply that content in problem-solving during real-life situations. Mobile technologies can empower student learning about and within their local natural environments, enhancing their experience of nature and ecological processes. Mobile applications (so-called "apps") allow users to create and play their own games in their own environment via smartphones equipped with a global positioning system and the Internet. This also offers opportunities for active engagement in learning.

Those who work in regions with extensive forest ecosystems (such as British Columbia) need to be able to describe the forest floor, classify humus forms, and understand the processes involved in forest floor development. The forest floor and humus forms are complex, yet relatively few learning resources are available, and those that do exist are static and often require interpretation or guidance from an expert (of which there are few!).

Dr Maja Krzic, a soil scientist jointly appointed between the Faculties of Forestry and Land and Food Systems, has launched a new learning resource for UBC's Introduction to Soil Science course. Working with a multidisciplinary team of soil scientists, educators, videographers, software developers, multimedia experts, and graphic designers, Maja and graduate student Darrell Hoffman developed a new forest floor and humus forms (FF&HF) laboratory module to present information on this complex and nuanced subject. The FF&HF module is supported by 2 innovative educational approaches:

1. web-based learning via the Forest Floor resource (http://forestfloor.soilweb.ca/), which gives students access to streaming videos, animations, descriptions, photos, and tutorials, and
2. mobile gaming via an outdoor self-study "quest", powered by a smartphone app called Questogo.

Incorporation of the web-based learning and mobile gaming into the course addresses the necessity of repetitive visual observations in the description of the forest floor and identification of humus forms. It also encourages students to conduct field assessments that are essential for mastering soil identification and classification skills.

The streaming videos included in the Forest Floor resource feature forest floor expert Dr Margaret Schmidt (Simon Fraser University), who introduces students to organic soil horizons, humus form orders, and how the forest floor influences and is influenced by the local ecosystem. Text descriptions, photos, graphics, and tutorial quizzes support the videos, and encourage

Screen shot from the Questogo app

users to explore the resource. The goal of the Forest Floor resource is to provide all of the necessary instructions to give learners the basic skills to carry out a basic description and classification of a humus form sample.

An outdoor educational "quest", inspired by the popularity of scavenger hunts and geocaching games, accompanies the FF&HF module. It is powered by Questogo, a free smartphone app that was originally designed for self-guided tours, many of which have been created around historic sites and landmarks in Vancouver. An exciting feature of Questogo is that any user can become a creator and develop his or her own quest. Local software company 14Oranges Software Inc developed Questogo and partnered with this project.

The quest is designed for the UBC Farm, featuring forest floor and forest humus forms in 2 different forest types: a Douglas-fir, western hemlock, and western redcedar stand and a red alder stand. The quest was modeled like a scavenger hunt, where a series of questions based on directions and subject matter must be answered in the Questogo app to progress through the quest. The background information to help students answer the questions correctly is provided in the online Forest Floor resource. The quest includes instructional, location-based, and question- and answer-type tasks that test students' knowledge of forest floor and humus forms in an outdoor setting. The learning objectives of the quest are to review previously learned course content, to enhance students' interest in soil science and forest ecology and to view the forest ecosystem in an integrative and interactive manner.

To make the quest more competitive and to encourage participation, students can create teams to participate in the quest. With one smartphone per team, the team registers for a special "event" in the app that is only open for 2 weeks around the FF&HF section of the Introduction to Soil Science course. The team name appears on a scoreboard in the app that can be viewed by all other teams participating in the event. There are hints and clues that teams can use (but it will cost them points)! The team that finishes with the highest score in the shortest amount of time "wins". The scores and answers can be accessed on the app and downloaded by the course instructor, who will review and evaluate the responses and provide a bonus mark to all who completed the quest.

The forest floor is often not described during soil surveys because changes in forest floor properties occur rapidly compared to mineral soil. However, knowledge of forest floor properties is important for management practices as well as assessments of global warming impacts on carbon storage in organic horizons and better understanding of nutrient cycling and soil biodiversity. Recently, it has been proposed that a comprehensive range of forest humus forms are included in the World Reference Base for Soil Resources. In recognition of the potential benefits of forest floor classification and monitoring, it is important to train our students to recognize and describe forest floor and humus forms.

The development of this Forest Humus Forms Quest was funded by the UBC Teaching and Learning Enhancement Fund in 2014, while development of the FF&HF module was funded by the UBC Flexible Learning Initiative in 2013-2015.

For more information, visit http://forestfloor.soilweb.ca/ or contact Darrell Hoffman (darrell.hoffman@alumni.ubc.ca), Julie Wilson (julie .wilson@ubc.ca), or Dr Maja Krzic (maja.krzic@ubc.ca).

Linking surface quality to durability of black spruce

Wood manufacturing is an extremely important part of Canada's forest industry. In 2013, solid wood product manufacturing accounted for almost half of the forest sector's contribution to Canada's gross domestic product. For the past few years, Canada's secondary wood manufacturing sector (windows, furniture, laminated beams, etc) has performed better than the primary sector (pulp and paper, lumber, particle board) and has generated close to 40% of the total forest product value. In response to this, the forest sector's transformative strategy includes expanding into new and traditional markets. Competitiveness can be increased by lowering production costs and improving product quality and durability. In particular, higher product value could be achieved by optimizing conventional and alternative machining processes used in secondary wood manufacturing.

Black spruce (*Picea mariana*) is widespread throughout the Canadian Boreal forest. Traditionally, its wood has been used in lumber or pulp and paper applications. Nowadays, it is increasingly used in glue-laminated structural products in Eastern Canada but could be used more in appearance applications such as furniture, panelling, doors and windows. However, to increase black spruce's utilization we need to know how it behaves (in terms of surface quality and product durability) under different wood machining processes. In appearance applications, surface quality is as critical as product durability and black spruce wood is known to contain numerous knots. Minimizing occurrence of surface defects such as torn grain (fibre tear-out) and raised grain will be key in the promotion of black spruce wood for appearance applications.

Dr Julie Cool is a newly appointed faculty member in the Department of Wood Science at UBC. As a wood machining expert, Julie has been looking at different machining processes and how they affect black spruce wood surface quality and adhesion of glue and coatings. Glues and coatings are used in secondary manufacturing and their performance depends on their chemical composition and the wood species on which they are applied. In the case of black spruce wood, no information is available on its performance with adhesives typically used in appearance products. A 2-component PVA glue and an acrylic water-based coating were selected because they are commercially used in the furniture industry. The objective in using both products was to provide manufacturers with valuable information they could use when introducing black spruce wood in their production. Durability was quantified as adhesion strength following an accelerated aging treatment as well as the loss in adhesion that glue and coating underwent

during aging. Shear strength was used to quantify glueline joints, whereas pull-off strength was used to measure coating adhesion.

Two conventional processes (peripheral planing and sanding) were compared to 2 alternative planing processes: oblique cutting and face milling (across the grain). These particular alternative processes are seldom used in North America although oblique cutting is often used in Japan as it produces very smooth surfaces. According to Julie's experience in wood machining, each of these processes should yield different surface characteristics that affect product quality and durability. Surface quality was assessed visually and microscopically as anatomic characteristics are used to better understand the wood-adhesive interaction and how it evolves during aging.

Torn grain was occasionally observed near knots of oblique-cut surfaces although they were very smooth and had a glossy finish. Microscopically, this was associated with the cutting tool action which takes place in between cells. Few tracheid cells were exposed during planing and the level of micro-fuzziness (partial detachment of tracheid cell wall) was low. Exposed tracheid cells are entry points for the penetration of adhesives within the wood. The fact that oblique-cut surfaces had few tracheid cells exposed reduced adhesive penetration and, consequently, the wood-adhesive interaction was limited. Interestingly, this negatively affected glue performance but effectively promoted coating adhesion. It is likely that the very smooth oblique-cut surfaces that have few exposed tracheid cells favored glue squeeze-out when applying pressure during gluing. A very thin glueline was therefore obtained which made oblique-cut glued wood more vulnerable to degradation during the accelerated aging treatment (highest adhesion loss). However, having a low coating penetration meant that oblique-cut surfaces had a thicker layer of coating protecting them when submitted to the accelerated aging treatment (lowest adhesion loss).

"Dr Julie Cool is a newly appointed faculty member in the Department of Wood Science at UBC. As a wood machining expert, Julie has been looking at different machining processes and how they affect black spruce wood"

No surface defects were observed on face-milled surfaces but they were characterized by the highest surface roughness because the lateral tool cutting action exposed most tracheid cells, induced micro-ruptures and enhanced the level of micro-fuzziness. Since exposed tracheid cells and micro-ruptures are entry points for adhesive penetration, the wood-adhesive interaction was important and adhesive mechanical anchorage should therefore be maximized. Surprisingly, this was not necessarily associated with product durability or high adhesion. Face-milled glued samples had the best performance out of all 4 machining treatments (lowest adhesion loss) but the coated samples had the lowest adhesion after the accelerated aging treatment (highest adhesion loss). Clearly, a certain quantity of exposed tracheid cells and level of micro-fuzziness are desirable to maximize mechanical anchorage and wood-adhesive interaction and reduce glue squeeze-out during gluing in order to strengthen glueline durability. However, a deep coating penetration decreases the thickness of the coating acting as a protective barrier against aging which yielded the poor performance of face-milled samples.

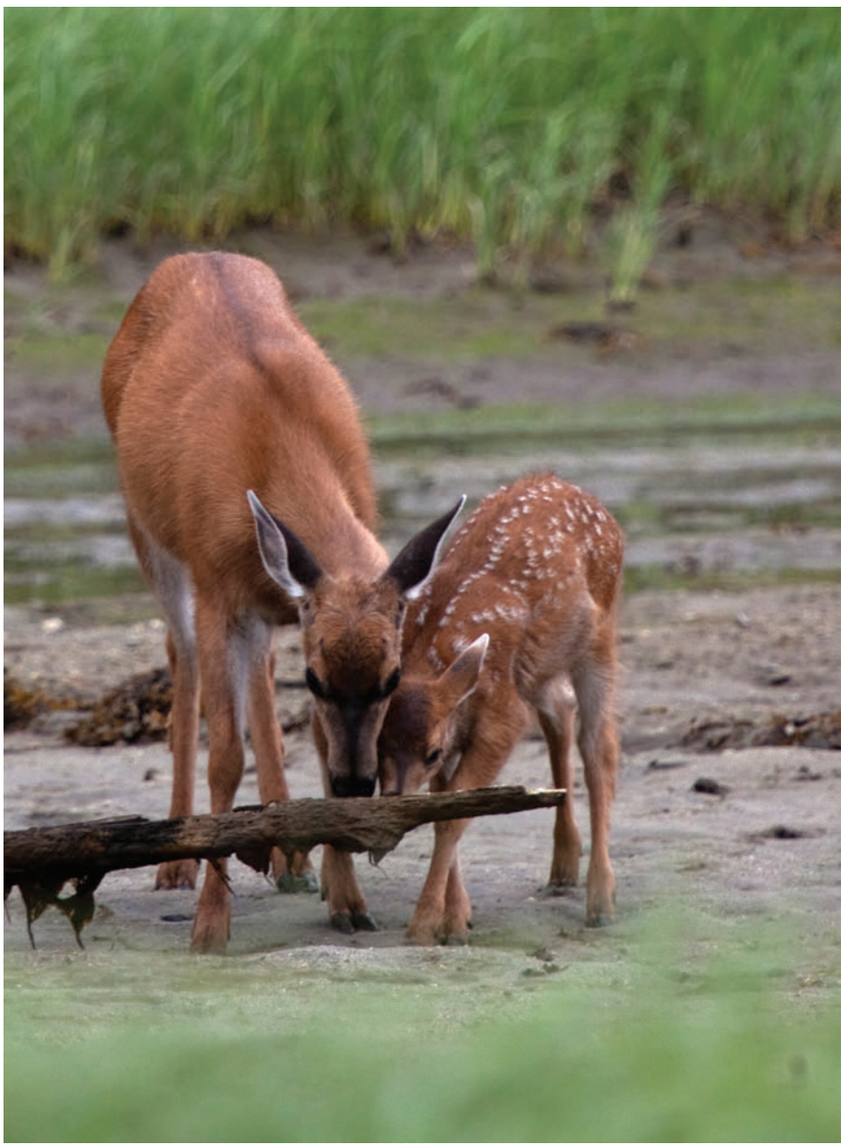
Visually and microscopically, peripheral-planed surfaces were similar to the oblique-cut ones although they did not have a glossy aspect due to more exposed tracheid cells and a higher level of micro-fuzziness. In other words, peripheral-planed surfaces had surface characteristics that were midway between oblique-cut and face-milled surfaces. Interestingly, peripheral planing was also associated with intermediate glue (intermediate adhesion loss) and coating performances (low adhesion loss).

Sanding is a well-known machining process in the secondary wood manufacturing industry and one of the most expensive. As expected, surfaces were visually smooth and uniform and no anatomical features were visible at the microscopic level. The level of micro-fuzziness was light and samples were characterized by cell crushing and micro-ruptures that occurred due to the magnitude of cutting forces. Cell crushing hinders adhesive penetration within the samples so a low wood-adhesive interaction was expected as well as low adhesion. However, the level of micro-fuzziness and the presence of micro-ruptures were sufficient to increase mechanical anchorage which provided the sanded surfaces with intermediate adhesion loss of glueline shear strength but high adhesion loss of coating pull-off strength.

As expected, the 4 machining processes yielded different surface characteristics that affected glue and coating performance. Interestingly, the best glueline performance was obtained from face-milled surfaces, while the best coating adhesion was obtained from oblique-cut surfaces. As surface characteristics of face-milled and oblique-cut were diametrically opposite, this highlights the fact that it is important to know how any wood species behaves in order to better understand expected product quality and durability as well as production costs. However, if a manufacturer wanted to use a single machining process to prepare surfaces for gluing and coating (as in furniture manufacturing), the conventional peripheral planing process would be the best option as it was associated with intermediate glueline adhesion loss and low coating adhesion loss. Future research should consider production costs (tool wear, maintenance, equipment costs, etc) in order to determine if the alternative planing processes would still be the most interesting machining processes to use for black spruce wood in secondary wood manufacturing.

For further information on this project, contact Dr Julie Cool at julie.cool@ubc.ca.

Deer: Beautiful, destructive and driving evolutionary change



For many individuals, seeing deer in the wild provides joy and a sense of connection to nature. However, deer also cause hundreds of millions of dollars in damage to gardeners, farmers and insurance companies and dramatically change forest and prairie ecosystems through trampling, browsing and grazing. In environments where deer numbers increase beyond the environment's capacity to support them (carrying capacity), which can occur in the absence of native predators or human hunting, deer often starve, suffer increased disease and rarely raise offspring to maturity. Given these outcomes, and despite their beauty, deer populations may often require stewardship to maintain ecosystem health and ensure the persistence of diverse communities of all native species.

Cora Skaien, a PhD student working with Dr Peter Arcese (FRBC Chair in Applied Conservation Biology, Department of Forest and Conservation Sciences), is studying how deer impact species in threatened Garry oak and maritime meadow ecosystems in Southwestern British Columbia. This ecosystem has been reduced to 5% of its original extent at the time of European settlement, making its conservation a key goal of local, provincial and federal recovery planners. Habitat loss, fragmentation and degradation are key threats to oak and maritime meadows, arising through the cessation of aboriginal burning (mid-1800s), conversion of meadows to agriculture and housing, the invasion of exotic forbs, grasses and shrubs, and extirpation of native predators. Without predators and with the decline or prohibition of hunting over much of the region, deer populations now reach densities as high as 170 deer / km^2 on some of the Southern Gulf Islands, or nearly 20 times the densities likely to have occurred under First Nations land management. As a consequence, many forest and meadow communities have lost most of their native understory and herbaceous species, which have been replaced by unpalatable native grasses, forbs and shrubs.

On Sidney Island, BC, Cora and Dr Arcese worked with local land owners and the Islands Trust to establish two


Shell Island – no resident deer


Sunshine Coast – evidence of resident deer

750 m^2 exclosures to investigate deer impacts experimentally. The exclosures prevented deer from accessing a degraded maritime meadow habitat dominated by exotic grass and herbaceous species, but also contained many iconic natives at very low densities. After only 3 years of protection, the cover of natives inside the exclosures roughly doubled despite no change outside. And strikingly, the cover of 2 *Brodiaea* species, iconic meadow species promoted by coastal First Nations peoples as a food plant, was 4 times higher inside exclosures than outside and also flowered extensively inside exclosures. Conversely, there was no change in exotic species cover despite widespread belief that exotics will thrive and outcompete natives in these critically endangered shallow-meadows if the top-down control of herbivores is removed. These results offer clear suggestions to managers that reducing deer densities, and thus deer herbivory, prior to attempting exotic species removal is an effective management strategy when endeavoring to restore degraded Garry oak and maritime meadow ecosystems.

Cora and Dr Arcese have also used these exclosures to study the role deer play in the evolution of Garry oak species, focusing on seablush (*Plectritis congesta*), a 'winter annual' that is highly susceptible to herbivory in winter and spring. With its bright green leaves and large pink inflorescences, seablush is a striking plant that welcomes wildflower lovers to Garry oak and maritime meadows each spring, but which differs dramatically in appearance and stature on islands with or without deer. Specifically, on Southern Gulf Islands without deer, seablush can reach 100 cm in height, with branches originating up to 4 cm or higher above the ground, and express `winged` seeds on ~90% of plants. In contrast, on islands with deer, plants tend to be short (~15 cm), with branches low to the ground (< 1 cm) and express wingless seeds (~90% of plants). On many islands with high deer densities, seablush is no longer present despite an historical occurrence. These observations led Cora and Dr Arcese to ask why these differences existed and whether deer were responsible.

To find out, Cora and Dr Arcese surveyed >300 sites from 2005-2014. They observed patterns throughout the Georgia Basin to discover that the observations made in the Southern Gulf Islands remained true; on small islands without deer seablush created beautiful pink and green mosaics of plants reaching up to 1 m tall, and on the mainland or islands with over-abundant deer, seablush was typically absent or represented by tiny plants missed by the average observer. Cora and Dr Arcese then collected seed from plants on each of 12 islands, 6 with and 6 without resident deer, and grew them in and outside the Sidney Island exclosures. This experiment allowed them to compare survival of plants with different morphological characteristics in contrasting environments with respect to deer. They found that plant survival was dramatically reduced in the presence of deer, but also that plants originating from islands without deer suffered a much larger decline in survival (23% survival relative to plants inside exclosures) than plants originating from islands with deer (56% survival relative to plants inside exclosures). Remarkably, plants exposed to deer only survived when less than 10 cm tall, whereas those inside exclosures grew to 80 cm and produced 5-10 times more seeds per plant on average.

To better inform conservation planning for seablush and other species iconic to the Garry oak and maritime meadow ecosystem, it is important to understand that deer are influencing native populations through preventing many native species from flourishing. It is also important to remember that we have created an unnatural environment where deer densities are far greater than they were historically due to predator extirpation and prohibition of deer hunting. Thus, we encourage land owners in southwestern British Columbia to fence remnant Garry oak and maritime meadow patches on their properties to prevent access by deer, plant historically present and culturally significant species (eg Camas, seablush, *Brodiaea*, chocolate lily, etc) within fenced areas, and to avoid increasing deer densities via feeding deer.

The relationship between deer and seablush also provides an excellent novel system in which to study evolutionary change in patchy environments. Deer have acted as a selective pressure to cause evolutionary change in the physical appearance of plants in seablush populations, resulting in smaller and less obvious seablush plants in areas where deer are present. Moving forward, Cora will investigate the heritability and underlying genetic architecture of the plant traits discussed in this article to further elucidate on how deer have acted as a selective pressure to shape plant morphology in seablush, and to address the management question of how to best re-establish seablush populations in habitats with and without deer.

For further information, contact Cora Skaien at cora.skaien@gmail.com or Dr Peter Arcese at peter.arcese@ubc.ca.

Certification, innovation and change management

In today's highly competitive business world, British Columbia's forest sector has been struggling to maintain competitiveness due to a number of economic, environmental and social factors. The collapse of the US housing market since 2008 and continuing weakness in demand for lumber exports, significant reductions in demand for newsprint, altered markets and consumer preferences, changing demographics, and emerging low-cost Asian producers, notably China, have resulted in a significant number of plant and mill closures across BC, company bankruptcies, and the loss of 32,000 jobs – more than one-third of the industry workforce – since 2001.

In recent years, there has been an escalation of interest among the policy makers in Canada in maximizing the value from each unit of fibre harvested ie investing in the value-added wood products sector and enhancing innovation in order to counteract the loss of global competiveness and increase profitability. British Columbia's value-added wood products sector is incredibly well poised to compete in global markets due to numerous competitive advantages such as access to high quality wood fibre, strong supply chain infrastructure and geographic proximity to robust markets including the United States, China and Japan. Yet, the evidence marshalled in previous studies suggests that BC's value-added wood products sector is lagging the value-added wood products sectors of other provinces in Canada, both in terms of its annual sales revenue and employment creation (measured by jobs per 1,000 cubic metres of timber harvested).

The ability to innovate is the "secret sauce" of success for any business. However, innovation in the BC value-added wood products sector remains challenged by factors such as the lack of slack resources (time and money), ineffective public policies towards the value-added wood products sector, a commodity-focussed mentality. Many value-added wood products companies are unable or unwilling to take the risks that are inevitably associated with innovation.

Haris Gilani has recently completed his doctoral research project under the supervision of Dr John Innes in the Department of Forest Resources Management at UBC. Recognizing the increasing importance of the value-added wood products sector in British Columbia, Haris' PhD research centred on the value-added wood products sector where he investigated chain of custody certification (CoC) adoption, the state of innovation, and change management. The project involved surveying the value-added wood products manufacturers in BC to determine their attitudes with regard to current and potential participation in CoC certification and to examine the current state of innovation in the sector. His interdisciplinary research drew upon forestry, business management, marketing and social sciences. Haris looked at CoC certification through the lens of diffusion of innovation theory to identify barriers to CoC certification and subsequently developed a change management framework using the ADKAR (awareness, desire, knowledge, ability and reinforcement) model for change management.

Chain of custody certification adoption

Increasingly, in a market of ecologically conscious consumers, a company needs to be capable of demonstrating sustainable business management acumen. Haris' research suggests that in the BC value-added wood products sector this has come to include concern for the environment. Chain of custody certification provides a powerful tool that has the potential to promote the environmental responsibilities of companies. Being a voluntary scheme, participation in chain of custody certi-

Photo: Structurlam Producets LP

Transit shelter at UBC

Photo: Structurlam Produccts LP

Ice rink in Banff, Alberta

fication depends on the decisions of individual value-added companies. Such decisions are invariably based on the net benefits that companies expect from CoC certification adoption.

Haris' results indicated that 41% of the value-added wood products manufacturers in BC had adopted CoC certification, compared to only 18 % in western Canada (British Columbia and Alberta) in 2004. Another 13% of the companies were interested in becoming certified in the next 5 years and the remaining 46% were not certified and were not interested in certification, citing a range of barriers including lack of customer demand, high costs and a lack of price premiums. The highest adoption level was among the remanufacturing subsector as they tended to consist of relatively large companies and were export oriented. All other subsectors within the value-added wood products industry had shown moderate or low levels of CoC adoption levels.

Certified and interested companies seemed to be ambivalent about the motivations regarding certification. For certified companies, improved corporate image and participation in LEED (Leadership in Energy and Environmental Design) building projects were the 2 biggest motivations for adopting certification. However, for interested companies, the ability to command price premiums was the top motivation.

Innovativeness

To assess value-added wood products industry practices with respect to innovativeness, Haris used an indirect self-evaluation scale that was originally developed by researchers at Oregon State University. This self-evaluation scale measures the propensity to create and (or) adopt new products, processes and business systems. Haris' results indicated that innovation had been very slow in this sector, and largely restricted to business systems innovation, as the results point to the importance of business systems innovation relative to product and process innovation.

Haris' research also showed that the value-added manufacturers were least innovative with respect to taking a leading role in R&D for new products. Despite the presence of world class universities in BC focusing on wood products related research as well as industry-focused research institutions such as FP Innovations, the research capacity appeared to be significantly challenged to address the research and development interests and needs of the value-added wood products sector. As the sector is composed primarily of small and medium sized enterprises, management capacity is routinely focused on their normal business operations, with a lack of organizational slack to devote to short and long term research interests. Hence, individual engagement between them and the research infrastructure is particularly challenging.

Change management

There are a growing number of studies that have measured the adoption level of chain of custody certification within the wood products industry in various jurisdictions and evidence in almost all studies suggested low levels of adoption. However, to date, no study has extended their work into the intricacies of certification adoption in the light of organizational change management.

Using the ADKAR model for change management, Haris developed a change management framework to explain and recommend interventions that the BC value-added wood products industry and related stakeholders could embrace in the process of adoption of CoC certification. The framework was developed based on the most important needs and barriers perceived by the industry and presented in a way that would facilitate awareness, thereby creating a desire to adopt CoC certification, improving knowledge about CoC certification concepts and processes, and developing the ability to implement the CoC certification. If these interventions are achieved, adoption of CoC certification would likely increase. After the successful adoption, change agents need to ensure that the change is reinforced. Change agents including governments, trade associations, research centres, and top management of firms have key roles in effectively promoting the change process by conducting workshops, seminars, trade fairs, and training for potential adopters.

For further information on this project, please contact Haris Gilani at harisgilani@gmail.com or Dr John Innes at john.innes@ubc.ca.

Special thanks to Drs Robert Kozak and Ian de la Roche for their guidance and support of this research.

Modeling forest carbon in Zambia

A red dawn broke over the Luangwa River Valley in Eastern Province, Zambia. Despite the stillness in the air, a loud chorus of hippos could be heard growling and grunting in the river below. The Luangwa River is the southernmost extension of the Rift Valley, and wildlife is abundant in the National Parks, Game Management Areas, and privately managed game reserves. The crew awoke to these sounds and sights ready for another day of forest inventory work in the miombo woodlands of Nyimba District. In these dry tropical forests, measuring trees on a plot is not difficult as tree heights and diameters are not large. The challenges, however, lie in access and possible encounters with wildlife. Improved road networks are sparse and long hikes under a hot sun are often the norm. At the end of the rainy season, sometimes these walks require moving through 3 m tall grass or large patches of stinging nettles. With lions and elephants a key part of this landscape, extra care and preparation are required along with accompaniment from local experts familiar with the communities, terrain, and wildlife behavior.

The crew was collecting data as part of the Nyimba Forest Project (NFP), funded by the US Agency for International Development and implemented by the Center for International Forestry Research-Zambia Office. NFP was tasked with 2 main objectives: to bring together intensive socio-economic, household level surveys with biophysical forestry data from inventories conducted by local community members, and to develop district-level models that inform and enhance forest monitoring efforts from local to national levels. Jamie Halperin, a PhD candidate in the UBC Forest Resources Management biometrics lab studying under Dr Valerie LeMay, is focusing his doctoral research on the latter by modeling forest carbon and canopy cover over space and time to help improve estimation of these key forest resource attributes in a comprehensive way.

Miombo woodlands are the characteristic forest type of the larger Miombo Ecoregion, which covers 9 countries in southern Africa. Rainfall is variable, but generally less than 1,000 mm/year with a distinct dry season lasting 5-6 months. The climate is sub-humid tropical, similar to the US Gulf Coast states. The similarity ends there, however, as the biodiversity and land use change issues surrounding miombo woodlands lead to complex relationships between people, wildlife, and the forest resources. Much of the rural population is heavily reliant on forest products for local livelihoods yet increasing urban migration also places demands on forests. Urban energy demands in Zambia are largely fulfilled with the use of charcoal, produced from harvesting trees in miombo woodlands. Combined with an increasing need for land to fulfill small-scale

agricultural development, change in the forest resource base is happening rapidly. Comprehensive forest monitoring systems are now being developed in order to track these changes.

The history of forest monitoring in Zambia has been challenged by the same field conditions encountered by the Nyimba crew. Logistics, funding, and capacity have all played roles leading to the current situation which gives a rather vague picture on the distribution and rate of change in miombo forest resources, such as forest carbon. Reports from FAO and other international agencies indicate that the rate of deforestation in Zambia ranges from 160,000 to 440,000 ha per year. The general figure used by the Zambian Forest Department is 300,000 ha per year, or about 0.6% of the total forest area. While this is not the highest rate of deforestation in a country worldwide, the change in forest resources is becoming very apparent at local and national levels due to increased demands for both timber and non-timber forest products. Additionally, the deforestation rate does not account for persistent forest degradation which can occur from tree harvesting for charcoal at unsustainable cycles.

Improvements in forest monitoring programs are needed for several reasons. First, for Zambia to engage in international initiatives such as REDD+, or Reducing Emissions from Deforestation and forest Degradation, transparent systems with quantifiable uncertainty need to be developed for Monitoring, Reporting, and Verification (MRV). In REDD+ lingo, MRV relates to forest monitoring systems that can provide timely estimates of forest carbon change, attuned to local conditions. One of the key components of a forest carbon-based benefit program is a robust MRV system. Second, policies and measures for improving land management are largely implemented based on experiences from pilot projects, guidance from key experts, and consultation with civil society. These are all critical aspects of any successful policy framework. However, reliable, comprehensive, and up-to-date data on the resource itself is often lacking. Multi-source inventories which incorporate ground based field measurements with readily available remotely sensed data provide one way in which estimations on the spatial distribution of forest resources, such as forest carbon, can be made at fine scales, and aggregated at any higher level of interest.

Zambia has been intensely engaged in improving its forest monitoring capabilities at both national and provincial levels under a partnership with the United Nations REDD Program. Underway since 2010, the Zambian Forest Department has been implementing a second National Forest Inventory as well as developing remote sensing analysis centers for forest mapping at provincial levels. The former is expected to develop estimates on forest carbon for specific land uses and forest types while the latter will develop maps of specific land uses and forest types. Forest carbon estimates are then applied to the forest and land use categories on the maps. The research that Jamie and others are doing in the Nyimba Forest Project will provide estimates of forest carbon at finer spatial scales using readily available remotely sensed data and open source software. By comparing estimation methods with satellite imagery, such as freely available Landsat 8 from the US Geological Survey, they will be able to advise on the best performing method with the most appropriate satellite imagery, as well as provide predictions of forest carbon for any area of interest, such as a district, chiefdom, or possibly even a village. Because they collected data according to the National Forest Inventory (NFI) protocol and on the NFI systematic grid, the methods can be expanded through the developing NFI and forest monitoring program.

Despite their small stature in comparison to BC's coastal rainforest, miombo forest ecosystems are known to exhibit high heterogeneity, or complex patterns of forest structure at small scales. This is due to the fact that disturbances such as shifting cultivation, small scale timber harvesting, fire, and even elephant grazing can all intermix within a distance of a few kilometers. Relationships between plot level estimates of forest carbon and satellite imagery are often difficult to tease apart. Research results that address these issues will be published later in 2015. However, the methods under development show promise in being able to deliver quantifiable forest carbon estimates and enhance ongoing and future monitoring efforts with repeatable methodologies.

For further information, please contact Jamie Halperin at j.halperin@alumni.ubc.ca or Dr Valerie LeMay at valerie.lemay@ubc.ca.

Wildfire legacies in Jasper National Park

Traditionally, forest fires have been thought of as high-severity disturbances that kill trees and initiate new even-aged forests. Most timber harvesting and silvicultural systems in British Columbia are designed to emulate such high-severity events. However, research conducted in the Tree-Ring Lab at UBC's Faculty of Forestry contributes to growing evidence throughout western Canada that wildfires are much more variable than previously thought. New research shows that historical wildfires in the montane forests of Jasper National Park were variable and complex, but much of that diversity has been lost during the 20th century. This research has recently been completed by Raphaël Chavardès as part of his master's degree, under the supervision of Dr Lori Daniels in the Department of Forest and Conservation Sciences and in collaboration with Parks Canada, Foothills Research Institute and Hinton Wood Products.

Understanding fire regimes is critical as it underpins silvicultural systems, biodiversity conservation and wildfire management. A fire regime describes the size, location, timing, frequency and severity of consecutive forest fires through time. High-severity fire regimes – the infrequent high-severity crown fires that kill many trees are most familiar. In contrast, low-severity fire regimes are characterized by frequent surface fires that kill few trees but leave cambial scars on thick-barked individuals. "Mixed-severity fire regime" is a relatively new term that describes the patterns and legacies of diverse wildfires across space and time. For example, a single wildfire can burn at low, medium or high severity in different parts of the forest leaving complex patterns of living and dead trees. Similarly, a single patch of forest can burn at high, medium and low severity during consecutive fires resulting in multiple age cohorts, fire scars on veteran trees, complex stand structure and diverse species composition. In short, mixed-severity fire regimes include diverse wildfires that drive stand and landscape diversity.

Raphaël used multiple lines of evidence to reconstruct detailed fire histories and forest dynamics through time at 29 montane sites in Jasper. He used a tree-ring analysis method known as "crossdating" in which the narrow and wide patterns in tree rings are matched among trees to ensure an exact calendar year is determined for each ring. He assigned a precise calendar year to 18 fires that burned between 1646 and 1915. Fire-scars were found at 20 of 29 study sites, most commonly on thin-barked lodgepole pine. Up to 5 fire-scars embedded in thick-barked Douglas-fir provided evidence of recurring surface fires that burned every 30 to 60 years, on average. High-resolution tree ages from increment cores revealed 460-year old spruce trees, other veteran trees that survived multiple fires over their lifespan, and many cohorts of trees that established after widespread fires in 1827, 1889 and

1905. Combined, fire-scars, veteran trees and post-fire cohorts of trees were legacies of past fires of mixed severity at 18 of 29 sites. At the other 11 sites, single even-aged tree cohorts were evidence of high-severity fires in the 1800s and early 1900s.

> **"Wildfires are needed in these forests to increase their diversity and make them more resilient to ongoing environmental change, including climate change."**

Thus, Raphaël was able to provide strong evidence of mixed-severity fires over the past 350 years in Jasper.

Raphaël's research revealed nuanced relationships between fire and forest dynamics. The traditional model of succession in which lodgepole pine establishes first after fire and is later replaced by shade-tolerant spruce oversimplifies forest dynamics in Jasper and could mislead interpretations of disturbance history. Instead, detailed reconstructions showed that lodgepole pine, hybrid spruce and Douglas-fir simultaneously established after low- to high-severity fires so that forest canopies are mixed in composition. In contrast, subcanopies are strongly dominated by shade-tolerant spruce, regardless of fire history. Tree-ring analysis revealed the subcanopy spruce were similar in age to their neighbouring canopy trees. Small subcanopy trees do not represent recent recruitment of trees. Instead, species-specific growth rates and adaptations to shade resulted in size stratification among species and canopy layers. Raphaël concluded that assessments of fire history based on canopy tree composition and tree sizes without high-quality age data could be misleading.

In a second landscape-level component, Raphaël cross-dated fire-scars and tree ages sampled at 172 sites to show that the fire regime of Jasper has changed dramatically during the 20th century. Over the past 350 years, 18 fires left fire scars and fire frequency was greatest from the 1880s to 1915, consistent with well-documented human use of fire by First Nations, European settlers and people of dual ancestries. In stark contrast, Raphaël found no fire-scars after 1915. The simultaneous, long fire-free intervals at all 172 sites during the 20th century are unprecedented in his multi-century fire-scar record.

The lack of fire during the 20th century has been explained by some researchers as a result of a warm but wet climate after the Little Ice Age, making climate unsuitable for forest fires. Alternatively, fire suppression by human impacts would explain the observed shift in the fire regime. Using tree ring-widths as a proxy record for past droughts, Raphaël was able to show that the 18 fires between 1646 and 1915 burned during significant droughts. Since 1915, there were several years and decades when climate was conducive to forest fires. Nevertheless, a lack of fire scars was found during these droughts, even though there were young thin-barked trees at all study sites that could have recorded fire had a fire burned. The documentary fire records for Jasper also indicate few or no fires. After the Park was created in 1907, local families were displaced, removing fire as a land and resource management tool. As of 1913, fire protection and suppression were implemented and have become increasingly effective with modern technology. Raphaël concluded that human impacts exceeded the effects of climate variation, and the change to the fire regime was primarily due to fire exclusion and modern suppression.

In the absence of fires of a range of severities during the 20th century, forest stands have developed similarly and landscape diversity in the montane forests of Jasper National Park has decreased. Today's landscape is dominated by relatively uniform, closed-canopy forests that have not burned for many decades. Wildfires are needed in these forests to increase their diversity and make them more resilient to ongoing environmental change, including climate change. Raphaël's research provides strong support for modern fire policies such as allowing managed wildfires and the use of forest thinning and prescribed burning to restore ecosystems and mitigate fuel hazards in Jasper National Park.

For further information contact Raphaël Chavardès at raphael3@alumni.ubc.ca or Dr Lori Daniels at lori.daniels@ubc.ca.

Surface fires recorded as scars in the rings of thin-barked lodgepole pine. This tree from Jasper National Park recorded 3 surface fires in 1878, 1889 and 1905

development & alumninews

Donor award has lasting impact

A decades-old decision to support Forestry students continues to make a difference today. In 1989 Ralph Cochran and his wife Elizabeth endowed a scholarship for graduate students, and today Shaghayegh Akhatari is using those funds to pursue her research in wood science.

Shaghayegh's work focuses on how to use sawmill and logging residues to generate energy in a way that maximizes social benefits and minimizes the environmental footprint. "Following my Masters in Industrial Engineering, I discovered the Industrial Engineering Research Group at UBC, and learned that my major could be important to the forest industry," she says. "I'm in the second year of my PhD, working with Dr Taraneh Sowlati."

"This scholarship has lightened my financial burden and allowed me to focus on learning. More importantly it has been an emotional boost and encouragement for me to work harder," she says. "I hope that one day I will be able to help a student get closer to their goals as this family has helped me."

Now age 95, Ralph Cochran struck out on his own at 16, armed with only a grade 8 education. "My family situation wasn't the best, and I needed to make my own way," he says. Ralph lied about his age in order to get work, but even so found it hard going during the Depression.

"I was originally going to become a blacksmith," he says, "but I got laid off because there were married men out of work and the boss thought they needed the job more than I did." Forest industry hiring halls were hard to get into, but eventually Ralph got a job at a logging camp.

Another obstacle appeared when Ralph decided to become a log scaler. After a year of independent self-study, he was denied the opportunity to take the exam because scaling jobs were being held for returning World War II veterans.

"So I went to night school to study grading," he says. The Pacific Lumber Inspection Bureau (PLIB) offered him a job on Vancouver Island, but with a young family he couldn't move immediately. "The head of the PLIB decided I wasn't good inspector material, and I didn't get a job there until 8 years later."

Ralph's career as a lumber inspector began in 1954 and lasted until his retirement in 1984. PLIB inspectors certified lumber for export, and also certified the wood that went into BC schools, dams that used lumber, and cribs lining public utility trenches.

"We worked on site at every mill, and each job could last from a few months to a couple of years," he says. "Some jobs were in the Lower Mainland and easy to get to, but others were very remote and you wouldn't have contact with your family for months at a time."

Job security was hard to come by in those days. "People could be fired for the smallest things, like being late for a shift due to circumstances beyond your control," he says. Ralph became active in the Lumber Inspectors Union, and advocated for inspectors who were threatened with dismissal.

Ralph is satisfied with his decision to endow a scholarship for Forestry students. "We did a lot of research, and considered several alternatives before choosing UBC," he says. "Forestry is a great career for anyone."

You can make a difference in the lives of Forestry students now and decades into the future. For more information on establishing an award, please contact Emma Tully, phone 604.822.8716 or email emma.tully@ubc.ca.

Alumni in action –
Hanmin Dong, MF 1986

One of the common questions raised by alumni is "What happened to my classmates after graduation"? Our students wonder "What can I do with my degree?" To answer both of these questions, this section features stories from our alumni, highlighting the various career paths our graduates have followed.

"Love what you do" – these words are Hanmin Dong's advice for UBC Forestry students and alumni. With three degrees and a career focused on forestry, Hanmin has followed this advice. He believes that forestry isn't necessarily a career you follow for money, so it is important that you have a passion for it.

Hanmin grew up in the countryside in China and wanted to see the world, something he knew little about as the world was China to him. He found that forests in novels amazed him. He decided to go to university and when he did his national entrance exam and entered 3 options for majors, he chose Forestry, Geology and Petroleum as he thought he could see what the "world" looked like. He was lucky to be permitted to be the first class to go to university after the Cultural Revolution in 1977.

Hanmin graduated from the Huazhong Agricultural University in Wuhan China with a Bachelor of Agriculture in Forestry. Through competition, he had the opportunity to study abroad and UBC was his top choice. He started in October 1983 and received his Master of Forestry in 1986.

Coming to UBC and Canada, there were many cultural shocks, a few of which Hanmin still remembers. The first was while taking a class on soils he was faced with writing his first project paper, something he had never done before. In China classes only had exams, so this was completely new to him.

The second shock was when he was out one night to visit a scholar, the bicycle he enjoyed riding was stolen outside of the scholar's hotel and the hotel called the police. According to Hanmin, dealing the police in Canada was very different and he was surprised when the police arrived with his bike 5 minutes later.

After graduating from UBC, Hanmin attended Texas A&M University where he completed a PhD in quantitative genetics in 1990. He started his first job in the same year at International Paper in Bainbridge, Georgia as the Project Leader, Forest Productivity and Research. There he developed and implemented accelerated breeding programs for the improvement of loblolly pine, slash pine, sycamore and sweet gum.

Hanmin stayed with International Paper until 2001. He moved to Chicago, Illinois with the company as their Project Manager of Wood Fiber for the Masonite Building Materials Division. From there he moved into the role of General Manager, Shanghai International Paper Trading Co, Ltd and Chief Representative, International Paper Asia Co Ltd, establishing a distribution system, a first for the company in China.

In 2001 his division was sold, and Hanmin became the Director of International Sales for CraftMaster Manufacturing Inc in Chicago. In 2004 he was hired back by International Paper and relocated to Memphis, Tennessee as the Manager, Global Forestry – Asia Pacific. In 2008 International Paper sold its timberland and most of the foresters went along with the forestland to Resource Management Service, where Hanmin currently is the Director of China Investments in Birmingham, Alabama, as well as the President of Guangxi Lee & Man Forestry Technology Limited in Wuzhou, China. While he has a home office in McLean, VA, he spends most of his time in China.

Besides his company work, there are 3 contributions to Chinese forestry community that Hanmin is most proud of looking back at his career. The first was in 1996 when he worked closely with the Zhejiang and Fujian Provincial Department of Forestry to have introduced 28 families of loblolly pine from a natural distribution area in southern US. The 2 provinces benefited greatly from these seed source studies to date.

His second contribution was when he helped China Eucalyptus Research Center conceptualize and initiate the China Eucalyptus Breeding Alliance, the first forestry industrial cooperative in China. The third was his work to have founded China Forest Growers Association, a grass-root NGO prepared to register with the purpose of meeting the urgent need of China's forest industry and providing a communications platform.

When asked what career he would have chosen if he hadn't been a forester, Hanmin admits that he's never thought of anything else. He loves what he does.

Brendan Guy
BSc (Natural Resources Conservation) 2010

From field school to the United Nations

I dash down to the United Nations to participate in the latest talks on the future of planet stewardship, grab a quick lunch with the Ambassador from Seychelles who is seeking innovative policy advice, and then head to a meeting with mayors from across the world who are teaming up to take action on climate change. During my formative years in the Natural Resources Conservation (NRC) program at UBC's Faculty of Forestry, I never thought my career trajectory would take me from the temperate rain forest of the West Coast to the bustling urban jungle of New York. Now instead of lacing up my caulks and running transects, I shine up my shoes and advise leaders on international climate change policy.

Global climate change is potentially the greatest risk to the resilience of our ecosystems, and threatens to undo many of the tremendous gains we have made in conservation and management over the past decades. Countries around the world are negotiating a new global climate change agreement due to be agreed in Paris at the end of this year and implemented from 2020. At the same time, however, there is growing attention to the initiatives by cities, regions, companies, and civil society groups around the world that are already acting to mitigate climate change and adapt to its effects. My work with the Natural Resources Defense Council (NRDC) seeks to build linkages among these diverse spheres to catalyze greater collective action and hope for the future.

Words that I read in my final year at UBC are now ringing true in my life, as the late Nobel laureate in economics Elinor Ostrom emphasized, "global solutions, negotiated at a global level—if not backed up by a variety of efforts at national, regional, and local levels—are not guaranteed to work effectively." To the contrary, they are virtually doomed to fail. The mantra of "thinking globally and acting locally" that I adopted during my undergraduate years has been brought to a new level in my current undertakings.

I came to my position at NRDC by way of graduate studies at the Yale School of Forestry & Environmental Studies. I never would have dreamed of attending the school if it hadn't been for Dr Sally Aitken. During an informal conversation with her following a graduate school advising session, she suggested that I look into Yale's offerings as it fit the professional program I was seeking. The policy-oriented Masters in Environmental Management program perfectly complemented the rigorous multi-disciplinary foundation the NRC program had helped me to forge. However, I hadn't exactly come to the NRC program in a bee-line.

I initially enrolled in the Faculty of Arts at UBC, as I was eager to explore the full diversity of the university's offerings and find a field that resonated with my passions. I happened to take the Introduction to Conservation course with Dr Peter Arcese and was immediately enthralled with the integration and application of the diverse disciplines of biology, sociology, anthropology, and political science that I had studied in silos through other classes. I soon learned that ironically the courses I had self-elected to explore were precisely the first year program requirements for the NRC degree. I knew that I had found my calling.

The Faculty of Forestry, and the NRC program in particular, truly nurture students' abilities to make real impacts in peoples' lives and in the world. The scientific discipline and cross-disciplinary skills the program cultivates are indispensable in my day-to-day job of translating the latest climate science into policy options and recommendations for leaders of all stripes. Some of my fondest memories from the NRC program were tromping around the alpine, grasslands, and aquatic ecosystems with world-renowned professors and world-class classmates. I am deeply grateful for the privilege to be part of the Faculty of Forestry's global community, united across diverse urban and rural ecosystems the world over.

Brendan Guy is a Global Fellow with the Natural Resources Defense Council in New York. He can be reached at bguy@nrdc.org.

MSFM graduates –

Where are they now?

Completing riparian habitat assessments on the North Coast of BC

Graduates of the first class of the professional course-based Masters of Sustainable Forest Management (MSFM) degree have indeed launched their careers…

Leah Ballin, MSFM 2013, RPBio, RPF *Wildlife Biologist with Ecofish Research Limited in Courtenay BC.*

Just 4 days after completing the MSFM program, Leah was hard at work in the field. She had 3 job offers and chose to move to Vancouver Island to work for Ecofish Research Limited – experts in environmental impact assessment, mitigation, compensation, and monitoring. Ecofish provides field and analytical services to government and industry on fisheries, aquatic, wildlife, terrestrial, and marine ecology issues. Leah's background in wildlife ecology and knowledge of forest management and ecosystem function gained from the MSFM program has enabled her to take on a wide diversity of projects. Some recent projects include a long-term monitoring study on riparian vegetation response to changing water levels in reservoirs and riparian area restoration prescription work. Leah enjoys the flexibility to pursue her interests and has gained an inside understanding about how the environmental assessment and mitigation components of projects are planned.

Ye Huang, MSFM 2013, RPF (BC and Alberta) *Woodlands Information Management Analyst with Canfor at Grande Prairie, Alberta.*

Just before graduating from the MSFM program, Ye was offered an entry-level field job with a small forestry consulting firm in the northern BC community of Chetwynd. He was on a steep learning curve doing silviculture field work through the summer. His employer extended his contract into the winter months and Ye applied his GIS skills in mapping and data management. Ye went on to work as a silviculture crew leader for Canfor in Alberta, and from there moved to his current job as a GIS analyst and permitting forester. He treasures the time he spent in the field in the beginning and believes it gave him a solid foundation for his current work. Ye's advice to prospective and current students is "take that entry level field job, it will serve you well!". His hard work and tenacity is paying off and he is looking forward to a long and rewarding career with Canfor.

Dan Macmaster, MSFM 2013, RPF *Fibre Supply Manager* & **Emily Beavan, MSFM 2014, FIT,** *Assistant Forester both with Vaagen Fibre Canada.*

As part of the MSFM program requirements students work with a real client on a real forest management plan project in their second term. Vaagen Fibre Canada in Midway, BC was one of the clients for the first class of the MSFM program in 2013. Vaagen Fibre is a family-owned company with operations in southern BC and north-central Washington State. Dan Macmaster, one of the students who worked on the Vaagen Fibre project, made such a good impression that they hired him right after graduation. The job was described as a forester and log buyer, with a dash of operations supervision. As the company got busier they decided to hire another forester and looked to the MSFM program once again. They hired Emily Beavan after her graduation in 2014. Dan manages the fibre supply to the mill, while Emily focuses on forest management. Together they source wood from BC Timber Sales, local woodlots, private land, and Community Forests. They also trade with other mills, and are continually developing strong relationships with First Nations licence holders. Dan also manages the West Boundary Community Forest and the 23,000m^3 AAC that has recently been approved by the Ministry.

Graduates, current students and prospective students stay connected through social media on Facebook @ UBC Master of Sustainable Forest Management.

For more information on the Master of Sustainable Forest Management Program please contact Deb DeLong at deborah.delong@ubc.ca.

Forestry alumni at the ABCFP Conference & AGM

UBC Forestry alumni attending the ABCFP Conference and those living in the Nanaimo area gathered on the evening of February 19th at a UBC Forestry Alumni Social. Attendees were lively, catching up and making new friends. Associate Dean, Undergraduate Studies, Peter Marshall spoke and recognized the number and range of alumni attending the event, including one alumnus from the class of 1948 and one current student. Thank you to everyone who joined us, we hope to see you next year.

Mark your calendars for the following events

- **Alumni Social in Prince George** in partnership with the COFI Convention – Tuesday, April 7th, 2015
- **Loon Lake Alumni and Friends BBQ & Tour** at the Malcolm Knapp Research Forest, Maple Ridge – Thursday, April 23rd, 2015
- **Class of 1985 Reunion**

Remember when Wham! was Billboard's number one song of the year, the wreck of the RMS Titanic was located and Rick Hansen launched his Man in Motion world tour? That same year the class of 1985 graduated from UBC's Faculty of Forestry. To celebrate your 30th reunion, join your classmates on Friday, May 29th for a social at the Forest Sciences Centre and on Saturday, May 30th for dinner and dancing at Koerner's Pub.

- **Alex Fraser Research Forest Alumni and Friends BBQ & Tour**, Williams Lake – Tuesday, September 1st, 2015

For more details on any of these events, contact Janna Kellett at janna.kellett@ubc.ca or 604.827.3082.

Electronic versus paper?

BranchLines is currently mailed to over 4,000 forestry alumni, interested groups and individuals. We also upload an electronic version of each issue to our Faculty website **www.forestry.ubc.ca/branchlines/**.

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forestry
university of british columbia
www.forestry.ubc.ca

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Faculty of Forestry
University of British Columbia
Forest Sciences Centre
2005 – 2424 Main Mall
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