branchlines

Volume 26#2 Summer 2015

Inside:

forestry
university of british columbia

dean'smessage

For many people, one of the key memories of a visit to western Canada is our magnificent forests. The impression that emerges is one of stability and longevity, but this is a false impression, and western forests are much more dynamic than many people realize. Many forms of disturbance are present; the frequencies of these different types of disturbance varies, as does their severity, and a range of different factors, including climate change, invasive species and anthropogenic modifications is resulting in changes to the magnitude-frequency relations of the disturbances.

In Vancouver, we have just experienced one of the driest Mays on record, and June will also be extremely dry. This follows on from a winter where the snow levels on the coast were unusually low. The forecasts for the rest of the summer predict drier and warmer conditions than usual, and the current El Niño event in the eastern Pacific is expected to intensify. These all point to the possibility of major disturbances to our forests this summer. The most dramatic of these will likely be wildfires, and already considerable efforts have gone into suppressing wildfires in the province, including fires at both of our Research Forests. The forests are drying out, making them not only susceptible to fire, but triggering the direct effects of drought. Stressed trees and warmer temperatures may encourage outbreaks of bark beetles and other damage-inducing agents.

It does not take long for the public to forget past disturbances and become complacent. How many people realize that the North Shore mountains had devastating fires in the early 20th century? The current structure of the Malcolm Knapp Research Forest is the direct result of large-scale wildfires in 1868 and 1931. Such fires are normally associated with the interior forests of British Columbia, yet history shows that even some of the wettest coastal rainforests have burnt in the past.

In this issue of Branchlines, several articles focus on the issue of disturbance, and we also feature a story about one of our generous donors and alumni, Bruce Blackwell, whose career has centred on wildfire. Shyam Paudel describes some of the management actions that we believe are necessary in the forests of southwest Yukon, where the impacts of climate change are very evident, including increased fire activity and a massive outbreak (now mainly over) of the spruce bark beetle. The importance of maintaining a diverse forest with frequent group or selective harvesting to maintain an uneven-aged mosaic forest structure is emphasized – a very different type of forest to the old-growth described at the beginning of this editorial.

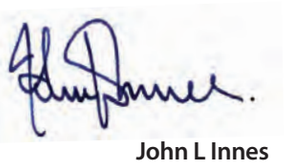
Bianca Eskelson describes how large-scale forest survey data can be used to estimate the magnitude of disturbance effects. This work is very important, as the statistical analysis of extreme events is difficult because of their low frequency. The work was developed for the western USA, but could be applied to analyses of the forests of British Columbia.

Recovery from large-scale disturbances takes time, and the services that we expect from our forests also take time to recover following a major disturbance. Ira Sutherland has been looking at this in the coastal rainforests of the west coast of Vancouver Island. Some services, such as timber production, recover relatively quickly, but it obviously takes a lot longer for redcedar trees to attain the size necessary to provide a canoe or even a house pole.

It is not only the incidence and severity of wildfire that is changing – Wesley Brookes' work is showing that changes are also evident in the extent, duration and frequency of insect outbreaks. These interact with other forms of disturbance, but the compounding effects of such interactions remain poorly understood.

Some disturbances may not affect an entire forest directly, but rather just one species. Most forest ecologists would however stress that significant effects to a single component of a forest ecosystem will have impacts throughout the forest ecosystem. This is likely the case with the loss of large numbers of arbutus trees from coastal forests in British Columbia. Anyone visiting places such as Lighthouse Park in West Vancouver can't have failed to notice the poor health of arbutus trees there, a problem that is apparent in much of the range of arbutus in British Columbia. The cause is a fungus known as *Neofusicoccum arbuti*, and its current prevalence is associated with ecosystem disturbances, including drought and human disturbances. Rob Roy McGregor has found that there are a number of different secondary hosts to this fungus, making its control extremely difficult, if not impossible.

Understanding the nature and causes of forest disturbance is clearly of great importance and the UBC Forestry is making significant contributions in this area.



John L Innes
Professor and Dean

forestrynews

New appointments

Vincent Leung has been appointed as an instructor in the Department of Wood Science. Vincent graduated from the UBC Wood Products Program in 2007 and was facilities manager at the Centre for Advanced Wood Processing (CAWP) before moving into his new teaching role in March. In addition to teaching in the undergraduate Wood Products Processing Program, Vincent will participate in CAWP's industry extension work. He can be reached at vincent.leung@ubc.ca.

Jörn Dettmer has joined the Department of Wood Science / Centre for Advanced Wood Processing as the new technical operations manager (CAWP). Jörn has also been appointed as a part-time lecturer in the Department of Wood Science and will be responsible for teaching courses at partner universities in China. Jörn completed a Diplom-Ingenieur in wood science at the University of Applied Sciences in Eberswalde, Germany, and a master's degree in wood science at UBC. Most recently, he was a project coordinator at Unison Windows and Doors. Jörn can be reached at jorn.dettmer@ubc.ca.

Sanya Sivic has joined the Department of Wood Science as the new Co-operative Education Coordinator and Recruitment Officer for the Wood Products Processing Program. Sanya holds a Bachelor of Business Administration in Human Resources and a joint major in Psychology from Simon Fraser University. She has previous experience working with several different co-op programs at SFU. Sanya (who replaces Sudeh Jahan in this role) can be reached at sanya.sivic@ubc.ca.

Announcements

Dr Cindy Prescott will be stepping down this June, after 12 years of excellent service as Associate Dean for Graduate Studies and Research. Cindy has done a wonderful job, stabilizing and enhancing our graduate programs, and steering in the new professional graduate programs. Cindy will be returning to her teaching and research position in the Department of Forest and Conservation Sciences.

Dr Yousry El-Kassaby will take on the role of Associate Dean for Graduate Studies, effective July 1, 2015.

Dr Nicholas Coops will assume the role of Associate Dean for Research and Innovation, also effective July 1.

Dr Gary Bull will take on Yousry's former role as head of the Department of Forest Resources Management on a *pro tem* basis, effective July 1.

Dr Sarah Gergel has been appointed as Assistant Dean for Equity and Inclusion, effective July 1.

Dr Scott Renneckar, a recently appointed member of the Wood Science Department (see BranchLines 25#3), has been officially named as the Tier II Canada Research Chair in Advanced Renewable Materials. Scott studies wood chemistry and how trees can be used as a sustainable material to replace products made from petroleum.

Summer programs in the Faculty of Forestry

This summer (July and August) we will once again be offering courses through UBC's Vancouver Summer Program. This is the 3rd year that we have been involved in this academic and cultural exchange whereby students take courses during the day and participate in a multitude of cultural and social activities in and around Vancouver in the evenings and on weekends. To date, our participants have mainly been 1st and 2nd year university students from China and Taiwan.

Enrolment in the Forestry program has grown steadily each year. This summer we have 83 students joining our program – up by over 40% from last year's numbers and by over 300% from 2013's initial cohort. One reason for this rapid growth is the increase in diversity of courses that we are now offering. In 2013 and 2014 we offered 1 program with 2 courses. This summer we are offering 3 different packages:

- Forest Management and the Effects of Carbon (27 students)
- Forest Products, Trade and Business Management (22 students)
- Urban Forestry (35 students)

It is great to see this program garnering more interest each year and we look forward to promoting our summer courses further and welcoming students from many other countries in the coming years.

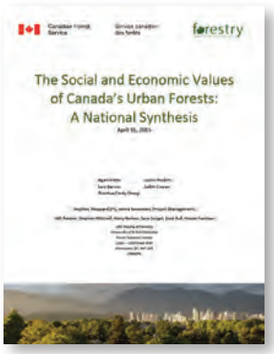
You're invited!

The Faculty of Forestry Co-op Program invites you to join us for our Co-op Presentation Night. Our senior and intermediate co-op students in the Forestry, Conservation, Forest Sciences and Wood Products Processing programs will deliver presentations on their recent co-op work terms. Also, work-term posters from junior co-op student will be on display. This is a great networking opportunity to meet our students, industry guests, and faculty members.

Wednesday, September 30, 6:00-9:00 PM – UBC Forest Sciences Centre – Room 1005

Please RSVP at www.forestry.ubc.ca/RSVP.

Valuing Canada's urban forests



This past spring, the Canadian Forest Service commissioned 4 UBC Forestry student researchers (Lorien Nesbitt, Ngaio Hotte, Sara Barron and Judith Cowan), under the direction of Dr Stephen Sheppard, to prepare a report synthesizing the burgeoning body of Canadian and international urban forest research. The primary goal of the investigation was to assess the value of Canada's urban forest resource to Canadian society and the economy, and highlight areas for future research. The report examined a range of urban forest assessment tools and reviewed the value of urban forest benefits in the areas of human health and well-being, ecosystem services, and economic prosperity. This research built on recent Canadian studies and projects that have reported on key ecosystem services provided by urban forests, using metrics to assign monetary and other values to support a business case for investment in urban forest management.

The report identified a wide range of urban forest benefits that are important to Canadian society and the economy. From energy savings, reduced air pollution, and climate change adaptation, to better mental health, improved pregnancy outcomes, and increased community economic development, urban forests provide key benefits to Canadian cities.

As the practice of urban forestry develops, there is still much work to be done in helping to shape the future of Canada's urban forests and maximizing their benefits. Balancing the costs of managing urban forests with the benefits they generate is essential in order for decision makers to sustain liveable urban spaces and quality of life for Canadians. The full report can be found at http://bit.ly/ufreport.

Proactive management to reduce forest disturbance impacts in the Yukon

The climate in Canada's north has become warmer and wetter over the past 50 years. Evidence suggests that the warmer winters and drier summers have contributed to severe infestations of spruce bark beetle (*Dendroctonus rufipennis*) affecting approximately 340,000 hectares of white spruce (*Picea glauca*) forests in southwest Yukon. The warming climate has also changed the characteristics of the region's fire regimes (frequency, intensity, and area burned). Researchers predict that the frequency of fires and extent of the area burned could double by the year 2080. In response to this, the government of Yukon (in collaboration with Champagne and Aishihik First Nations) prepared a Strategic Forest Management Plan (SFMP) in 2004 to address spruce bark beetle problems and to achieve sustainable forest management in the long term.

Shyam Paudel completed his doctoral research at UBC under the supervision of Dr John Innes. Shyam's research was intended to support the objectives of the SFMP, specifically to assess the variation in pattern, composition and structure of the ecosystem as a key indicator of the Plan. Shyam studied the impact of climate variability, disturbances, and environmental factors on stand structure, forest regeneration and vegetation diversity within the Champagne and Aishihik Traditional Territory (CATT). The research was conducted in close collaboration with the Ministry of Energy, Mines and Resources of the Yukon Government and the Champagne and Aishihik First Nations Government. It was anticipated that Shyam's findings would be useful for developing forest management tools to sustain and secure the forests in the region in the context of predicted climate change, forest disturbances and associated future uncertainties.

Shyam collected ecological data from 90 sample plots located along 8 topographic transects within the forested landscape of the CATT using stratified systematic sampling techniques. The forest landscape was stratified in 5-disturbance types: recent fire (< 20 years old); old fire (> 60 years old); spruce bark beetle affected; salvage harvested and unaffected (control). The ClimateBC model was used to estimate climate variables for the study area. Various statistical methods such as Maximum Likelihood regression, Canonical Correspondence Analysis, Multiple Co-Inertia Analysis and several biodiversity indices were used in the data analysis.

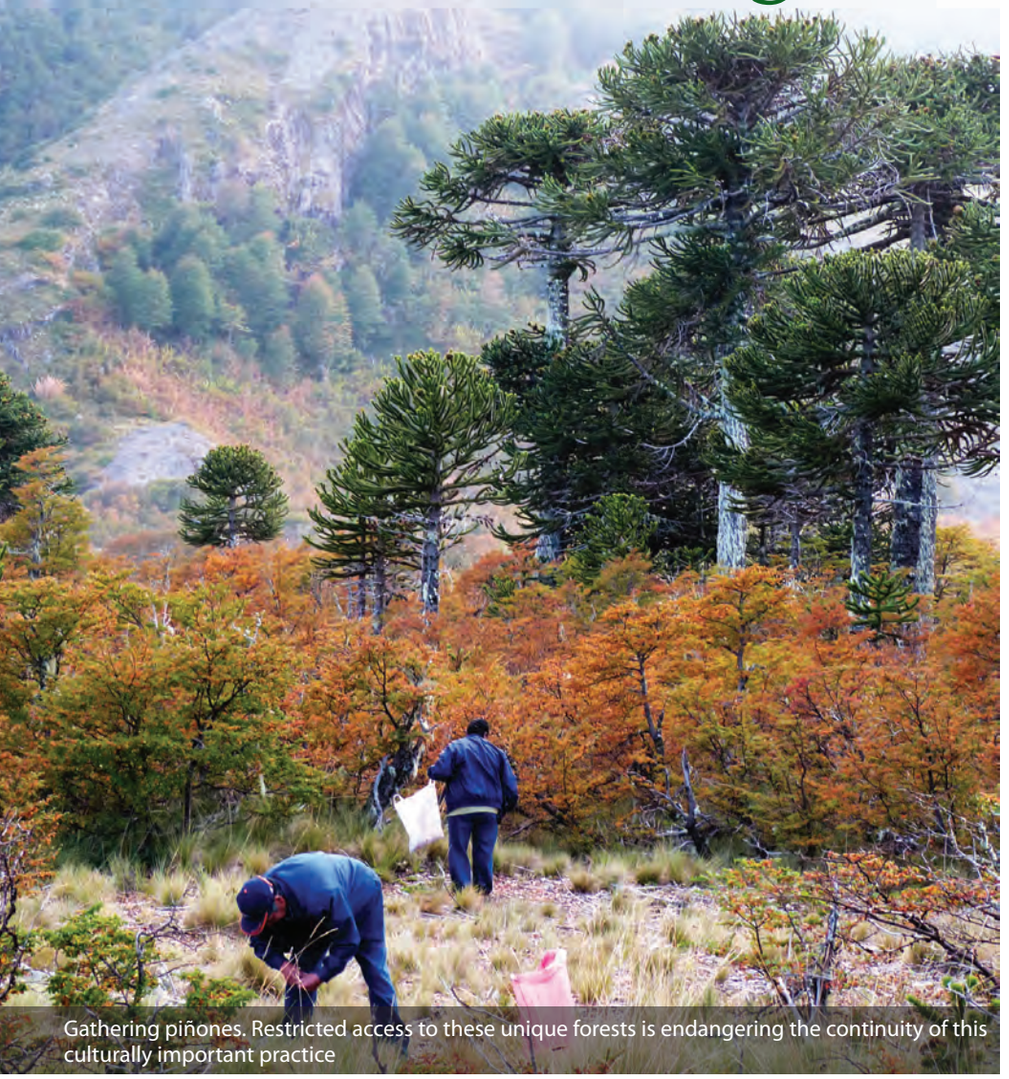
Key findings and implications:

- More than 80% of trees in the beetle-affected areas were dead. Dead trees were mostly in older and pure white spruce stands and warmer sites. Average age of white spruce in the study area was 102 years and that of beetle affected white spruce was 124 years. Beetle affected plots had low vegetation diversity and were occupied by a more than 30% cover of red stemmed feather moss.
- Disturbances had significant impact on understory vegetation. Nine species of herbs and shrubs were found exclusively in the disturbed plots. Disturbed plots also exhibited a significantly higher regeneration ability and density (white spruce, trembling aspen and balsam poplar) as compared to undisturbed sites. However, the broadleaved species occupied disturbed plots at higher ratios than white spruce, especially in open sites with exposed aspects. This finding suggests that broadleaved species may prevail on the landscape if current disturbance patterns persist.
- Higher levels of plant diversity were found in stands characterized by low crown cover and low stand densities suggesting that light limitation is an important constraint on plant diversity.
- Mixed stands had several attributes that would positively strengthen the resilience of forest ecosystems. For example, mixed stands of white spruce and trembling aspen had higher structural diversity, higher vegetation diversity, higher average basal area and were less affected by spruce bark beetle than pure stands of white spruce or trembling aspen. However, average basal area in mixed stands decreased with increased density of aspen (more than 1000 stems per hectare). These results suggested that mixed stands of deciduous and coniferous species should be promoted (where appropriate) maintaining aspen density below 1000 stems/ha.

Shyam's results suggest that proactive management to create mixed stands constitutes a more resilient ecosystem and minimizes the risks and impacts of forest disturbances. Further, such stands would also enhance forest productivity and vegetation diversity. The current practice of salvage harvesting and even-aged management may undermine such ecosystem benefits. Therefore, uneven aged management with frequent group or selective harvesting is suggested to maintain mixed stands with a mosaic forest structure. In addition, regular prescribed early burnings may help to achieve rapid regeneration of spruce forests and minimize the risk of uncontrolled fire.

Shyam Paudel is currently working with UNDP in Vietnam as an international technical advisor for the UN-REDD programme. He can be reached at shyam.paudel@undp.org.

Forests as a source of food and knowledge in the Andes



Gathering piñones. Restricted access to these unique forests is endangering the continuity of this culturally important practice

A woman asks, "How can we teach our children if we can´t access the forests?"

For indigenous communities that live in or near forest ecosystems, forests embody far more than just a source of timber. They are also home to countless species of plants used for a variety of purposes, including an important source for food. For the Mapuche People – the largest indigenous group in Chile – forests also represent a hands-on classroom, a space for tightening social bonds and a sacred place where natural entities and spirits must be respected and venerated.

The name Mapuche means people (che) of the land or earth (mapu), reflecting their intimate relationship with the land. In the Andean temperate ecosystems of southern Chile, there are still many Mapuche communities that co-inhabit with forests dominated by *Nothofagus* species and, in higher elevations, the sacred pehuen or monkey-puzzle tree (*Araucana araucana*). Wild edible plants of the temperate forests have been, for centuries, gathered by Mapuche families as a complement to the food provided by their crop-livestock system.

Wild edible plants refer to species that are used for nourishment, but are neither cultivated nor domesticated; they grow naturally in their environments. They include those yielding edible leaves, flowers, stems, fruits, seeds, or starchy underground parts (fungi are also generally included). Their highly nutritious values means that the consumption of wild edible plants has a dual function: to contribute to dietary diversity and to the maintenance of health. They also serve as a source of cultural identity, reflecting a deep connection to the land and are associated with a complex body of knowledge about the environment and its constituents. This is commonly known as traditional ecological knowledge – an accumulated body of localized knowledge passed on through generations, embodied in practice and interlaced with a system of beliefs about nature.

As part of her master's research in the Faculty of Forestry at UBC (and as a Darrell Posey Fellow, working with the Forests and Communities in Transition Lab, under the guidance of Drs Robert Kozak, Felice Wyndham and Alejandro Rojas) Antonia Barreau used ethnographic methods to explore the importance of forests as sources of food in a Mapuche community in the Andean temperate forests of Chile. Antonia addressed the state of ethnobotanical knowledge of wild edible plants and the vitality of its transmission among generations. Her research aimed to: (1) document forest wild edible plant knowledge and current consumption of these species; (2) explore local perceptions of present and past relations between people and wild edible plants, knowledge systems and landscape change; and (3) investigate factors and historical processes, both ecological and cultural, influencing today's use of

wild edible plants, food choices and management decisions for Mapuche families.

Between November 2012 and April 2013, Antonia conducted participant observation in an Andean Mapuche community, which meant living and being immersed in the local culture. On a daily basis, she took part in everyday agricultural and household activities as well as crafting activities, immensely rich situations for data collection. This core methodological strategy was complemented by ethnobotanical techniques, semi-structured and informal interviews, recording personal stories and memories regarding plants, food and the landscape and conducting weekly food diaries in different households to gain a sense of current eating habits.

Local inhabitants were able to list 47 wild edible plants and provide detailed information on species seasonality, ecology, abundance and changes in availability over time. Adult participants knew forms of preparations and alternative uses to most wild edible plants. This ethnobotanical knowledge was not given as isolated information, but rather was elaborated within stories and memories of their relations with these plants and the landscape. Forests provided different wild edible plants all year round: edible leaves, shoots and some mushrooms in the spring; a variety of wild berries and fruits in the summer; and highly nutritious seeds and mushrooms in the fall, and to a certain extent, in the winter.

Findings of the study were wide-ranging, with highlights being interesting discussions around the consumption of: the highly prized maqui berry (*Aristotelia chilensis*), which was consumed raw and as a fermented drink called teku; huempe, which is rotten wood mixed with mycelia of fungi, prepared in different manners; and, very importantly, ngüilliu, the relished seed of the venerated monkey-puzzle tree. Not surprisingly, ngüilliu was held up as a culturally salient species for the Mapuche people. In past times, every April, most families prepared their horses or wooden carts pulled by oxen to get to the nearest pehuen forests in the high Andes. People camped for days or even weeks until they had gathered enough ngüilliu to last the winter. These gathering trips were vital as instances of socialization and also for knowledge transmission: "…it was a social act because there you met other neighbours who were also hanging around with their families and they made a fire and elders would sit up most of the night chatting…" Elders would tell stories as a way of teaching younger generations about life, respect and the value of nature and other life-forms.

A Mapuche woman teaches her niece how to sustainably gather the leaves of hoja del paño

Although some species of wild edibles are still being consumed, most are no longer used. This was largely attributed to a lack of access to gathering sites and the increasing scarcity of many species. Today, most forests have been relegated to small patches and streamside buffers on Mapuche farms and families are forced to negotiate the increasingly limited areas devoted to forests, crop fields, orchards, home gardens and pastures. This has resulted in wild foods and many traditional crops being left behind, while industrialized (store bought) foods are being substituted into their diets, sometimes with dire nutritional consequences.

What also became evident was that, despite the wealth of knowledge held by most adults and elders, knowledge transmission was being interrupted as younger generations were failing to learn what the elders once learned: "We do not learn by reading, we are taught by doing". The Mapuche teaching is oral and, for the most part, *in situ*, meaning that tasks are taught where they are to be performed and learning is by repeated practice over time. Participants attributed this obstruction to the transmission of ecological knowledge and cultural values to 2 major factors. First, the privatization of property and the rise of industrial forest plantations and national parks has limited the community's access to gathering sites. Second, the local school system has had an acculturation effect wherein children no longer have time to engage in traditional pedagogies with elders and peers. Moreover, school food programs – based on industrialized foods – have led to the attenuation of children's food preferences for more traditional foods.

In the final analysis, though, land tenure issues seem to be at the core of the problem, and therefore, resolving them is a key part of the solution. The Mapuche territory has been subject to a long history of land grabbing, by both legal and illegal means, and this has deeply impacted their communities' social, ecological, economic and spiritual systems and identities. The transmission of traditional ecological knowledge must be conducted *in situ*; it makes little sense when abstracted from its cultural context. In order to ensure that plant knowledge of wild edibles is maintained, emphasis needs to be placed on understanding the important role that forests play for Mapuche people´s food and health systems, not to mention social cohesion. These research findings open new lines of inquiry on how to approach cultural and biodiversity conservation when land tenure and acculturation contexts disrupt this important link.

For further information, contact Antonia Barreau Daly at abarreau@gmail.com.

Estimating disturbance effects using large-scale forest survey data

Large-scale forest surveys have traditionally focused on estimating commodity production (eg, timber volume) or the current state and trends of forest resources. Over the past few decades, large-scale forest surveys have also included the assessment of non-timber forest resources (eg, down wood, understory vegetation) and forest health conditions. This change in objectives requires the measurement of additional variables. Survey objectives and management questions will continue to evolve, and so will our forest survey designs and the variables that we measure to answer relevant questions. Large-scale forest survey data are used to observe changes in the state and trend of forest resources, and it is often desirable to answer questions such as, "What caused the observed change in forest resources?" or "How much change did occur?" In other words, it is often of interest to establish cause-and-effect relationships and to quantify the magnitude of the causal effect. In a cause-and-effect relationship one event A makes another event B happen, where A is the cause and B is the effect.

Thinking back to introductory statistics classes, you may remember statements such as "Statistical inferences about cause-and-effect relationships can be drawn from randomized experiments, but not from observational studies!" or "Correlation does not imply causation." Typically, we don't know whether an observed response is caused by a treatment or caused by some other variables that differ between treated and untreated groups. In a randomized experiment, the investigator uses a random mechanism (eg, a coin flip or random number generator) to assign experimental units to a treatment group. Therefore, the treated and untreated groups are, on average, identical. In an observational study (eg, survey data), the investigator has no control over the treatment assignment. The gold standard for establishing cause-and-effect relationships and for quantifying treatment effects is the randomized experiment. However, there are cases where randomized experiments are impossible to implement and we have to rely on observational studies. Natural disturbances such as fire and insect outbreaks are examples where randomized experiments cannot be implemented to estimate the magnitude of the disturbance effects on forest resources (eg, forest biomass). In these cases, observational studies or survey data can still be used to estimate that natural disturbance X (eg, fire) caused effect Y (eg, loss in forest biomass) of magnitude Z (eg, mg/ha). The use of forest survey data to establish cause-and-effect relationships and to quantify the magnitude of disturbance effects is surprisingly controversial despite survey data having been successfully used to establish cause-and-effects relationships in other fields, such as epidemiology, econometrics, and medicine. One of the most famous examples is probably the case of lung cancer. Few will dispute the statement "Smoking causes lung cancer." Yet, this

widely accepted cause-and-effect relationship was established with decades of observational studies.

Dr Bianca Eskelson is a newly appointed assistant professor in the Department of Forest Resources Management at UBC. With her collaborator Vicente Monleon from the US Pacific Northwest Research Station, Bianca has explored the use of forest inventory data to quantify fire effects on forest biomass pools using US national forest inventory plot data from Washington, Oregon, and California.

To determine which of the inventory plots had been burned within 5 years prior to plot measurement, the plot network was overlaid with the Burned Area Boundaries datasets available from the US Forest Service. Unburned plots were selected that were similar to the burned plots. Each of the burned inventory plots was matched with an unburned inventory plot based on distance (<16.4 km), forest ownership, and the proportion of forest cover on the plot. The matching process resulted in a set of burned inventory plots and a set of unburned inventory plots that were as similar to each other as possible. In terms of randomized experiments, these 2 sets of plots could be referred to as treated and control plots, respectively. The idea behind the matching process is to make the observational data (survey data) as similar to a randomized experiment as possible, before looking at the response data (eg, forest biomass by live and dead pools). This allows an analysis similar to that of a randomized experiment and with the ability to establish cause-and-effect relationships and to quantify the magnitude of the disturbance effect. The 2 sets of burned and unburned plots were comparable in terms of variables such as mean annual temperature, annual precipitation, elevation, and latitude.

The matched burned and unburned plots were used to estimate the average combustion factor of coarse woody material (CWM) biomass in order to quantify how much forest wildfire decreases the amount of this biomass. The combustion factor is the fraction of CWM consumed by fire. For the basic model, CWM biomass was used as the response variable (variable of interest) with a burn indicator (1 if plot burned, 0 if plot did not burn) as the explanatory variable and a random pair effect to account for the plot matching. Combustion factors for total CWM biomass and for CWM biomass by piece size (≥ 20 cm vs < 20 cm) were reported for Oregon and Washington combined and for California. The estimated combustion factors were higher than values previously published in the literature.

To test whether the combustion factor for CWM biomass depends on remotely-sensed burn severity, the burned plots were overlaid with the National Burn Severity Mosaics that are available in the US for forest wildfires. This overlay provided 3 burn severity classes (low, moderate, and high) that were incorporated in the model as indicator variables. The burn severity indicators derived from remote sensing data were not significant in the model, suggesting that the combustion factor for CWM biomass does not depend on remotely-sensed burn severity.

Bianca's study demonstrates one of the important uses of large scale forest survey data and how these data could be used to estimate the magnitude of disturbance effects. While Bianca's study focused on fire effects on coarse woody material biomass and was undertaken using national inventory data from the US Pacific coast states, the approach can be adapted to inventory data collected in British Columbia and to assessing effects of other natural disturbances. Natural disturbances (eg, fire, windthrow, and insect and disease outbreaks) are expected to increase in frequency, severity, and extent due to global climate change. In order to quantify the effects of natural disturbances on forest structure and carbon dynamics and to adapt our management decisions accordingly, the analysis approach demonstrated in Bianca's study may provide some insights on the magnitude of disturbance effects as well as suggestions for the direction of future research. Small studies conducted in one wildfire cannot typically be generalized to a population larger than the sampled wildfire. These small studies have high internal validity but lack external validity (a study has external validity if its results can be generalized to other situations). Therefore, another advantage of using large-scale survey data for quantifying disturbance effects is the availability of information across all fires that occurred in the survey region and the ability to generalize the results to a large population. Studies based on large-scale survey data have a high level of external validity.

For further information, contact Dr Bianca Eskelson at bianca.eskelson@ubc.ca. Funding for this research was provided by the US Forest Service Pacific Northwest Research Station.

Tracking ecosystem services recovery on Vancouver Island

Ira Sutherland measuring understory plant ecosystem services

The forests of coastal BC provide a bundle of ecosystem services that are foundational to the region's ecology, economy, and culture. They provide us with beautiful places to recreate, wild berries to gather, and timber to build our houses. They regulate water flows thus mitigating potential flood risks, and they store carbon to help regulate the global climate. Furthermore, forests provide cultural ecosystem services such as heritage values for old trees and existence values for symbolic or rare species. Recognizing the multiple benefits provided by nature through use of the ecosystem services framework is advocated as a way to promote sustainable management of the diverse ways that ecosystems contribute to human wellbeing.

A focal area in ecosystem services research is to recognize that ecosystem services occur together in bundles, and thus trade-offs may occur when management actions aim to increase one ecosystem service, such as timber. Extracting timber from forests can negatively affect multiple other services because it removes structural features, which underlie a forest's capacity to provide ecosystem services. For example, it removes tree stems that store carbon, understory plants that provide wild edible foods, and large red-cedar trees used traditionally by First Nations for carving totem poles and canoes. However, nearly all cut forests in coastal BC are restocked and regrown. Thus over time, some of their structural features and the ecosystem services they provide may recover.

Ira Sutherland is a master's student, co-supervised by Drs Elena Bennett (McGill University) and Sarah Gergel (UBC). In his thesis, Ira identifies a broad suite of ecosystem services provided by forests on the west coast of Vancouver Island and examines how they recover following forest harvesting.

Ira used a 250-year vegetation chronosequence to study the recovery of 8 ecosystem services provided by coastal forests. Chronosequences are a type of space-for-time substitution used to study long-term changes in forest structure from the initial period of forest regeneration right up the to old-growth stage, which is defined as 250 years old on the coast of BC.

With this long-term dataset, the researchers were able to estimate the recovery trajectories of 8 ecosystem services. Their results show that ecosystem services recover along varying non-linear trajectories and at markedly different rates. For example, wood volume and carbon storage reach their maximum rates of recovery at around 65 years, while some other services such as habitat for the at-risk marbled murrelet, a culturally valued rare species, only begin following a century of regrowth. Meanwhile, large cedar for First Nations carving were absent in most recovering stands, but present in the old-growth. These results suggest that recovery of a bundle of ecosystem services is a prolonged process, and that while trade-offs for some ecosystem services may dissipate over time, they can persist for hundreds of years for others.

Ira also looked at how the recovery of ecosystem services varies in different ecosystem types at Clayoquot Sound, Vancouver Island. Thanks to a grant from the IMAJO Cedar Management Fund, Ira was able to work with a master carver of the Tla-o-qui-aht First Nation during fieldwork in August 2014. This allowed them to incorporate traditional knowledge into the assessment of cedar cultural resources, and they made a video about it (https://vimeo.com/110663633).

Managing forests for timber while simultaneously sustaining other ecosystem services is especially difficult due to uncertainty in the speed that different ecosystem services may recover. Understanding how ecosystem services recover from timber harvest can inform management how to sustain the diverse ecosystem services of BC coastal forests, for example, by lengthening rotation times, retaining structural diversity when harvesting or creating conservation reserves.

For further information contact Ira Sutherland at mountainira@gmail.com.

Interactive effects of natural disturbances

Disturbances, such as fires and insect outbreaks, are natural components of forests. The combined and interactive effects of such disturbances have impacted forested ecosystems for millennia. Legacies of past disturbances can persist for centuries, such that the structure, composition, and processes of today's ecosystems are at least partly a result of them. Disturbances are integral to ecological communities and healthy forests by influencing forest succession, biodiversity, and biogeochemical processes, such as carbon sequestration and water cycling. Furthermore, they promote temporal and spatial heterogeneity throughout a landscape, thereby impacting a forest's susceptibility to future disturbances. Mounting evidence suggests that factors such as land management, fire suppression, and climate change are contributing to altered disturbance regimes around the world, and considering the substantive role that disturbances play in ecosystem function, the impacts on ecosystems will be absolute.

Most notably, the extent, duration, and frequency of insect outbreaks appears to be increasing. General expectations are for climate change to contribute to an expansion by affecting over-winter survival and host susceptibility. In addition, fire suppression has been linked to altered forest structure, leaving some forest types more prone to insect attack. Fire suppression also leads to a build-up of fuels, especially in drier forest types. Increased fuel loads along with lengthened and more severe fire seasons, due to drier and warmer conditions, have resulted in an increase in both the frequency and severity of forest fires throughout North America.

An increase in the frequency and duration of disturbances naturally increases the probability of concurrent events and a greater chance of interactions. Disturbances can interact so that the total effect cannot be predicted by the sum of each individually. They can also link, where one disturbance is able to change the extent, severity, and/or probability of further events. These compounded and linked interactions can lead to unpredictable and substantial qualitative changes to ecosystems.

Natural disturbances have functioned in a balanced manner across the landscape in the forests of North America to help create systems that are resilient. However, if ecosystems are not able to recover from what we believe are novel and unprecedented frequency and severity of disturbances, thresholds can be crossed resulting in drastic qualitative changes and altered states.

This has prompted collaboration between Drs Lori Daniels and Allan Carroll within the Faculty of Forestry at UBC. They are supervising Wesley Brookes, an MSc student, in a research project to quantify the magnitude of the recent changes to the disturbance regimes of fire and western spruce budworm in the dry forests of the Cariboo region of British Columbia, Canada. Wesley will be using signals in tree-rings to reconstruct past disturbance regimes and will compare these results to contemporary records. In addition, his research will determine the existence of temporal correlations between these disturbances and, from this, seek likely mechanisms of interactions.

A full understanding of the magnitude of the changes we are seeing and the time-space interactions amongst them is key for the maintenance of ecosystems. Without a knowledge of historical disturbance regimes we cannot be sure of the nature and magnitude to which they are changing. Thus, understanding the historical regimes helps us to determine whether current events fall within or outside the historical range of variability. Furthermore, understanding the key drivers behind disturbances and when one disturbance may interact with another will enable more confident predictions of the number and likelihood of the same disturbances in the future. This information will be invaluable for forest managers in assessing the vulnerability of dry Douglas-fir stands to disturbances and in prescribing appropriate measures to mitigate the impacts.

For further information contact Wesley Brookes at wesleybrookes@hotmail.com.

High altitude wetlands in the Central Andes

High altitude wetland in Tarapacá region, Volcán Isluga National Park

> **"In Chile, the protection of water sources has never been a priority in conservation strategies. Government and policy makers are aware of the overuse of water in the Chilean Altiplano, but it has been a challenge for them to focus discussion on the limitations of this resource"**

The high altitude wetlands of the Central Andes Cordillera in South America are a unique ecosystem and one of the environments most threatened by climate change. These wetlands serve as oases in otherwise dry areas and play a significant role in sustaining endemic biota, grasslands for cattle, and water storage to one of the driest regions on the earth, the Atacama Desert. The ecosystem is dependent on groundwater sources. Vegetation regulates the amount of water available during dry periods. Chile's increasing water needs necessitate a better understanding of this ecosystem if degradation is to be avoided.

Wetlands are found in a wide range of ecological conditions around the world and provide many ecosystem services and functions such as water supply and regulation, disturbance and climate regulation through carbon storage and methane production, cultural and spiritual recreation, nutrient recycling, habitat/refuge, erosion control, genetic resources, among others.

Wetlands in arid environments at high elevations (above 4,000 m) are extremely rare and are highly fragile. These ecosystems are susceptible to natural impacts such as droughts and human influences such as non-sustainable agriculture, excessive grazing and mining.

The highest elevation and most distinctive geological feature in the Central Andes is the grass-dominated High-Andean plateau or Altiplano. In valley bottoms or basins, the grasses become sparser and are replaced by cushion-peat bogs. Communities of native "Aymara" and "Atacameños" peoples use these peat lands for grazing llamas and alpacas, which are the basis of the local indigenous economy.

María José Ruiz-Esquide has recently completed her MASc in the Faculty of Forestry at UBC. She used remote sensing and multivariate analysis to study the effects of human disturbances and groundwater sources on plant community composition and wetland health in the Chilean Altiplano.

These wetlands are very difficult to assess with remote sensing techniques. Floristic mapping can be very time-consuming, and extremely costly. Mapping requires intensive fieldwork, taxonomic information, data analysis and a visual estimation of percentage cover for each species. Wetland plants are not as easily detectable as terrestrial plants, and there can be confusion between vegetation reflectance spectra and the underlying soil, water and atmospheric vapor spectral noise.

María José found that vegetation classes with less reflectance variation were dominated by 3 different species while mixed grass salt patches expressed most of the spectral variation. She used a General Discriminant Analysis model to identify 2 spectral bands and 1 vegetation index as the most important variables for distinguishing differences between vegetation classes.

These 2 methods can help potential users discriminate between vegetation types on Altiplano wetlands. However, the type and detail of information is different. Multivariate analysis can be used to determine which plant assemblages are found on each wetland type and to delineate plant communities. This information is extremely useful in reclamation initiatives when it is necessary to reproduce a wetland by recreating the original plant communities. However, wetlands are complex systems that cannot be considered as isolated entities even though they appear as independent units in the middle of the desert. They are connected by superficial channels, streams and lakes from Andean glaciers to the valleys or by underground flows when those streams disappear in the middle of the desert.

High spatial resolution satellite images from Geoeye-1 and IKONOS-2 can help to identify wetland plant communities and assess Altiplano wetlands. Their spectral and spatial resolution is suitable for discriminating between plant groups at a community level, which is a good approximation for these wetlands. The results of María José's research illustrate that a combination of ecological and remote sensing techniques is an excellent and necessary approach for the accurate assessment of Altiplano wetland communities.

Discussions of conservation programs and protected areas in the Andes are usually focused on forested ecosystems. However, the Andes Cordillera has a vast semi-arid area with unique ecosystems. Although high altitude wetlands management is regulated under international strategies such as the Ramsar Convention, their protection is not guaranteed because of the application of local norms that do not always assure the protection of water supplies. The key element for support of life in this zone is water availability and any discussion about protecting these areas must acknowledge that the water resource is the basis for human development.

Cushion-like plant formation of *Oxychloe andina* and organic matter in a Bofedal wetland type

Planning restoration initiatives for vegetation systems, particularly wetlands, can be very challenging in harsh environmental conditions such as the Altiplano. In Chile, the protection of water sources has never been a priority in conservation strategies. Government and policy makers are aware of the overuse of water in the Chilean Altiplano, but it has been a challenge for them to focus discussion on the limitations of this resource. Discussion of a long-term solution is urgently needed.

Finally, restoration initiatives and conservation policies for Altiplano wetlands must be given the highest priority if these water sources are to be protected. As one of the most arid ecosystem in the world, these habitats are under threat. A watershed approach is mandatory. Any changes in water usage must be assessed carefully given that the boundaries from superficial, underground, upper and lower lands are all connected through these unique terrestrial-aquatic ecotone ecosystems, the Altiplano wetlands.

María José Ruiz-Esquide completed her MASc under the supervision of Dr John Richardson in the Department of Forest and Conservation Sciences. She is now working for the UBC Alex Fraser Research Forest, in charge of their Riparian Assessment project. María José can be reached at jose.ruizesquide@gmail.com.


Principal channel of a high altitude wetland, panoramic view

G8 bamboo project (update)

A G8-sponsored collaboration between UBC, Massachusetts Institute of Technology (MIT), Cambridge University, and Cambridge Architectural Research on the development of structural bamboo composite building materials is nearing completion (see earlier article in issue 24#4 of this newsletter). Since August 2011 the UBC Department of Wood Science's Wood Composites Group (headed by Dr Greg Smith, and including Dr Kate Semple, Research Scientist; Ms Polo Zhang, MSc candidate; and Mr Felix Boek, PhD candidate), have been developing, fabricating and testing structural bamboo composites for future use in housing construction in countries where bamboo is grown.

Construction materials, including steel, glass and mortar are among the world's leading sources of CO_2 emissions. Rapidly renewable biomaterials such as wood and bamboo hold enormous potential for putting future infrastructure development in developing countries onto a more sustainable path. Bamboo is widespread throughout the developing world, and has been a staple of traditional housing construction throughout Africa, China, India, South East Asia, and Latin American countries for millennia. Although over 1 billion people currently live in bamboo-based dwellings, this construction material is still widely considered a 'poor man's timber' associated with primitive agrarian and forest-dwelling societies. Aspiring middle classes do not want to live in structures made of bamboo or wood; a model of development that is in contrast with North America and Europe where wood has retained its central place in housing construction at all socioeconomic levels, with solid wood slowly giving way to a highly successful range of engineered panel and beam products.

Bamboo grows easily on degraded sites and produces harvestable biomass much earlier than trees. Harvest is around 5 years compared with 30 to 40 years for most tree crops. It is a perpetual multi-aged crop with continuous regeneration of new culms (aboveground stems of grasses and sedges) as older ones are cut. Silvicultural management can be intensive, requiring monitoring and selective harvesting of culms at the correct age (4-6 years). Thin hollow stems mean that in any given year sustainable biomass yield from a grove is relatively low; < 3 dry metric tonnes (mt) per ha per year, compared with 8 to 35 dry mt/ha/yr for clonal poplar or eucalypt fibre plantations. This obviously makes supplying North American-scale composite manufacturing (such as an oriented strand board [OSB] mill) from within an economic supply radius a significant challenge. Nevertheless bamboo holds significant potential as a substitute for dwindling supplies of tropical timber; China's first bamboo OSB factory was established to produce a tough and durable replacement for shipping container floors normally manufactured using tropical hardwood plywood. China has also adapted the Australian Scrimber technology, which shreds, applies adhesive and reconstitutes the material into heavily compressed solid forms, to produce bamboo decking and flooring boards that are an excellent substitute for tropical timber. The hollow culms are easily split or crushed down into elements by the growers using simple low cost machinery, then transported to nearby processing facilities.

In the sub-tropical regions of China and Vietnam bamboo has been a cornerstone of ambitious re-afforestation efforts to stabilise slopes left bare from historic deforestation and defoliation. Bamboo groves supply a diverse range of small-scale secondary manufacturing enterprises in China and Vietnam exporting mostly to Western markets for 'green' building products. Limited annual harvest, and intensive management, handling and processing stages greatly inflate the cost of bamboo supplies to manufacturers, and by extension local consumers. Rising labour costs and labour migration to cities in China have exacerbated the marginal economic viability of bamboo manufacturing, which relies heavily on consumers in the West paying a premium for bamboo products.

Some other challenges associated with bamboo manufacturing industries include bamboo's high sugar and starch content which makes it highly susceptible to biodeterioration, particularly in tropical conditions. This is a significant factor in local preferences for inorganic building materials. Compared

with most wood and wood-based construction materials, bamboo is high density but with relatively low stiffness (resistance to deformation under load). As a functionally graded narrow stem designed to flex without rupturing, the culm wall is very dense and extremely strong in tension at its outer periphery, but lower in density and weaker towards the inner wall lining. The intermittent internal node diaphragms along the stem disrupt the continuity of structure and properties of the culm wall tissue, posing challenges for composite manufacture. The very hard and siliceous outer cortex also makes slicing and sawing using wood cutting blades more difficult than wood, and with greater wear on tooling.

Despite rising culm and other processing costs in Asia, bamboo isn't always processed and used as efficiently as it could be. For example bamboo 'plywood', a highly labour-intensive product made from hand woven mats and curtain plies, is almost exclusively used for disposable concrete formwork in China, and has not found a place in the value-added or more permanent construction materials market. Other products such as flooring laminates are made by milling away and burning the strongest outer tissue of the culm, and many bamboo products use adhesive systems and application methods that require several times the amount of costly glue as conventional wood composites that are manufactured in North America or Europe. Products such as bamboo Scrimber have an extremely long production cycle, and compress (and damage) a large volume of material down into a very dense product that in its current form is much too heavy for mainstream construction purposes.

While milled strip-laminated bamboo beams have found a small foothold in LEED-certified construction in Europe and the US, the wider adoption of engineered bamboo-based building materials, such as structural composite lumber and engineered panels, is currently heavily constrained by limited engineering data, structural building codes, limited or non-existent production capacity, lack of consumer awareness, and strong preferences for inorganic materials, particularly in bamboo growing countries. A core objective of this G8 collaborative project has been to redress this situation by developing a standard system of nomenclature for bamboo products and processing, and generating engineering data on structural building products; laminated beams (Cambridge), reconstituted strand and crushed element composites (UBC), and testing and modelling of the material at the micro-structural level (MIT). Strand- and crushed element-based composites hold considerable potential. Many bamboos, including both Moso and Guadua have very high tensile modulus and fracture toughness compared with wood, especially the outer culm wall and there is enormous untapped potential for combination with fast-growing plantation wood for higher performance composite building materials. Researchers at UBC have found that while it is a challenge to produce good quality bamboo strands using wood stranding equipment, particularly from Guadua, selectively adding bamboo strands to the surface layers of wood OSB can produce significantly stronger and more moisture resistant panels than if only wood (in this case, aspen) is used. However, stiffness is unchanged. The UBC research group is also believed to be the first to fabricate strand boards from Guadua. In ongoing research, Felix Boek is furthering the use of crushed bamboo elements to make long structural composite lumber members similar to Parallam. Limited annual biomass availability from bamboo groves compared to forest plantations, and its high density, create an imperative to combine bamboo with commodity wood in smart ways for composite manufacturing.

"Rapidly renewable biomaterials such as wood and bamboo hold enormous potential for putting future infrastructure development in developing countries onto a more sustainable path"

The research team at UBC has been funded by an NSERC G8 Tri-council grant, and is heavily indebted to Mr John Hoffman of FPInnovations, Vancouver. Without this collaboration, the ability to crush and convert culm stock to strands would not have been possible. Momentive Specialty Chemicals, Inc (Edmonton) has kindly supplied resins throughout the project.

For further information on this project contact Dr Greg Smith at greg.smith@ubc.ca or Dr Kate Semple at kate.semple@ubc.ca.

Reproducing traditional Pacific Northwest Coast First Nations finishes

The Faculty of Forestry is working hard with First Nations people to "help solve challenges associated with the conservation and management of forests and the goods and services they provide", and also to ensure that its curricula and research accurately represents and includes Aboriginal cultures, histories, and systems of knowledge. With this commitment in mind, Mr Jun Lee (PhD student in Chemical and Biological Engineering) and Vinicius Lube (Masters student in the Department of Wood Science) endeavoured to better understand and then reproduce the traditional wood finishes that were used by the First Nations people in BC before they had contact with Europeans. Vinnie and Jun's research was part of an undergraduate course on wood finishing taught by Philip Evans of the Wood Science Department. They also worked very closely with the Museum of Anthropology (MOA) at UBC.

Finishing of wooden objects by First Nations people was very important. The finishes were used in a symbolic way to enhance the status of the owner of the object. For example, new totem poles with painted family crests were erected during the potlatch, so that guests would remember the event. When the finishes on totem poles faded, re-finishing was rarely carried out, suggesting that the most important function of the finishes were their immediate cultural impact rather than any long term protective effect.

Prior to European contact the finishes used by First Nations people to decorate wooden objects were made from naturally occurring materials. It was these finishes that Jun and Vinnie sought to reproduce and apply to western red cedar (*Thuja plicata*) and yellow cedar (*Cupressus nootkatensis*) - the wood species most commonly used by First Nations people. Archaeological evidence reveals that First Nations people used western red cedar over three thousand years ago. Western red cedar was referred to as the "Tree of Life", and its wood was used to craft a variety of items, such as canoes, paddles, planks and posts for traditional longhouses, totem poles, bent-wood boxes, bows, masks, bowls, dishes and drums.

The first step in finishing cedar involves drying the wood. A skilled artisan could quickly decide whether the wood was dry enough to finish by touching or smelling it. First Nations people rarely sanded their wooden items before finishing them, unlike modern practice. Vinnie and Jun fol-






"The key to producing the finish was to chew the salmon eggs for about two minutes and in the process mix the chewed eggs with copious amounts of saliva"

lowed this traditional practice and omitted sanding from their finishing process.

Their biggest challenge was making First Nations finishes using traditional raw materials. According to reference works and Bill McLennan, the author of the book "The Transforming Image: Painted Arts of Northwest Coast First Nations", different coloured finishes were made by mixing local pigments, such as magnetite or bone black, red ochre (hematite), green earth (celadonite) or a white diatomaceous earth, with a binder. The binder is an important component of any finish and its function is to 'glue' pigment to the wood. Modern finishes use binders consisting of polymers (eg acrylics, polyurethanes) or oils (eg linseed, tung oil) containing heavy metals as drying agents. The binders used in traditional First Nations finishes were often chewed salmon eggs or chewed halibut tail!

Although the ingredients used in First Nations finishes were known, there was little information available to Vinnie and Jun on the process of making a finish. They needed a consistent finish that could easily be applied to wood, and had the appearance of the finishes on authentic artifacts in the Museum of Anthropology. After several trials, and many unsuccessful attempts, they developed a method of making different coloured First Nations finishes by combining the natural pigments mentioned above with salmon eggs as a binder. The key to producing the finish was to chew the salmon eggs for about 2 minutes and in the process mix the chewed eggs with copious amounts of saliva. This chewed mixture was then ground together with the desired pigment in a mortar and pestle, until a homogeneous dispersion, free of obvious solids, was formed. Simply grinding the salmon eggs and pigments together, without the addition of saliva, did not produce a finish with the desired consistency or properties. Presumably, enzymes in the saliva acted upon proteins, fats or carbohydrates in the salmon eggs to aid their dispersion in the aqueous salivary media.

Vinnie and Jun applied different coloured finishes to both western red cedar and yellow cedar wood. The finishes adhered strongly to the wood surface – possibly because the denatured protein from the salmon eggs acted as a glue. After the finishes dried, the colour was measured with a spectrophotometer and high quality photographs were taken with a macroscopic lens. The red, green, black and white colors of the finished cedar species were compared with those of authentic artifacts held by the MOA at UBC. The resemblance was quite good in some cases, especially considering that the colours of the finishes on the artifacts held by the museum had probably faded since they were applied over a century ago.

The existing literature on First Nations traditional arts largely focuses on the social and spiritual aspects of the art. This project focussed on the technical aspects of making and applying traditional First Nations finishes. The difficulties Vinnie and Jun experienced in making the finishes, and in particular the time-consuming step of rendering salmon eggs for use as a binder, provided a clue as to why First Nations peoples quickly abandoned traditional finishes and adopted trade pigments and modern paints following their contact with Europeans. However, the results of this project indicate that traditional finishes could be reproduced if the natural pigments could be obtained and if someone was willing to chew large amounts of salmon eggs!

This course project provided Vinnie and Jun with a fascinating insight into traditional paint technologies and the cultural life of First Nations people of BC. They have expressed their gratitude for the learning experience and help given to them by Philip Evans, Bill McLennan and faculty members Heidi Swierenga, Krista Bergstrom and Karen Duffek from the MOA.

For further information about this project please contact Vinicius Lube (lube@mail.ubc.ca) in the Department of Wood Science, Faculty of Forestry at UBC or Jun Sian Lee (jslee@chbe.ubc.ca) in the Department of Chemical and Biological Engineering, Faculty of Applied Science at UBC.

A hidden threat to the iconic arbutus

Cankers along the trunk of a diseased arbutus

Arbutus (*Arbutus menziesii*) is a tree that is close to the hearts of those who live near it. With its smooth vermillion bark that peels off like paper to reveal pistachio-colored juvenile bark, its contorted growth form, the way it glows in the sun, and the fact that it looks like it would be more at home in a tropical forest than a temperate rain forest, arbutus is a species with character. In addition to its Seussian qualities, arbutus is gaining notoriety for another common characteristic: dieback in the crown, dead stems, and gnarled cankers along the trunk and branches. Arbutus is an iconic component of coastal forests in southern BC and along the Pacific Northwest of the US. In the northern part of its range, arbutus has been in a slow decline for the past 40 years. As is the case with many declines, there are multiple causes, and their relative roles and impacts are not well understood, but they are thought to include climate, human impacts, and disease.

Among the diseases that affect arbutus, a fungus known as *Neofusicoccum arbuti* is thought to play a central role in the decline. This fungus is referred to as a "latent endophytic pathogen" which means that it can live within a host that appears perfectly healthy. When the host becomes stressed the pathogen takes the opportunity to express itself, which in the case of this fungus, comes in the form of deadly cankers on the main trunk and branches of the tree. These cankers are the reproductive factories of the fungus, producing sooty black spores. As the cankers increase in frequency and size, they begin to girdle the stem, shutting off water and nutrient transport. This leads to dieback in the crown, decreasing the ability of the tree to repair and regenerate. In severe cases this can result in a decline spiral ending in the death of the tree.

In 2012, undergraduate student Rob Roy McGregor began a research project under the supervision of Drs Richard Hamelin and Monique Sakalidis (Department of Forest and Conservation Sciences). He aimed to better understand the biology of the fungus and in particular to find out if additional plants and trees could act as a reservoir for this pathogen and what effect human disturbance had on the prevalence of the disease. This research could provide important information for forest management practices.

In recent years, declining arbutus trees have been observed in Lighthouse Park, Vancouver, Canada.

A healthy arbutus trunk

The park is about 75 ha (185 acres) in size and is one of the best remaining examples of Coastal Douglas-fir old growth forest in the Vancouver area. The park was surveyed to pinpoint the location of arbutus, assess disease, identify plant species growing in close proximity to arbutus that might be hosts to the pathogen, and rate the level of human disturbance (such as carving and trampled roots). Tissue samples from diseased arbutus and suspected hosts of *N arbuti* were collected for lab analysis. In the lab, fungi growing inside plant tissues were cultured on Petri plates. Then, the power of genomics was used to conduct DNA barcoding and generate DNA profiles of the fungal cultures that can reveal the identity of the species.

The suspected culprit, *N arbuti* was indeed prevalent at Lighthouse Park with over half of the sites showing 75% infection rates. The DNA barcoding identified the fungus in the majority of the samples collected from diseased arbutus.

In addition, half of the sites exhibited some type of human inflicted disturbance. Although there was no statistical correlation between human disturbance and canker severity, only the sites with no disturbance had a "low" level (≤25%) of trees with cankers. It's possible that system wide stresses such as changing fire regimes and changing climates in the park combine with human disturbances to contribute to the overall decline of these trees.

As for the host range of *N arbuti*? Six new hosts of this fungus, were identified! The new host species, both native and non-native, span 4 taxonomic orders and include Saskatoon berry (*Amelanchier alnifolia*), salal (*Gaultheria shallon*), English ivy (*Ilex aquifolium*), a species of rose (*Rosa sp*), Sitka mountain-ash (*Sorbus sitchensis*), and hardhack (*Spiraea douglasii*). Additionally, Scotch broom (*Cytisus scoparius*) was confirmed as a host (reported once in a previous study).

The results of this study suggest that *Neofusicoccum arbuti* has a wide host range, and is likely more limited by other variables, such as climate, than by host. While it remains to be seen whether this fungus is actually capable of causing disease in these other host species, this finding may have major implications for the management of *N arbuti*. If this fungus can cause disease in these plants, learning more about the distance of dispersal of the spores could inform managers about the possibility of removing the sources of inoculum around stands they want to protect. Likewise, the chance for an accidental spread of the disease could be higher. Salal, which is used for ornamental flower arrangements, and Saskatoon, which is cultivated for its fruit, are both traded internationally, and as such could be vectors for *N arbuti*.

The best option to help these iconic trees survive is to reduce the stress they may be experiencing. While it is difficult to mitigate the effects of a changing climate, management strategies involving the reduction of deleterious human activities and the planting of arbutus within the optimal ranges of the species may help. The best treatments involve reduction or removal of sources of inoculum (ie heavily diseased trees), proper pruning methods that promote healing, and management of competing vegetation. Fungicide regimes may help on individual trees. Unfortunately, since the host range of *N arbuti* extends to indigenous and ubiquitous species other than arbutus, efforts to reduce inoculum levels in a natural forest context may be difficult.

Rob received the "best undergraduate thesis award" for his work on arbutus. For further information, contact Rob Roy McGregor at robroy.m1@gmail.com, Dr Monique Sakalidis at monique@sakalidis.com, or Dr Richard Hamelin at richard.hamelin@ubc.ca.

Youth involvement in international forestry

by Gabrielle Schittecatte

The International Forestry Student Association (IFSA) is a student-run organization bringing together forestry students from across the world to engage in discussions around international forestry issues. The Faculty of Forestry at UBC has had an active IFSA local committee for the past several years. In 2014 IFSA–UBC hosted IFSA's annual conference and welcomed over a hundred forestry students from around the world to present on and discuss forest and forest related topics, as well as to learn about forestry in British Columbia. Though the 2013-2014 year was exciting in its own right, this year proved even more exhilarating. Our members had the opportunity to participate in international policy forums in South America, Europe, Asia, and North America. Still, this is only the beginning of what we're sure will be a growing international impact of UBC Forestry students.

After having UBC students elected to the IFSA – World board (May Anne Then (BSc Forest Sciences) was elected President of IFSA World, Olivia Sanchez (BSc Natural Resources Conservation) was elected head of International Processes, and Anna Stemberger (BSc Natural Resources Conservation) was elected UNFF Sub-commission Head) last summer, some of our students traveled to Lima, Peru in December 2014 to attend the Conference of the Parties (COP) on the United Nations Framework on the Convention of Climate Change (UNFCCC) and the Global Landscapes Forum (GLF). At COP, students including myself (Gabrielle Schittecatte, MSc), Anna Stemberger (BSc Natural Resources Conservation), and Khalil Walji (BSc Natural Resources Conservation) had the opportunity to learn about the functioning of the UNFCCC, attend educational workshops, and lobby for the interests of Children and Youth to scientists, politicians, and decision-makers.

Two months later, in February of this year, the United Nations Forum on Forests hosted a week-long, inter-sessional and country-led conference (UNFF Interlaken +10) in Interlaken, Switzerland. A youth workshop was held with participation from forestry students around the world at both the graduate and undergraduate levels, and was facilitated by 2 UBC Forestry students, Anna Stemberger and Olivia Sanchez. I had the opportunity to run a 3-day workshop for participants on policy analysis skills, as well. UBC Forestry graduate student Andrea Vasquez and Lorea Coronado-Garcia also attended the workshops. We eventually produced several policy recommendations concerning international forestry governance, forests and education, forests and technology, and forests and climate change, and the recommendations were presented at the closing ceremony by UBC student May Anne Then and Jacob Amoako.

The recommendations formulated during the workshop were used as the building blocks for the Major Group Youth and Children's official statement at the United Nations Eleventh Forum on Forests (UNFF11), which took place in New York this past May. Here, 3 other UBC Forestry students – Olivia Sanchez, Anna Stemberger, Jesse Way (BSc Natural Resources Conservation) – and I had the chance to represent youth and children's interest during the international discussion on sustainable forest management. After, Ms Sanchez, Ms Stemberger, and I were able to present to the forum on the value of civil society engagement, as well as the important role youth play in international forestry and governance.

IFSA–UBC's momentum is not slowing down. Indeed, now more than ever we are looking to what opportunities are available for our students in the future. July and August will see 3 of our members travel to the Philippines to take part in the International Forestry Student Symposium. Erin Fitz (BSc Natural Resources Conservation), Mikki Narukage (MSc), and I will present our current research at the conference, then spend 2 weeks in the Philippines learning about South East Asian forestry. And this fall, IFSA–UBC has activities planned to integrate incoming UBC Forestry students into the international forestry dialogue and to raise awareness about the importance of youth participation in such dialogues. The organization will build on this year's community work, such as our International Food Night and International Day of Forests celebrations, and will continue to meet our high standards of having a meaningful impact at both the local and international levels.

These opportunities to participate in large-scale international events are invaluable for students here at UBC. However, IFSA would not be as successful without funding to make these opportunities possible, and so our students also demonstrate leadership and learn in preparing applications for and obtaining funding and grants. Those who succeed in gaining funding have the opportunity to contribute to the global community and to learn from it. These opportunities provide students with a chance to apply what is taught in the Faculty at UBC, and enhance those skills as well. The skills that these student learn are then brought back to the community level at UBC, as well as to their own work and studies. These experiences also endow our students with the necessary skills to become future leaders and decision-makers in society, which is a global benefit for all. Finally, a mainstay of not only the UBC Faculty of Forestry, but also of the international forestry youth community is the diversity of its members' backgrounds, skills, and worlds of knowledge. IFSA-UBC will continue to provide the opportunities for students to learn from each other and improve forestry practices both near and far. IFSA-UBC is grateful for the continued support from the Faculty that, in part, allows us to run our yearly activities and outreach, and enables participation in many of these fora.

Gabrielle Schittecatte is the out-going IFSA – UBC President and has just finished her master's research under the supervision of Dr George Hoberg in the Department of Forest Resources Management. She is currently working in the Department of Sociology on a climate change policy network study. She can be contacted at gabrielle.schittecatte@forestry.ubc.ca.

development & alumninews

Alumnus Bruce Blackwell is fired up about student scholarships

"We're in the midst of a paradigm shift in how we think about fire," says Associate Professor Lori Daniels, whose research centres on understanding the effects on the forest of fire, insect outbreaks, and climate change. "We used to put all our effort into preventing, detecting and suppressing fires, and now we are starting to understand how fire is an important part of forest ecosystems."

Bruce Blackwell RPBio, RPF, a Forestry alumnus and Principal of BA Blackwell and Associates, agrees. "Too much emphasis on protecting the forest from fire leads to fuel buildups and stress in the forest, increasing susceptibility to disease, and eventually larger and more serious fires that impact social, environmental and economic values important to society."

Bruce has been involved with fire for his entire career, and is passionate about fire science. So passionate, in fact, that he has established the BA Blackwell and Associates Scholarship in Fire Science. The scholarship will be awarded annually to a graduate student studying fire science, beginning in 2015-16.

"I've really benefitted from my UBC education, and it's important that I give back," he says. Bruce received a BSF in 1984 and an MSc in 1989.

Bruce established BA Blackwell and Associates in 1988, with a focus on integrated forestry and environmental consulting services. Today the North Vancouver-based company has a team of 4 associates and 20 staff.

Since the early 1990s, when Bruce worked on the management plan for Metro Vancouver's water supply, the firm has specialized in forest fire management, and Bruce has become an acknowledged expert in this field. "It's very diverse and rewarding work. We have worked with Aboriginal communities, all levels of government in western and northern Canada, and with many areas outside forestry, like agriculture, mining, parks and the environment."

Bruce believes strongly in giving back to forestry. He teaches students looking to join the profession via the Ecological Restoration Program at BCIT. He taught fire science at UBC before Professor Daniels joined the Faculty, and is a popular guest-lecturer in her course on fire. He's also been a volunteer speaker at the Student Industry Networking evening, offering advice about careers in forestry.

"There's such a strong need for more people researching fire," he says. "We need to treat fire as an ecological factor in forest development, not as the purely detrimental thing we used to see it as. We have to research the various effects that fire has on forest structure and function."

Lori Daniels agrees. "This scholarship will help support students to learn about fire as an ecological process; to understand its impact historically and today, and how it shapes the landscape. Everything from fire history over hundreds of years to the effects of fire suppression around rural communities to using prescribed fire to restore the habitat of endangered species."

Prof Daniels' lab currently supports 6 graduate students, 5 of whom are working on fire-related research projects. In addition, up to 10 undergraduate forestry students work as research assistants or complete essays or directed studies about fire each year.

To learn more about this scholarship, fire science research, or to discuss creating a student award of your own, please contact Emma Tully, phone 604-822-8716 or email emma.tully@ubc.ca.

Undergraduate students receive scholarship to study in India

"It's been a whirlwind," says Marina Melanidis, who has just finished her second year in the Natural Resources Conservation (NRC) program. "Yeah, it's all happening really fast," adds Lucas Ortuba, who's just completed his third year in NRC. "But it's really exciting and I'm so looking forward to it."

"It" is what both students call an amazing opportunity: as recipients of the Canadian Queen Elizabeth II Diamond Jubilee Scholarship, they will be doing research and study for 3 months in the forests of India, starting in June 2015.

"We will be doing a field school for the first 4 weeks," Lucas says. "After that, we'll be working with the Wildlife Institute of India." Marina adds, "We will be working in a tiger reserve, an agricultural research centre, and local indigenous communities, with a focus on strategies for climate change mitigation."

Maria has also received the Governor General's Bronze Academic Medal and the Dean of Forestry Scholarship in 2014. Lucas was a 2012-2013 UBC Chancellor's Scholar.

Neither student has visited India before, but both are excited about the opportunity for international study. "I had wanted to do an exchange term in another country," Lucas says, "and this is even better because it's a co-op internship." Marina agrees: "I hope to be working globally after graduation so this is a great start."

These internships are part of a larger Faculty of Forestry project called Green Leaders: Scholarship Program for Commonwealth Forests. In March 2015 this project received $500,000 in funding from the Canadian Queen Elizabeth II Diamond Jubilee Scholarships.

The funding, awarded by Rideau Hall Foundation, Community Foundations of Canada and Association of Universities and Colleges of Canada, allows Canadian undergraduate and graduate students to participate in internships or academic study for periods of 3 months to 1 year in another Commonwealth country.

The Green Leaders project has developed partnerships with 8 institutions in India, Ghana, South Africa, Kenya and the UK.

Dean John Innes is a strong proponent of the project. "India and Africa both contain global biodiversity hot spots, where natural resource conservation challenges are paramount, and also where our Faculty is well-positioned to maximize ongoing collaborations and partnerships," he says. "The Green Leaders project will help us strengthen these ties and give important research and study opportunities to our students."

Alumni in action

Often our alumni ask "What happened to my classmates after graduation?" while our students wonder "What can I do with my degree?" To answer these questions, this column features stories from our alumni highlighting the various career paths they followed.

Bronwen Beedle, BSF '74

Bronwen Beedle's first words of advice to alumni and grads are "Everyone should be fired once in their life to learn how to pick yourself up and move forward". She found herself in just that situation and moved from being fired to an impressive career with some of the proudest moments of her life.

Bronwen's adventurous spirit started with a childhood spent traveling. Up until Grade 7 she had never finished a full year of school because her family was always taking off, for example to England or Malaysia for a year. That same spirit led her to UBC's Faculty of Forestry, even though she was advised that she might be the only female in the Faculty at that time. She ended up being one of 4 females that year and they were a bit of an anomaly. Bronwen thoroughly enjoyed her time at the Faculty and found the male students in her class and in the more senior years to be some of their best ambassadors, however they did like to play the occasional tricks on the female students. While at field camp at Loon Lake, the guys picked up her mother's Austin Mini and moved it to a narrow spot at the end of the road, behind the yacht club. However, with a lot of back and forth maneuvering and advice from the other female students, she was able to get the car out.

After graduating, Bronwen worked for the Ministry of Lands, Parks and Housing in Courtenay, BC. She then moved to Cranbrook to open up a district office for Crown Lands, which oversaw the whole East Kootenays. In 1979 she accepted a position as a silviculture forester for Weyerhaeuser Canada in Vavenby, BC. Seven years later she decided to pursue her MBA at Queens University.

In 1988 she returned to BC after completing her MBA and was hired by a forestry company where she worked for 6 months before being fired. Though shattered at the time, she took people's advice to treat it as a learning experience. She moved on and was hired in Fort Nelson as the first female District Manager. From there her career has included: Deputy Chief Forester for BC; Assistant Deputy Minister, Ministry of Forests; and Chief Negotiator for the Ministry of Aboriginal Affairs and Reconciliation, after which she retired.

Bronwen's second piece of advice is "Don't set your sights too narrow, work in the Fort Nelsons of the world for 2-3 years and move on, it's an incredible experience". For her, some of those experiences included: visiting some of the most remote and beautiful parts of BC; seeing amazing wildlife such as elk, grizzly bears, wolverine, mountain goats and stone sheep; watching dog teams as they practiced sled racing outside the office; and being invited to participate in a sweat lodge, an honour she greatly appreciated but was unable to accept.

Looking back at her career, one of Bronwen's proudest moments was leading the provincial negotiations team that resulted in the ratification of the treaty with the Tsawwassen First Nation, a historical first agreement for BC, as well as her work on several other agreements.

These days retirement hasn't slowed Bronwen down as she now spends her time kayaking, traveling and skiing. At home she volunteers as the science co-ordinator at the Elder College in the Comox Valley and is also part of the Comox Valley Ground Search and Rescue. Looking back, Bronwen is proud to be a UBC alumnus, to have her Forestry degree and believes she has been lucky to have had incredible jobs with incredible people. In her words "I had a great career and learned from all my jobs."

Upcoming and recent alumni events

Alex Fraser Research Forest Alumni and Friends BBQ & Tour – Join us at 2:00pm on September 1st, 2015 at the Gavin Lake Forest Education Centre, near Williams Lake, BC for a tour of the forest. At 5:00pm mingle with students and faculty over drinks and a BBQ dinner and finish off the evening listening to a moderated panel discussion. Save the date now and formal invitations will be sent in July. Contact Janna Kellett at janna.kellett@ubc.ca for further information.

If you missed "**In search of happiness: Is there a secret to feeling content?**", the UBC Dialogue held on May 27th, 2015 featuring Dean John Innes as one of the panelists, go to www.alumni.ubc.ca/podcasts/ for a recording of the event.


Loon Lake Alumni and Friends tour of the Malcolm Knapp Research Forest

To view photos from the recent Forestry events listed below, visit the Forestry Alumni website at http://getinvolved.forestry.ubc.ca/events/

- Alumni and Friends BBQ Tour at Loon Lake – April 23rd, 2015
- Alumni Social at the COFI in Prince George – April 7th, 2015

Electronic versus paper?

BranchLines is currently mailed to over 4,500 Forestry alumni, interested groups and individuals. We also upload an electronic version of each issue to our Faculty website **www.forestry.ubc.ca/branchlines/**.

If you would prefer to stop receiving paper copies we can notify you by email when electronic versions are available online. To change your subscription from paper to electronic notification please send your request to jamie.myers@ubc.ca.

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