FACULTY OF FORESTRY • **NEWSLETTER** • THE UNIVERSITY OF BRITISH COLUMBIA

Branch LINES

Volume 9 No. 1 March, 1998

Forestry and the Kyoto protocol

Few human impacts on the Earth are as well documented and uncontroversial as the increase atmospheric concentrations of carbon dioxide. Careful measurements began in 1958 in the relatively unpolluted air high on Mauna Loa in Hawaii (Keeling, 1984). After 40 years of data, only regular seasonal peaks associated with photosynthesis on the great land masses of the northern hemisphere punctuate an otherwise steady upward trend of about 1.5 ppm/yr. The Swede Arrhenius first described the physics of how carbon dioxide traps heat and warms the Earth in 1896 (see Uppenbrink, 1996, for an accessible account). Despite over a century of scientific research on the subject, incontrovertible empirical confirmation of the linkage between the measured increases in carbon dioxide and changes in climate remains elusive. The bulk of the evidence on this important relationship comes from large-scale computer-based models of the atmosphere and oceans. Since the first-order effects of the known trends in carbon dioxide concentrations on climate are uncertain – especially at the national and subnational levels most important for policy analysis – the second-order effects on humans and nature are necessarily more speculative. The third-order efforts to craft appropriate policy responses contain still another layer of measurement and model errors.

In the midst of this controversy the world came together in Kyoto to hammer out an acceptable global approach to climate change aimed at reducing the accumulation of greenhouse gases in the atmosphere. Forests and foresters have a great stake in the outcome.

The interactions between climate change and forests are many and varied. For example, the annual fluctuations in Mauna Loa data confirm the profound effect that plants (and, *inter alia,* forests) have on the global carbon cycle. Increases in atmospheric concentrations of carbon dioxide – a basic plant nutrient – can enhance forest growth (as every nurseryman knows) and can improve water-use efficiency of individual trees, thereby making forests more tolerant of drought. Modeling studies suggest enormous and rapid latitudinal shifts in the ecotones between forest types, (e.g. Solomon, 1986). In northern forests small changes in temperature can produce large changes in carbon balance (Goulden *et al.*, 1998). While the technologies needed to adapt managed forests to modeled climate change appear to be available (National Academy of Sciences, 1992), the necessary institutional structures probably are not. And what of the vast expanses of unmanaged forests that characterize much of the Canadian North?

At the same time that forests are part of the problem, they may be part of the solution. Between 1920 and 1990, Canada's forests actually fixed more carbon than Canadians released through fossil-fuel consumption, although aging of our forests and increased losses due to fires and insect activity have reversed this earlier trend during the last two decades (extrapolations from Kurz and Apps, 1996). Plantation establishment on non-forested lands is a low-cost means of removing carbon dioxide from the atmosphere (e.g. van Kooten *et al.*, 1992; Moulton and Richards, 1990). In typical Canadian conditions, natural forests fix from two to four tonnes of carbon/ha/yr (MAI basis), an amount that could be enhanced at low cost through active management (Binkley *et al.*, 1996). A one hectare hybrid poplar plantation might sequester as much as eight tonnes of carbon/year. Carbon credits – specifically authorized under the Convention – may dramatically alter the economics of forest management, increasing the returns and lengthening optimal economic rotations (van Kooten *et al.*, 1995).

Article 3 of the Kyoto Protocol explicitly recognizes afforestation, deforestation and reforestation as greenhouse gas sources and sinks if "verifiable changes in stocks" confirm them. An achievable afforestation program could obviously make a measurable contribution to meeting Canada's obligations under this important international agreement.

Of course, as trees age the rate of net carbon fixation slows. Maintaining a forest's capacity to serve as a carbon sink requires either (i) continued expansion onto lands currently supporting lower-carbon-storage vegetation, or (ii) use of the wood from carbon plantations in ways that contribute positively to the world's carbon balance. One approach is to substitute wood (either mill residuals or roundwood) for fossil fuels, as many chemical pulpmills have in their energy recovery systems. Another is to substitute long-lived wood building products for such fossil-energy-consumptive materials as concrete and steel. Interestingly, the oldest wooden structures in the world, the Toshadaji and Horyu-ji temples in Nara – just 100 km west of Kyoto – are perfect examples of a desirable modern policy response.

Clark S. Binkley
Dean

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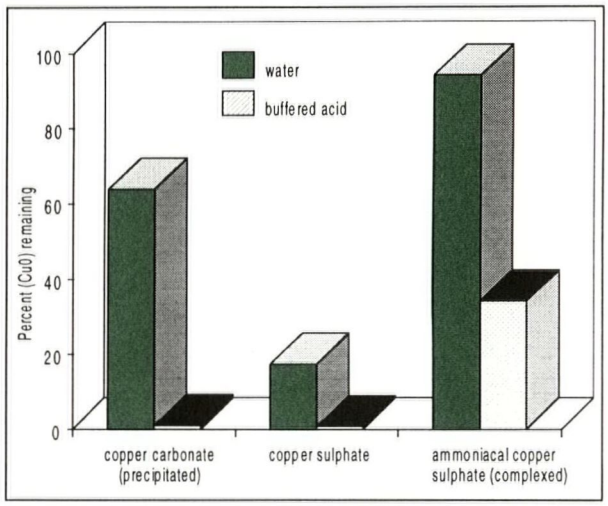
RESEARCH HIGHLIGHT

Wood protection and the environment

WORLDWIDE, the environmental impact of industrial operations has become a major focus of attention. Like other industries, the wood products industry has had to implement fundamental changes in its mode of operation in order to respond to stringent new environmental standards. This is particularly true wherever chemicals are used as part of the manufacturing process. The wood preserving industry contributes significantly to our environmental well being, by greatly extending the service life of wood products, thereby reducing demand for replacement timber. In wood preservation, any concerns over the environmental impact arising during manufacture of treated wood in Canada were effectively addressed through the "Codes of Good Practice" which were created in 1988 and updated in 1997. However, of equal importance is the impact of treated wood on the environment during its use, and this has formed an important component of the research program conducted by the NSERC/Industrial Chair in Wood Preservation at UBC.

The fixation of preservatives in wood is an important aspect, which strongly influences their acceptability by the consumer. With increasing interest in ammoniacal or amine-copper based formulations, it is important that their fixation chemistry is well understood. Research by the NSERC/Industrial Chair has identified the importance of ammonia- or amine-copper complex formation in treated wood on preservative permanence. Studies of the leachability of ammonia-copper complexes have shown them to be more resistant to leaching in acidic environments, than simple copper compounds precipitated in wood (see figure). This research is now being extended to the fixation chemistry of amine-copper systems. This knowledge will be beneficial in predicting environmental impact of the treated wood as well as developing preservatives with superior performance.



Copper remaining in treated sawdust after leaching.

During the past decade, consumer pressure has encouraged the industry to develop fixed waterborne preservatives that do not contain either chromium or arsenic, both of which are present in the treated wood used widely around homes for landscaping, decks and fences. Quaternary ammonium compounds (QACs) offer excellent potential as a wood preservative component. The Wood Preservation group at UBC has an ongoing program designed to improve the performance of QAC preservatives. One component of this research focuses on the role of mould fungi in degrading QACs. While these naturally occurring fungi may limit the performance of the QAC preservative, they can also decontaminate the QAC-treated wood waste prior to recycling. Current research is targeted at developing evidence for the primary degradation path, believed to involve the oxidation of the long alkyl chain in the molecule. Since QACs are widely used as lubricants, germicides, algaecides and slimicides, the research has implications not only for cleaning treated wood waste, but also for cleaning other QAC-contaminated materials.

In 1997 the Wood Preservation Group designed a research project to examine the leaching profile of copper and arsenic from treated utility poles. This data is critically important for the development of accurate environmental impact models.

For more information on these or other projects on wood preservation please contact Dr. John N.R. Ruddick at (604) 822–3736; fax (604) 822–9104 or e-mail ruddick@unixg.ubc.ca. ❑

DEPARTMENT NEWS

The Department continues to have strong support from our European education partners in the delivery of new Wood Products Processing program. Professors Albin, Koester and Scholz from FH Rosenhiem are teaching at UBC this year. Prof. Schleusner of SISH Biel is teaching our wood finishing course.

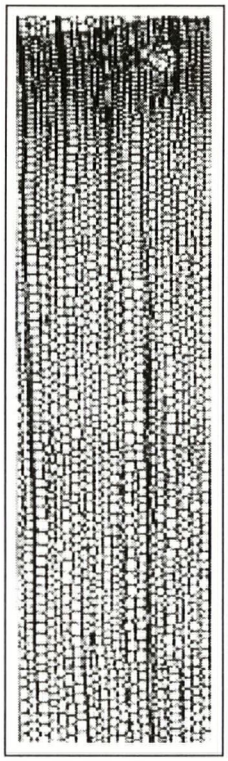
Dr. Jack Saddler is collaborating with Paprican to organize the Seventh International Conference on Biotechnology in the Pulp and Paper Industry to be held at the Hyatt Regency Vancouver from June 16–19, 1998. The triennial conference series provides a forum for presentation of research into all aspects of biotechnology relevant to the pulp and paper industry.

Dr. John Ruddick was appointed Head of the Canadian delegation to the new ISO TC 165 Task Force to develop a consensus position on harmonized ISO Standards on wood durability and hazard class designations. Dr. Ruddick also participated in the Fourth International symposium on Wood Protection and the Environment. ❑

RESEARCH HIGHLIGHT

Wood quantity *and* quality?

THE goal of most tree improvement programs is to increase forest productivity while maintaining or enhancing wood quality. The wood trait of primary interest is usually wood density, as it affects both strength and pulp yield. Increased utilization of younger trees from faster growing, managed stands will result in a higher proportion of lower density juvenile wood, and increases the need for consideration of wood density in selection programs. For most conifers a negative relationship exists between growth rates and wood density, i.e., faster-growing trees on average have less dense wood than their slower-growing counterparts. This unfavorable relationship presents tree breeders with a dilemma, as it is impossible to simultaneously obtain large genetic gains in both stem volume growth rates and wood density.

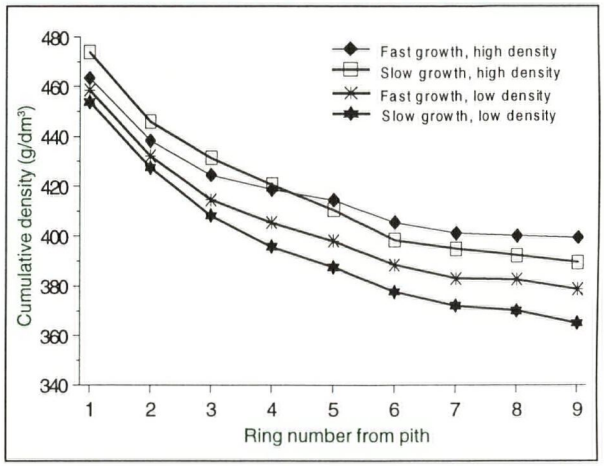


Tracheid size and shape may affect both wood quality and water use.

While most foresters think of tree stems in terms of wood production, they also serve an important physiological function in trees. In addition to providing the strength and spatial structure to support foliage, stems conduct water from roots to leaves. Water ascends in columns through tracheids, and under drought stress, these columns break. Wood fibre characteristics may vary in ways that affect water use as well as economic value. Thus, genetic selection for wood density may affect adaptive traits relating to moisture regime.

In a project funded by Forest Renewal BC, post-doctoral scientist Tongli Wang is studying lodgepole pine families from the BC Ministry of Forests lodgepole pine breeding program in the laboratory of Sally Aitken. Seedlings are being characterized for growth rate, growth timing and water-use physiology in well-watered and water-limited environments. Wood properties including density, earlywood proportion and fibre size and shape are being characterized using both digital image analysis of wood sections (see electronic image on left) and x-ray densitometry.

Preliminary analyses of wood properties and growth rates have yielded some interesting observations. Wood density in young lodgepole pine typically decreases from year to year across early growth rings. However, it appears that families combining fast growth and above average juvenile wood density have a less pronounced decline in juvenile wood density than other families, resulting in more uniform wood properties (see graph). The trees in these families have high stem volumes due primarily to rapid height growth rather than diameter growth, as height and wood density are positively correlated while diameter and wood density are negatively correlated. It may make sense to manage lodgepole pine diameter growth through stand density, while height growth rate and wood density are improved through genetic selection. Studies investigating the genetics of both adaptive and economic traits will help to ensure that genetic gain in growth rates and wood quality does not come at the expense of adaptation and forest health.



Families combining fast growth and high density show more uniform juvenile wood density.

For further information, please contact Dr. Sally Aitken at (604) 822–6020; fax (604) 822–5744 or e-mail aitken@unixg.ubc.ca. ❑

DEPARTMENT NEWS

Dr. Gene Namkoong is working on a CIDA grant to the International Plant Genetic Resources Institute to develop conservation priorities for forest trees, and will be advising the International Centre for Forest Research on criteria and indicators of sustainable forestry.

Dr. John McLean is spending his administrative leave at the New Zealand Forest Research Institute in Rotorua. His major research is centered on the use of Maliase trap catches to describe insect biodiversity in various man-made and natural ecosystems, especially native and exotic forests.

Dr. Bart van der Kamp is also in Rotorua, working on root diseases of radiata pine with Ian Hood. Bart's sabbatical plans also include field work in B.C. and a trip to Europe to present papers at a IUFRO meeting in Finland and at the 7th International Congress of Plant Pathology in Edinburgh.

In September, Dr. Kathy Martin gave a plenary lecture at the 1997 Wildlife Society meeting in Aspen, Colorado entitled "The role of animal behaviour studies in wildlife management and science". The paper will be published in an upcoming Wildlife Society Bulletin. Dr. Martin is also co-chairing and organizing the annual meeting of the Society for Canadian Ornithologists in August 1998 to be held at UBC. The theme of this meeting is "Avian dispersal and migration across altered landscapes". ❑

RESEARCH HIGHLIGHT

Where do the headwaters come from?

IT seems simple enough. Rainfall generates stormflow events in forested headwater basins and these waters are routed downstream. Although we have models that can predict storm runoff from these basins, we lack the fundamental knowledge of the hydrologic pathways by which water falling onto headwater catchments enters the small stream systems. Why is this important? For several reasons – first, these pathways determine timing of peak flows; secondly, hydrologic response in steep headwater basins triggers landslides and debris flows; and finally, "hydrologically active" zones in headwaters may be sensitive to certain land use practices. For the past 25 years, forest hydrologists have been guided by the concept of a "variable source area" for streamflow generation. This approach assumes that riparian zones expand during storms thereby generating saturated overland flow. The significance of this overland flow as well as mechanisms of subsurface flow are currently being debated.

Dr. Roy Sidle, Forest Renewal BC Chair in Forest Hydrology, has been collaborating in an ongoing series of investigations at Hitachi Ohta Experimental Watershed in Japan, to unravel some of these complex mechanisms of stormflow generation. The watershed is located about 200 km north of Tokyo and supports a 75-year old stand of Sugi and Hinoki. The steep sideslopes and resulting narrow riparian zones are very typical of forested headwater basins.

Dr. Sidle conducting tracer tests at the Hitachi Ohta Experimental Watershed in Japan.

Detailed stormflow data are being collected in a series of nested headwater basins ranging in size from 0.25 to 15 hectares. To elucidate the hydrologic contribution of soil macropores during periods of increasing wetness, several tracer tests have been conducted in slope segments of the catchment. Finally, staining tests in slope segments have revealed specific mechanisms of macropore 'connectivity'.

What is beginning to emerge from this collaborative research is a new concept of stormflow generation based on hydrologic linkages among distributed geomorphic units. During dry conditions, most stormflow is generated from riparian areas as saturated overland flow or channel interception. As soils begin to wet, subsurface flow from the soil matrix contributes to the peak and recession limbs of storm hydrographs. During wetter conditions, subsurface macropores contribute to stormflow and small hillslope hollows become recharged to the point where they begin to yield surface runoff. Finally, during the wettest conditions, macropore systems appear to 'self-organize' and drain large portions of the lower hillslope. Hollows, although often remote from stream channels, deliver significant runoff during storm peaks.

Present plans are to conduct a series of studies in coastal British Columbia that build on the Hitachi Ohta investigations. Focus will be on understanding macropore dynamics, the role of subsurface flow systems in landslide initiation, and modeling headwater stormflow generation. Dr. Sidle has applied for a basic NSERC research grant to support this research.

For further information, please contact Dr. Roy C. Sidle at (604) 822–3169, fax (604) 822–9106 or e-mail sidle@unixg.ubc.ca.❑

DEPARTMENT NEWS

Following Dr. Gordon Baskerville's retirement at the end of December, 1997. Dr. Valerie LeMay has been appointed Acting Department Head for a one year period.

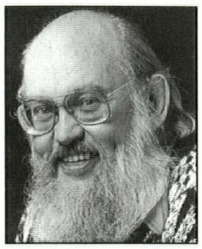
Dr. Jonathan Fannin gave an invited seminar to the Seattle Geotechnical Society on January 22, entitled "Landslide initiation and runout on clearcut slopes."

Dr. Younes Alila is organizing two one-day workshops in conjunction with the B.C. Branch of the Canadian Water Resources Association entitled: "An Improved Regional Frequency Approach for Estimating Design Floods in B.C." held on February 26, and "Managing Forest Lands and Water Resources in B.C. – Challenges for the Next Century" to be held on April 16 at the Plaza 500 Hotel, Vancouver. *For more information, please contact Dr. Alila at (604) 822–6058.*

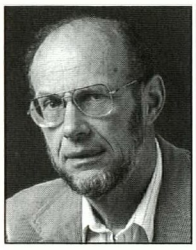
Dr. Alila has recently launched a web site on the newly established Forest Engineering Hydrology Lab at UBC. The web site address is: http://www.forestry.ubc.ca/hydrology/mainpage.htm.

Dr. David Haley was appointed by the Minister of Forests, the Hon. David Zirnhelt, to serve on the Community Forest Advisory Committee. The initial task of this committee is to provide recommendations on the guiding principles for the development of community forest tenures.❑

Fred Bunnell and Gordon Weetman earn ABCPF Awards



The Association of British Columbia Professional Foresters (ABCPF) and the Association of Professional Biologists have conferred the Bill Young Award for Excellence in Integrated Resource Management upon **Dr. Fred Bunnell** "having served on over 70 provincial, national and international committees dealing with resource management, 11 of which he is currently active on, and having published over 200 scientific articles, Fred Bunnell's contribution to the promotion of integrated resource management is profound. His tireless efforts to promote integrated resource management, at home and abroad, make him a most worthy recipient."



The ABCPF has conferred the Distinguished Forester Award for 1997 on **Dr. Gordon Weetman** in acknowledgement of his immense contributions to the profession and to forestry education over the past 43 years of his career "through his research, teaching and participation on numerous committees, Gordon Weetman has profoundly influenced and improved forest management, particularly silviculture, in British Columbia and throughout Canada."

Gordon Weetman and Fred Bunnell received their awards on March 5, 1998 at the 50th Anniversary of the Association of Professional Foresters Annual General Meeting in Victoria, B.C. ❑

We called to say *Thank YOU*!

A group of Forestry students – all winners of scholarships funded by alumni and friends of UBC – joined Dean Clark Binkley to volunteer during the evenings of January 20th and 21st for a donor appreciation phonathon. Our students called hundreds of our alumni donors to express their appreciation for the tremendous support they receive from alumni each year.

If you are interested in finding out more about how you can support the Faculty of Forestry, please call Tara MacKenzie, Faculty Development Officer at (604) 822–8716. ❑

New faculty positions

The Department of Wood Science has an opening in **Advanced Wood Adhesives and Composites**. This tenure-track faculty appointment will require teaching at the undergraduate and graduate level and an associated program of research.

The closing date for this competition is May 15, 1998. For further details visit the Department's web site at www.wood.ubc.ca.

The Department of Forest Sciences has a senior position open for an **FRBC Chair in Silviculture**. The position will require research leadership, supervision of graduate students, and some teaching. Candidates should have extensive experience in silviculture, a broad understanding of forest management issues, and a well established research program.

Applications are also invited for an **FRBC Chair in Applied Conservation Biology**. Possible areas of expertise sought include terrestrial vertebrate population ecology and community ecology in terrestrial and/or riparian systems. Responsibilities will include teaching, supervision of graduate students and research.

The closing date for the Silviculture position is April 3, 1998 and for the Applied Conservation Biology position is May 15, 1998. For further details visit the Faculty's web site at www.forestry.ubc.ca.

The Department of Forest Resources Management has junior and senior openings in forest management. The senior position is for an **FRBC Chair in Forest Management**. Candidates should have an internationally recognized reputation as one of the world's leading scholars in a field closely related to forest management, a record of involvement in public debate concerning forest management and teaching experience. Responsibilities will include research, supervision of graduate students, and teaching.

The junior position is a tenure-track faculty appointment in **Forest Management** responsible for teaching and research at the forest and landscape level.

The closing date for these two competitions is June 15, 1998. For further details visit the Faculty's web site at www.forestry.ubc.ca.

Harvesting priorities at the Alex Fraser Research Forest

Timber harvesting is an important activity at the Research Forests providing opportunities for teaching and research and helping to pay the bills.

In general, harvesting efforts at the Alex Fraser Research Forest are dictated by natural forces. In order to protect the forest resources and manage the timber most effectively, we harvest by the following priorities:

1. infested by insects
2. dead or dying
3. at risk of infestation by insects
4. affected by disease
5. declining vigour
6. healthy and vigourous

GIS map of the Gavin Lake Block (6,315 ha) showing high hazard stands (lodgepole pine more than 80 years old)

Bark beetles continue to be the most significant pest problem confronting the Forest. The age and species structure of the Research Forest is conducive to bark beetle populations that cycle between endemic and epidemic levels through time.

Currently, mountain pine beetle is increasing to epidemic conditions. So far this year, staff have found approximately five trees attacked for each tree that was killed last year.

Strategies for management of the beetle focus on maintaining a low population through prevention and suppression techniques.

Prevention is practiced by harvesting stands of highest hazard first according to species composition and age, and by rationalizing and prioritizing access development to high hazard areas.

Suppression is encouraged during periods of high beetle pressure by harvesting infested areas while the beetles are still under the bark (in conjunction with pheromone baiting).

Hazard for mountain pine beetle attack depends upon the amount of lodgepole pine in a stand, and its age. The figure above shows lodgepole pine stands at Gavin Lake that are at risk of attack.

Intensive management of bark beetles requires vigilant detection and aggressive harvesting to control the spread during periods of high beetle pressure. Although prevention is the best management option, it takes a long time. Since 1989, approximately 30% of the timber harvested from the Research Forest has come directly from bark beetle control activities on a single-tree salvage basis.

Harvesting bark beetle infested trees takes two forms:

- single-tree salvage of small groups of infested trees; and
- development of small cut blocks under Silviculture Prescriptions, which are baited with pheromones.

Annual operations to manage for bark beetles include prompt detection, thorough ground reconnaissance, prompt salvage and thorough cleanup. Additionally, access development and maintenance are carefully monitored, baits are used as necessary and harvesting is planned according to risk of loss.

Because the allowable harvest on the Research Forest is relatively small, we are trying hard not to let an epidemic of mountain pine beetles develop. If control fails, then the impact on the non-timber resources will be significant, and the dislocation of harvesting programs will have severe financial ramifications. We will continue to be vigilant.

For further information, please contact Ken Day, Alex Fraser Research Forest Manager at (250) 392–2207, fax (250) 398–5708 or e-mail kenday@unixg.ubc.ca. ❑

We are moving...

The new **Forest Sciences Centre** is very close to completion. We will be moving into our new home during the months of May and June, 1998.

Our phone numbers will not be affected by the move, although you may have difficulty reaching individuals for a few days either side of our moving date.

Our new address will be **2424 Main Mall, Vancouver, B.C. V6T 1Z4** (we are diagonally across the street from our old building).

The official opening celebration for the Forest Sciences Centre is scheduled for September – details will be mailed out when a date has been confirmed.

Our web site www.forestry.ubc.ca will carry regularly updated information on our move and relocation details.

Newsletter Production

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