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SILVICULTURE
SPRING 2005

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Aerial Seeding

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Editorial

by Dirk Brinkman

Canadian Forests: the World's Model Techno Garden

The importance of Canada's leadership in sustaining the flow of ecosystem services from its natural forests was given a boost by three lucid documents recently published. These documents clearly illustrate how everyone's well-being depends on the services that are provided by Earth's ecosystems. Because these visions empower those of us providing ecosystem maintenance and restoration services, they are required reading for all silviculture leaders.

The UN's Millennium Ecological Assessment Synthesis Report (MEA Report) was released in March 2005. Beginning in the year 2000, this report collates the work of 1,360 scientists from around the world. Unlike other UN reports, the structural problem and solution statements match up to its highest analytic thinking.

See page 14 in this issue for a MEA report image of the link between the health of earth's ecoregions and everyone's "freedom of choice and action to be able to achieve what an individual values doing and being."

Of the 25 major bioregions on the land surface, 15 (or 60%) have been degraded to critical tipping points. The most rapid ecosystem changes in history have taken place in the last 50 years. The short-term gains in human well-being and economic development were at the cost of diminishing ecosystem benefits for future generations. These degradations of ecosystem services could grow significantly worse during the first half of this century.

Canadian Ronald Wright's 2004 Massey lecture is a lucid lesson in the potential consequences. It is now available on tape from the CBC Ideas program or on bookstands as A Short History of Progress. Wright describes, "Many of the great ruins that grace the jungles and deserts of the earth are monuments to progress traps, the headstones of civilizations that fell victim to their own success. In the fate of such societies—once mighty, complex and brilliant—lie the most instructive lessons for our own."

Wright's history lessons will alarm many. An expert on the Meso-American corridor, he brings us back to the centuries of successful Mayan agriculture and population growth. Today's ruinas are mute testimony to the possibility of a civilization's collapse.

In January 2005, Jared Diamond's book Collapse: the choices societies make that cause them to succeed or fail revealed a more extensive and methodical analysis of the factors that caused historic and recent societies to succeed or fail. Diamond also wrote Guns, Germs and Steel: the fates of human societies, which looked at the environmental and structural factors that lead to Western society's dominance of the world. Diamond, UCLA's Geography head, compares similar sets of societies that survived or failed due to ecosystem degradation and fragility, superbly nuancing the cultural factors.

He identifies 8 historic factors and adds 4 modern factors, which in various combinations threaten today's highly interconnected geopolitical world. He organized these factors into 4 groups:

A. Losses
1. loss of natural habitats
2. exhaustion of natural food sources
3. loss of genetic diversity
4. erosion or degradation of agricultural soils

B. Limits
5. deeper dirtier energy
6. over-utilized and depleted freshwater
7. over-utilized photosynthetic surface capacity

C. Harm from
8. toxic chemicals
9. alien species
10. atmospheric gases

D. Increasing consumption from
11. population growth
12. increasing per capita consumption.

Through Diamond's eyes we see what was behind the genocidal chaos in Rwanda. General Romeo Dallaire's moral dilemma of keeping his Canadian UN troops neutral during the 1994 killing is well documented in his book (and CBC's documentary of the same name) Shake Hands with the Devil. Dallaire's dilemma has become a part of Canada's international accountability angst.

Rwanda is a tropical country with moderate rainfall and excellent soils for subsistence agriculture. Virtually every hectare was cultivated until the population reached the carrying capacity of the bioregion. Ecosystem degradation combined with several drought years stressed civil society to the breaking point. The terrible killing of 11% of the population was seen internationally as ethnic cleansing. However, in areas where there were no Tutsis, Hutus killed entire Hutus families for their land. It was not simply ethnic cleansing, it was a collapse of the capacity of the natural resources to support the demands of a growing population. Rwanda's horror is the tip of the geopolitical nightmares that will be inevitable without globally coordinated sustainable ecoregional solutions. The MEA report explores global and regional solutions through four future response scenarios. Today's predominant paradigm Order from Strength prioritizes national security and protection. The resulting fragmented world of tariffs and subsidies leads to poor economic growth, especially for developing countries. It results in the worst 50-year projection. The MEA report encourages three alternative responses.

Global Orchestration is the commonly understood alternative for Order from Strength. It assumes a globally connected free trade society with a strong reactive response to ecosystem, population and poverty problems.

Adapting Mosaic focuses locally on adaptive management of watershed based ecosystems. This has the potential to limit initial economic growth unless it is interlinked with Global Orchestration.

The combined scenario of Global Orchestration and Adapting Mosaic is called Techno Garden in which a globally connected world relies on environmentally sound technology (transferred rapidly to developing countries) to optimize ecosystem services from highly managed ecosystems.

Canada's forest ecosystems provide, in addition to clean air and water, 10% of the world's forest wood and fibre. The global threat of geopolitical collapse is an urgent driver to make the changes required in practice, institutions and policy to make Canada the world's model for ecosystem-based forest management. Through adaptive practices, trade and development, Canadian forests can be the world's model Techno Garden.

& Aerial Satellite Imaging Surveys

by Laird Van Damme and Dr. Ulf Runesson

Monitoring changes in forest cover resulting from management activities and natural events is necessary for reporting upon the state of the forest. These reports are in turn a necessary step in evaluating forecasts and objectives that are part of the adaptive management cycle and are a prerequisite for improving forecasts of wood supply and evaluating biodiversity values in subsequent forest management plans. The reports also shed light on the effectiveness of silviculture programs.

Forest cover inventories currently provide the data for all forest management and monitoring programs in Canada. In some unique cases this data is supplemented by permanent sample plots that are measured on a periodic basis (usually every five years).

The basic forest inventory relies upon the interpretation of aerial photographs. Photo interpreters delineate forest stands using a limited amount of field data from plots judged to be representative of certain forest types. These stands are based upon their appearance in terms of relative tree species composition, crown closure, average age and tree height. This technique has been in place since the 1940s and remains relatively unchanged, although each province uses slightly different types of photography, mapping and reporting standards.

Inventories are updated on an annual basis to track changes in forest cover using supplemental aerial photography and satellite imagery. There have been considerable advances in image acquisition and analysis technology over the last several years. There are opportunities to use several types of images to improve the efficiency and timeliness of forest inventory updates or new inventories of large remote forests. This article provides an overview of the technology currently available and its applications.

Satellite Imagery

Satellite images became available in the 1970s and have been successfully used in many forest inventory applications. Early systems had low resolution but the digital format allowed for semi-automated methods of image classification. New technology is now available that can deliver a wide array of products.

Landsat Thematic Mapper (TM) imagery is widely available and was one of the first satellites providing images useful for applications in forest management. TM multi-spectral imagery is

	Satellite	Sensor	# of Bands	Spectral Coverage	Resolution (m)	Scene Size (km)	Cycle (days)	Approximate *Cost/km2
	IKONOS	Panchromatic	1	B/G to IR	1	Custom	2 - 4	$18.00 US
		Multispectral	4	B to IR	4	Custom	2 - 4	$18.00 US
	QuickBird	Panchromatic	1	B to IR	0.61	Custom	1 - 3.5	$22.00 US
		Multispectral	4	B to IR	2.44	Custom	1 - 3.5	$22.00 US
	IRS P	Panchromatic	1	G to IR	5.8	23 x 23 - 70 x 70	24	$0.51 - $1.70 US
	IRS LISS	Multispectral	4	G to IR	23.5	70 x 70 - 140 x 140	24	$0.13 - $0.39 US
	Spot 5	Panchromatic	1	B/G to IR	2.5	20 x 20 - 60 x 60	26	$2.15 - $6.88
		Panchromatic	1	B/G to IR	5	20 x 20 - 60 x 60	26	$1.21 - $5.69
		Multispectral	4	G to IR	10	20 x 20 - 60 x 60	26	$1.21 - $5.69
	LANDSAT 7	Panchromatic	1	G to IR	15	185 x 170	16	2.5¢ for all 8 bands
		Multispectral	7	B to IR	30			

* Prices estimated as of April 2005 for standard Canadian data. Discounts for archived data, large orders, or other promotions are not included in estimates.

Table 1: Satellite sensors with potential for forest management planning

very affordable and provides ideal spectral coverage and spatial extent for landscape-scale information extraction. Unfortunately, the relatively low spatial resolution of TM multi-spectral data (30 m) is insufficient for providing accurate species types and developmental stages without data from other sources. Landsat imagery has generally been limited to providing a broad summary of forest cover and activities for forest management in Canada.

Forest inventory updates to account for harvested or naturally disturbed areas require higher resolution. Spot 5 and IRS are commonly used for this task. Table 1 lists some of the high resolution options that are now available.

There are several ways to supplement forest cover evaluation using more than one sensor. Multi-stage sampling and image fusion are two options. Multi-stage sampling uses sample theory probabilities to train a low cost, low resolution image with a sub-sample taken from higher resolution images of portions of the same scene. Fusion combines the digital data from one image with another image using statistical methods.

Both approaches were used to develop forest cover themes for the Caribou Forest in Northwestern Ontario in two separate graduate student projects at Lakehead University. These projects were sponsored by the Living Legacy Trust Fund.

The first project used 5 scenes of 4-metre, multi-spectral data from the IKONOS-2 satellite to sub-sample a Landsat scene showing full coverage of the forest. The second project fused the image provided by Landsat with IRS. Both methods generated acceptable forest cover themes at much lower costs than traditional inventory methods but provided limited information about forest structure (i.e. age class). Additional data from historical fire event maps, older forest inventories, or further sub-samples with higher resolution images will be necessary to assign stand structure attributes. Figures 2 and 3 illustrate the sub-sample and fusion methods respectively.

The digital data supplied by satellites allows for semi-automated methods of classification. New systems are available that allow for object-oriented classification by first segmenting the image into polygons based upon certain characteristics, such as (but not limited to) shape, context, texture and colour. Another approach is the statistical canopy separation based on colour (spectral) characteristics for individual tree classification (ITC), which has shown some potential, but there are challenges related to operational implementation with some common boreal cover types. This process is similar to what a photo interpreter does on an aerial photograph (Figure 3).

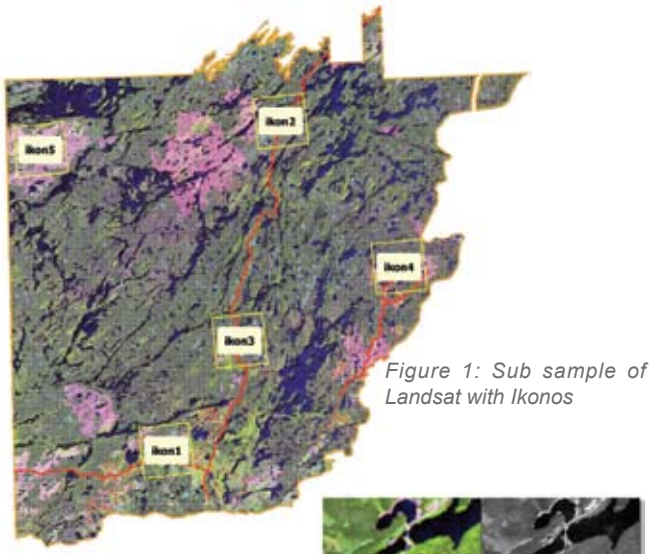


Figure 1: Sub sample of Landsat with Ikonos

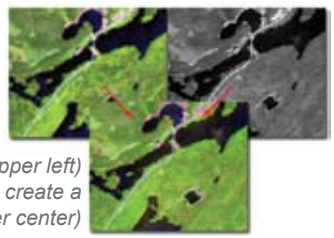


Figure 2: Example of Landsat (upper left) and IRS (upper right) fused to create a new image (lower center)

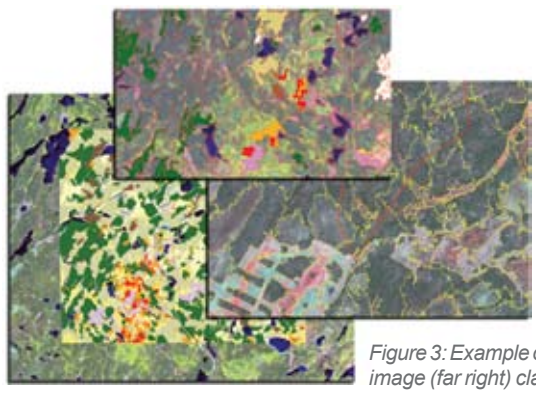


Figure 3: Example of segmented image (far right) classified using several other sources of information depicted by themes on the left

Aerial Sensors

The advances in remote sensing are found partly in new air borne sensors, including digital cameras or digital capture of conventional photographic prints. LIDAR and other sensors provide accurate tree heights and elevations. Despite rapid technological advances, most forest inventories and updates rely on conventional or digital aerial photography for the following reasons:

- Superior resolution
- More consistent availability (cycle times not dictated by orbits as shown in Table 1)
- Competitive costs
- High quality stereo

Digital aerial photographs can be interpreted manually (either with prints or with softcopy tools) or assisted with classification and segmentation software that is used on satellite imagery. Ortho rectification and mosaic construction can facilitate inventory updates (Figure 4).

Figure 4: Ortho rectified mosaic of digital aerial photographs

Silviculture effectiveness monitoring requires high resolution data. The highest resolution images available today use helicopter fixed booms to generate stereo images on 70 mm film (Figure 5). These images can show detailed forest structure attributes such as seedlings in regenerated areas and coarse woody debris.

Figure 5: Large scale aerial photograph platform (with permission from Wiskair).

Other data require even greater resolution. A person in the field is still the most reliable source for this level of detailed data such as height increment of seedlings (Figure 6).

Figure 6: Field personnel still have vital roles to play in data capture.

The challenge is to make efficient use of these new data sources and tie them together into a system designed to deliver meaningful information in a timely fashion. For example, Ontario released a silviculture effectiveness monitoring guideline in 2002.

The backbone of effectiveness monitoring is a record keeping system and two types of surveys: 1) Silviculture condition (i.e. regeneration survey) and 2) free to grow (FTG) through air and ground surveillance. Only the latter survey is mandatory. Large scale aerial photography can provide an objective, auditable source of data for these surveys.

The proposed methods are a good start but operate at a course scale. By the time any trends show up in the data, they would be self evident and actions would likely already have been implemented to correct for any apparent problems. The current objectives for stocking and time to reach FTG are somewhat arbitrary in most silviculture ground rules (SGRs) published in forest management plans. Similarly, the funding level of the renewal trust fund is based on historical precedent and is somewhat arbitrary. If companies choose to spend less money on silviculture and still meet FTG and SGR objectives then the companies' obligations for forest renewal have been met. This approach encourages efficiency, but the feedback system is coarse and has sufficient time lags that some problems may go undetected.

Many companies recognize this potential problem and implement silviculture condition surveys that consist of the systematic placement of fixed area plots where tree stocking and density (sometimes by height class) are recorded along with percent cover of competing vegetation. A sub sample verifies soil/ecosite information. This approach can detect problems in a timely fashion. However, when problems are detected, the root causes can be elusive and confounded by variable site, stock, treatment and weather conditions inherent with systematic surveys that cover large operating areas.

One solution is to supplement effects monitoring with controlled experiments. Experimental methods can also be used to test cost effectiveness of new or competing practices. These methods require high resolution images and/or people on the ground collecting data. The array of images and information available as described above can be used to help stratify the forest, reduce survey costs, and make more detailed surveys affordable.

Summary and Conclusions

A wide range of image sources are now available on different platforms to detect forest cover changes over time. Higher resolutions and wider spectral ranges come at a higher cost. Multi-stage sampling and image fusion can combine low cost sources with high cost sources in a manner that reduces overall costs.

Silviculture effectiveness monitoring requires detailed information. Practices can be improved by using experimental design principles. This data can be acquired, if traditional survey costs are reduced, or used to stratify the forest to facilitate increased sample efficiency. Despite technological advances there are still important roles for field personnel in the collection and interpretation of data describing forest change.

Laird Van Damme is a managing partner at KBM Forestry Consultants Inc. and an adjunct professor at Lakehead University. Dr. Ulf Runesson is an associate professor at Lakehead University. The article is based upon their collaboration with Dave West at Bowater Canadian Forest Products Inc. and Shelagh Duckett at the Ontario Ministry of Natural Resources in Thunder Bay, Ontario.

AERIAL SEEDING

By Rob Vassov and Katherine Wolters

Photo courtesy of Oceanview Helicopters

Photo courtesy of Oceanview Helicopters

Photo courtesy of Telko Industries

Aerial seeding of conifers came into operational use with the advent of helicopters and blading site scarification in the late 1950s and 1960s in BC, Alberta and Ontario. The invention and development in 1962 of an airborne tree seed broadcaster, by Howard Brohm of the Research Branch of the Ontario Ministry of Natural Resources, dramatically increased the area of forest lands that were direct seeded. Until 1968, the Brohm seeder was used in combination with helicopters but since has been adapted for use with fixed wing aircraft.

Seeding Helicopter, Grant Glessing, Silviculture Forester, Tolko Industries Ltd, Quest Wood Division Quesnel, BC

MacMillan Bloedel employed this regeneration technique up until the 1980s. The achievement of improved planting success rates, supported by research funding and public approval, lead to the phasing out of aerial seeding programs in the western provinces.

Seeding in Canada, as a form of artificial regeneration has declined from 31% in 1980 (CCFM 2005) to less than 5% in 2002. In 2002, reforestation in Canada was comprised of 55% natural regeneration, 40% planting, and 5% seeding. Approximately 93% of the seeding efforts were found in Ontario and 7% in Alberta, in 2002.

Past use of aerial seeding in Alberta and British Columbia achieved variable results caused by uncertain losses attributed to rodent predation, lack of a proper seedbed, a short window for germination, spring frosts, and droughts. Aerial seeding also requires a large volume of expensive viable seed and, if pine is seeded, an extensive exposure to mineral soil. There are additional worries about site degradation due to scarification and the public's acceptance of these treatments.

Aerial seeding may pose a risk to plantation performance through overstocking and excessive competition for sunlight, moisture and nutrients. This can result in costly thinning requirements or re-treatment for an entirely new crop. However, wood quality may suffer from understocking and forest managers need to balance density requirements across their forests to meet their overall plantation performance objectives.

Today, there is a greater knowledge of individual tree species germination and site requirements. Changing climatic conditions have exacerbated forest health concerns, increased the extent and intensity of destructive wildfires, and complicated forest management. Silvicultural foresters are required to be increasingly creative when they consider their approach to planning future forest stands and they are aware that there is no single solution to regeneration problems. Foresters are always looking at cost-effective alternatives and aerial seeding of conifers could provide an effective choice, under the right circumstances.

Aerial seeding in Ontario, however, has a high success rate and is employed as a low cost effective regeneration technique for jack pine, red pine, and black spruce in the boreal forest. Jack pine represents about 80% of areas seeded while black spruce makes up the remainder. Weyerhaeuser Dryden adds 5% red pine to the seed mix to meet their mandate of increasing red pine content on suitable sites. Aerial seeding programs in Ontario practice strict adherence for the re-introduction of seed to parent seed zones.

Jack Pine Seed, Jeff Leach, Silviculture Forester, Tembec, Kapuskasing Ontario.

Companies in Northwestern Ontario, such as Weyerhaeuser and Bowater, predominantly aerially seed jack pine on medium to coarser textured soils where broadleaf competition is not a problem. Inaccessible or difficult to reach sites are also considered for an initial aerial seed followed by spot and fill plants if adequate stocking is not attained. Some years, up to one third of all regeneration activities consists of aerial seeding.

Jack pine seeding can occur from mid-February to the beginning of May. Typically, jack pine is seeded on top of the snow at a rate of 50,000 seeds/ha. More recent practice shows successful regeneration as a result of seeding later in the season, after the snow has melted, and at lower rates (35,000 seeds/ha); however, the site must contain enough moisture for the seed to germinate and establish a robust root system. Local hydrological site characteristics and weather patterns are critical to avoid early summer drought conditions.

Mineral soil exposure is a pre-requisite for successful application of seeding. Often, barrels and chains or power disc trenchers are used to expose mineral soil, remove slash and provide some density control. Jack pine aerial seed success rates are reported as relatively high for this area of Ontario and few plantations are considered failures. Part of this high success may be attributed to the favourable silvics of jack pine towards natural regeneration.

Once a plantation is established, density control in the form of pre-commercial thinning is required on approximately half of the treated blocks. An average total cost for an aerially seeded thinned plantation without a herbicide treatment is in the neighbourhood of $630/ha (site preparation $220, aerial seed $20, seed collection and extraction $90, pre-commercial thinning $350, and herbicide if needed +$120).

Tembec of Kapuskasing has experienced success in aerially seeding lowland black spruce sites in the Claybelt of northeastern Ontario since 1987. Their program incorporates the use of a Piper PA-18A fixed wing aircraft equipped with a Brohm Mark III Seeder. The aircraft

also incorporates a differential GPS guidance system, which allows for maps and records documentation of flight sessions. Black spruce seeds are broadcast at a rate of 50,000 seeds/ha over 2 consecutive years. The target sites are specifically sphagnum lowland sites containing an undisturbed seedbed whereby the underlying water level can provide continuous moisture to the surface. Suitable sites are also selected where there is an insufficient supply of natural seed source within the vicinity of the block.

Mistik Management Ltd, of Meadow Lake, Saskatchewan relies on pine natural regeneration to reforest the majority of their harvested lands, but an aerial seeding treatment was used in a situation where the natural seed source was non-existent. 800 hectares, consisting of mostly young plantations were burned in a large wildfire.

Although, the plantations had been declared free-growing, the foresters realized that due to the extent of the fire and the age of the burned stand, without any intervention, the area would remain under-stocked. The low cost of an aerial seeding treatment was considered to be a trade-off with the potential variable results.

A helicopter with an Alberta Forest Service aerial seeder attachment was used to spread seed at the rate of approximately 40,000 seeds/ha onto the very poor, sandy site in 1995.

Seeded Black Spruce on Sphagnum, Jeff Leach, Silviculture Forester, Tembec, Kapuskasing Ontario.

The increased risk of seed predation in winter and the advantage of moisture provided by snow cover was balanced by choosing to complete the treatment in the month of April, with melting snow present on the ground.

Now, 10 years later, the company foresters admit that they may not have achieved the government reforestation standard of 80%, but they are pleased that they have a new forest growing on the site.

Saskatchewan government policy does require that forest companies maintain a 10-20 year seed supply. This would enable the planning of an aerial seeding program if specific circumstances warranted it.

Sanitation harvesting in pine dwarf mistletoe affected stands could result in the elimination of a natural seed source, resulting in a potential use for aerial seeding.

Tolko Industries Ltd, Quest Wood Division in Quesnel, BC experimented with an aerial seeding program by choosing to treat a 60-hectare block characterized by a sufficient exposure of mineral soil. Cone surveys identified that an insufficient amount of wild, lodgepole pine seed was available to naturally regenerate one portion of the block.

After a professional biologist determined that rodent populations were a low risk, hybrid spruce seed was spread at 200,000 seeds/ha on one-third of the area, which had insufficient wild seed, and at 100,000 seeds/ha on the remainder of the block, to achieve a diversity of species and a completely stocked block.

A helicopter fitted with an Isolair Broadcaster attachment and equipped with a GPS guidance system made for very accurate seed application.

Seeding was completed in January 2005, to take advantage of the protection of the anticipated winter snowfalls. Instead, an unusual warming trend resulted in significant rain and the reduction of the snow pack, but the block will be monitored over the next 3 years to determine germination success and ingress.

Low cost Class “B” spruce seed was used for this project, which meant that the treatment cost of approximately $270.00/ha compared favourably with other regeneration methods.

Forest companies in the western provinces could consider aerial seeding as an alternative to add flexibility to their reforestation programs.

Aerial seeding might be combined with a light density planting treatment or used to increase stocking levels of young stands affected by significant forest health losses.

The combination of technological advancements like GPS capability, a greater understanding of the silvics of tree species, the ability to manage predation risks and the production of viable seed at affordable rates could result in greater success rates in aerial seeding treatments.

Aerial seeding in Canada is a reforestation method that has experienced more popularity in the past and appears to be on the radar screen of forest managers as a lower cost regeneration alternative to planting in the future.

Thank you to the following people for their contributions to this article: Colin Bowling, Ken Broughton, Craig Evans, Craig Frame, Vicky Gauthier, Tim Griffin, Grant Glessing, Dr. Scott Green, Dr. Chris Hawkins, Bill Klages, Dave Kolotelo, Janet Lane, Jeff Leach, Roger Nesdoly, and Ernst Stjernberg.

Rob Vassov (Ontario Registered Professional Forester and a BC Transferring Professional Forester) is a forestry consultant providing services in resource planning, growth and yield, and LiDAR application to forestry. Visit www.rjv.ca. Katherine Wolters (British Columbia Registered Professional Forester) has an extensive background in silviculture and ecosystem classification. Currently she is involved in resource planning, growth and yield and timber supply analysis.

Industry News

Forest Regeneration Symposium

A symposium dealing with forest regeneration is taking place in Thunder Bay, Ontario from July 25-28. There will be two days of concurrent sessions and a day of field tours viewing forests regenerated by innovative reforestation practices. Papers being presented come from Canada, the US, and Europe. For registration information go to www.forestrenewal.ca/thingreenline or contact Sonia Gellert at sgellert@kbm.on.ca or 807-345-5445 ext. 34.

Stock Handling Workshops

The Forest Renewal Co-op is presenting Stock Handling workshops reviewing successful tree seedling handling from nursery to field. This is an opportunity for forest companies, contractors and nurseries to discuss appropriate stock handling. Sessions will be held April 28th in Hearst and May 5th in Kenora, Ontario. Contact 807-343-8669 or forestrenewal@lakeheadu.ca for registration information.

Revision to IPM Legislation

Environmentally safe animal repellents are now easier for BC professional foresters to include in their silviculture toolbox for managing newly reforested areas. BC's recently revised Integrated Pest Management Legislation (IPM), Bill 53, promotes increasingly benign solutions to mitigate browse damage by animals such as deer, rabbit, elk, moose and voles. Animal repellents that have federal Pesticide Management Regulatory Agency approval are now listed as 'excluded pesticides' under the BC Pest Control Act. Provincial ministry permits are no longer required by BC foresters to apply animal repellents.

The previous Pesticide Control Act is still in effect where existing authorizations are issued until permits expire or are revoked so foresters would need to make a written request to have the repellents taken off the pesticide list to be free of the licensing and certification requirements.

ABCFP Awards

The Association of BC Forest Professionals recognized individuals for their commitment and dedication to forest resources management and the forestry profession in BC. Bill Bourgeois, PhD, RPF and Larry Pedersen, RPF were presented Distinguished Forest Professional awards for outstanding service to the forestry profession and for furthering the Association's principles. Dirk Brinkman, editor of *Canadian Silviculture* was the first silviculture practitioner to be made an ABCFP Honorary Member for his outstanding contributions to forestry and forest resource management in BC. Norm Shaw, RFT was awarded Forest Technologist of the Year for his efforts to create the Registered Forest Technologist designation.

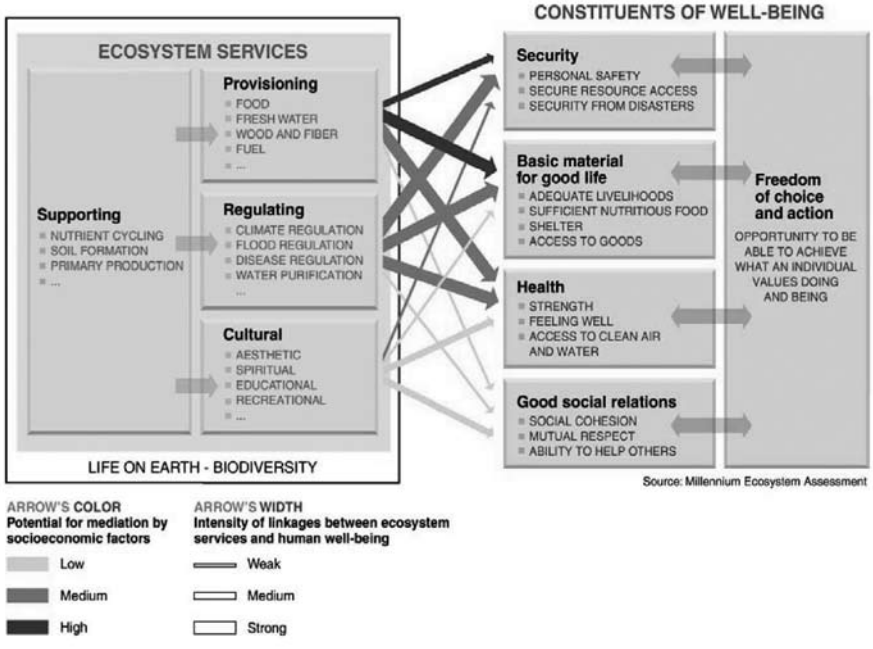
New Brunswick Forestry Hall of Fame

During the recent annual Silvicon forestry conference in Fredericton, Girvan Harrison - who retired one year ago from the Maritime College of Forest Technology - was inducted into the New Brunswick Forestry Hall of Fame. Harrison has the accreditation of Certified Forest Technician and Registered Professional Forester. His career includes work in surveying, forestry consulting and contracting services, Crown land management, and most recently, as an instructor at the Maritime College of Forest Technology.

Nova Scotia Forestry Hall of Fame

On March 31st, Ed Bailey, Russell McNally, Bob Burgess, and Gary Saunders were inducted into the Nova Scotia Forestry Hall of Fame.

Editorial continued: The following image shows linkages between ecosystems and human well-being



Forest Health

by Judy Loo & Tannis Beardmore

Butternut May Be Doomed

The Committee on the Status of Endangered Wildlife in Canada (COSEWIC) announced their recommendation that butternut (Juglans cinerea) be listed as an endangered species in November 2003. This designation is significant because it is the first time that a relatively widespread tree species has been listed as endangered in Canada. Butternut is native to three provinces in Canada: Ontario, Quebec and New Brunswick. Although it is not an important timber species, it does have high value locally, both economically and ecologically. Butternut lumber is valued for furniture, paneling, and specialty products and its nuts are valued primarily for stains and for human and wildlife consumption. Historically, the nuts were prized by Aboriginals and early settlers.

Photo by Ed Hurley, Atlantic Forestry Centre, showing crown dieback in a diseased butternut tree.

The species is endangered because of a fungus, Sirococcus clavigignenti-juglandacearum, which is presumed to have been introduced from Asia; it causes multiple cankers in the crown and bole, resulting in the death of susceptible trees. To date, control measures for this disease do not exist. Butternut canker has spread rapidly, since the fungus was first identified as the causal agent in 1967, from the southern and western areas of the species range in Tennessee and Wisconsin, northward and eastward.

The fungal spores causing butternut canker are thought to be spread by rain, and possibly by insects or birds. The spores grow, usually appearing first in the fine branches of the crown. Spores are carried down the trunk by rainfall and cankers typically form on the trunk after the crown begins to die back. The first visual sign of butternut canker is often a thinning of the canopy and death of small branches in the crown. Unfortunately, a number of diseases cause similar symptoms, and without a close inspection of the small branches, it is impossible to be sure that observed dieback is caused by butternut canker. When the more readily identified cankers appear on the trunk, the disease is usually already well established in the crown. Cankers are longitudinal and have the appearance of dark cracks in the bark. Trees are eventually killed when the cankers become so numerous that they girdle the trunk.

Butternut canker kills trees of all sizes and ages. Unlike Dutch elm disease and beech bark disease, both of which preferentially kill large trees with the result that many trees reach reproductive age before dying, butternut canker kills small trees first, because a small bole requires fewer cankers to complete the girdling. Large trees may survive for many years before succumbing to the canker simply because it takes time for cankers to form, side by side around the trunk, girdling and killing the tree.

Fungal spores causing butternut canker may be carried on nursery stock and even on the surface of or inside the nuts. It is essential to avoid moving seeds or seedlings from an infected area into an area that is still free of the disease. This will help slow down the spread of the canker. Unfortunately, it appears that only small pockets remain disease free within the natural range of the species.

Butternut may go the way of American chestnut over the next few decades. In fact, that scenario is highly probable unless genetic resistance to the disease already exists in natural butternut populations. There is some evidence for the presence of partial genetic resistance occurring at low frequency in natural populations, but this has not yet been proven. If such resistance exists, it is important to find and propagate the trees, in order to maintain a base of resistant genotypes that is as diverse as possible. This means that trees should not be cut at the first signs of disease, because this valuable germplasm may be lost. Natural selection will operate by killing susceptible trees and those trees remaining after all trees are exposed may exhibit partial or complete resistance to the fungus. A resistance breeding program could then be implemented to develop material to restore butternut to the landscape.

Photo by K.J. Harrison, Atlantic Forestry Centre, showing the form of butternut canker on an exposed root.

In the absence of genetic resistance to the canker, butternut is doomed. If it exists, genetic resistance may save butternut from extinction, but only with help from landowners, who must refrain from cutting the trees at the first sign of canker.

Judy Loo and Tannis Beardmore are Ecological Geneticists with Natural Resources Canada, Canadian Forest Service, Atlantic Forestry Centre, in New Brunswick. For more information, contact the Atlantic Forestry Centre at afcpublications@nrcan.gc.ca.

WESTERN SILVICULTURAL CONTRACTORS' ASSOCIATION

by Tony Harrison

Making Sense of BC Forestry Funding

Adequate forestry funding with a long-term commitment dictates the fate of silviculture and ultimately whether the forest industry on the whole is sustainable. The province values its standing forest asset value at $250 billion, which generates exports of $16 to $19 billion a year, and government revenue of $1.4 to $1.9 billion a year. What is a reasonable cost to maintain the forest asset to ensure we continue to reap the benefits of an annual 75 million m3 harvest level?

The funding numbers are broken down between industry and government as follows:

Steady state forestry funding is borne by the private sector and BCTS by legal statute. It costs $190 million annually to reforest newly harvested areas on public lands. This process gets trees back on the landscape with a commitment to grow but not necessarily a commitment for long-term wood quality and optimum stocking of the site.

NSR backlog (not sufficiently restocked areas logged, disturbed by wildfires or pests prior to 1987,) is government's responsibility and the historic arena of provincial and federal wrangling over cost-sharing. Annual levels of NSR funding in the past peaked at $175 million in the late 1980s, dropped to $100 million in the early 1990s, fell to $50 million in the late 1990s, and plummeted to $4.5 million in 2004 with FIA. The record low of 2004 was preceded by a disturbing legal precedent: a provincial forest practice code amendment dated December 17, 2002 left reforestation on certain NSR sites at the discretion of the provincial government.

Without enough funding to address increasing wildfire damage, or brushing of existing plantations, the devil NSR is on the rise again. Add this to the 7 million ha affected by Mountain Pine Beetle (MPB) and we're at our current full-blown forest crisis.

So where's the cavalry? Ministry of Forests sources estimate that the annual cost to meaningfully address current backlog is $150-200 million annually for the next 10 to 15 years. The current provincial Liberal government announced "Forests for Tomorrow" (FFT) in March 2005 as a five-year plan to address the increasing NSR (outside industry obligations), initially focusing on areas affected by MPB and large fires. The plan is to ramp up over 4 years to a $96 million annual commitment that stays in place for 10 to 15 years. (A particularly inspired approach that FFT has taken is to make the funding available directly to silviculture consultants and contractors, if the local licensees are not interested in taking on the projects for the 9% administration overhead.)

The proposed provincial contribution is half of what is needed to keep the forest industry viable. The Feds have committed $100 million for 2005, with rumours of $1 billion over 10 years to make up the difference. Sounds good, but do the math. We need a minimum of $2 billion over the next 10 years and we have $285 million committed at time of publishing.

To use an old cliché, "the road to hell is paved with good intentions." We need to vigilantly lobby for forest funding guaranteed over a longer term than political mandates, and at levels that can effectively maintain our forest asset. We need to make sure that this current momentum carries through to commitment and that the funds are spent wisely. There's too much at stake here to throw money at outdated processes. We need to support research to promote profound change and long-term solutions.

To this end WSCA is in the process of forming a coalition of forestry related businesses to lobby and undertake three studies that will be funded by federal, provincial and private sources. Funding topics are as follows:

1. Define the extent of the silviculture need. Develop a map base to estimate the spatial scale of silviculture investment opportunities. How much productive forest is not being reforested? How close are we to meeting or even coming close to our sustainability goals?
2. Establish that silviculture investment makes economic sense. Develop a comparative economic analysis comparing discounted cash flow and multi attribute approaches. Reshape the economic analysis framework so that silviculture expenditure is not seen as a future investment but is rather accrued to current costs.
3. Identify what are the most cost-effective models from a site level perspective. This entails an analysis of the costs of doing good quality reforestation versus the costs of doing poor silviculture or just leaving for naturals. What is the actual cost to free growing and how does managing to minimums at the front-end of the process affect the long-term economics?

For more information on forest funding and the WSCA initiative refer to www.wsca.ca and www.forestgroup.ca

ONTARIO

FOREST RENEWAL CO-OPERATIVE INC.

by William F. Murphy, RPF General Manager

Is there a shortage of logs? Is there a shortage of fiber? Is there a shortage of land? Is there a shortage of funding? And finally, where are the shortages? In Ontario, there is a growing concern over the above items. We have a renewable resource, and the economy requires some sort of agreed input from the pulp and paper, logging industry and the Ontario Ministry of Natural Resources (OMNR). The crown lands of Ontario were initially managed by the Ministry of Natural Resources, which gradually relinquished the management to the forest companies. Who is managing the vacant farm land and old agricultural fields that are gradually increasing throughout Ontario? Who is managing the private land after the timber has been harvested? It is coming to a point where the private land is going to become devoid of valuable timber assets because no one is there guiding the way. On the Crown Forest lands, there are harvesting guidelines, riparian reserve guidelines, silviculture guidelines, and forest management plans starting in 2007 and spanning a 10-year period. Where are the guidelines for the private land? The landowner sees a good dollar in the timber that is available to others for harvesting but no one is responsible to put the land back into active production. Up to 1994, there were programs initiated by the OMNR to provide people with tree seedlings to try to cover their small lots with trees. That was 10 years ago, and today the lots are a lot bigger, wood fiber is more valuable and nothing is being done in a big way to regenerate this land. Some forest companies are buying private land, harvesting the timber and replanting. Some are buying vacant farmland and afforesting with prime seedlings, while others are just starting to think about it and are still buying wood off these lands. In Nova Scotia, the lands are 80% privately owned and there is a program which states that private land cannot be harvested by a contractor unless the mill receiving the wood provides a regeneration program for that property. We now have the Woodlot Association, which works well in Southern Ontario, the Stewardship Council, Conservation Authority Associations, and the Managed Tax Incentive Program. This tax incentive is no longer becoming an incentive but a hindrance to managing private land. Where are the guidelines, the incentives and the responsibilities to govern these issues? We are worried about our Crown Forest lands and we have all the highest levels of the Ministry and the forest companies trying to solve the fiber situation. Who is going to look after the growing void being left on private lands while the Ministry and the companies settle a crown problem? Have we forgotten that this renewable resource extends beyond the boundaries of our Crown Lands?

QUEBEC

ASSOCIATION DES ENTREPRENEURS DE TRAVAUX SYLVICOLES

par Marie-Andrée Mill, Responsable des communications

Coupure de 20 % de la possibilité forestière des régions du Québec

Au moment de soumettre mon texte pour la présente édition du Canadian Silviculture, une nouvelle a secoué l'industrie forestière québécoise qui m'a forcée à revoir complètement le propos de cet article. En effet, le ministre des Ressources naturelles et de la Faune a déposé le 17 mars dernier un amendement au projet de loi 71 contraignant les régions ressources à une réduction de 20% de leur possibilité forestière respective dès le 1er avril 2005. Cette décision du ministre a complètement ébranlé le monde forestier québécois. Selon les premières estimations, une coupure de cette ampleur pourrait coûter à la province plus de 11 000 emplois, ce qui créerait un déséquilibre économique monstre pour les régions ressources.

Le ministre a justifié sa décision en affirmant mettre en branle la recommandation la plus importante de la Commission d'étude sur la gestion des forêts publiques québécoises qui affirmait en décembre dernier que les calculs de possibilité forestière avaient une marge d'erreur significative et qu'il était important de procéder à une réduction de 20 % par mesure de précaution. Toutefois, la Commission avait également signalé au ministre dans la recommandation 9.5 l'importance de mettre en place simultanément plusieurs mesures afin d'atténuer les conséquences néfastes qui découleront inévitablement de cette importante coupure. Parmi ces mesures, les commissaires avaient entre autres ciblé l'intensification de l'aménagement forestier comme une manière de conserver une partie des emplois tout en favorisant l'augmentation du capital ligneux. À ce jour, le ministre n'a considéré aucune de ces avenues. Il propose plutôt d'agir sur un seul facteur déterminant et de prendre le pari que l'industrie forestière s'ajustera d'elle-même aux compressions envisagées. Par contre, il est bien évident que pour les villes dont l'activité économique principale se situe au niveau de la récolte et de la transformation du bois (elles sont plus de 150 au Québec), les conséquences n'en seront pas moins dramatiques.

Grille de taux

Le Ministre des Ressources Naturelles d'abolir la grille de taux qui régit actuellement le paiement des traitements sylvicoles pour les soumettre aux règles du libre marché dès avril 2005. L'AETSQ a appris en février dernier que le ministre avait choisi d'écouter les recommandations de notre organisation et de maintenir la grille de taux pour la saison 2005 permettant ainsi à l'industrie sylvicole de se préparer à un éventuel retour au libre marché en avril 2006.

Toutefois, une modification a tout de même été apportée au règlement. Jusqu'à maintenant, le gouvernement remboursait aux bénéficiaires de contrat d'approvisionnement et d'aménagement forestier 100% du montant prévu dans la grille pour la réalisation de travaux sylvicoles. À compter d'avril, le ministère exigera des bénéficiaires qu'ils assument 10% des investissements en sylviculture, ce qui implique que le gouvernement ne remboursera que 90% de la valeur des traitements sylvicoles.

Au cours des prochaines semaines, le ministre des Ressources naturelles devrait mettre en place un comité chargé de préparer l'industrie des travaux sylvicoles au retrait de la grille en avril 2006. L'AETSQ compte bien participer activement aux travaux de ce comité. D'ailleurs, un des projets qui facilitera un retour au libre marché réside dans l'instauration d'une accréditation des compétences des entreprises sylvicoles. Ce dossier a reçu un appui majeur de la Commission et nous avons bon espoir qu'il voit le jour au cours des douze prochains mois.

QUEBEC

TRANSLATION

by Marie-Andrée Mill, Communications Co-ordinator

A 20% Cut in Quebec's Regional Forestry Potential

As I was about to submit my text for inclusion in the current issue of Canadian Silviculture, an announcement shook the Quebec forestry industry that obliged me to revise the content of this article. On March 17, 2005 the Ministry of Natural Resources and Wildlife tabled an amendment, taking effect on April 1, to draft law 71 imposing a reduction of 20% of their respective forestry potential on the resource regions. This decision by the Minister has completely upset the Quebec forestry community. Preliminary estimates indicate that a cut of this magnitude could cost the province more than 11,000 jobs, creating a huge economic imbalance in the resource regions.

The Minister justified his decision by claiming to be implementing the most important recommendation of the Commission to Study the Management of Public Forests in Quebec (Coulombe Commission), which stated last December that calculations of forestry potential were subject to a significant margin of error and that it was important to proceed with a 20% reduction as a precautionary measure. However, the Commission had also pointed out to the Minister, in its recommendation 9.5, the necessity of putting in place simultaneously several measures designed to reduce the negative consequences that will inevitably result from this major cut. Among these measures, the commissioners had targeted intensification of forest management practices as a means of retaining part of the jobs while bringing about an increase in timber supply. To date, the Minister has taken no account of these proposals. He intends instead to act on the basis of a single determining factor and to gamble that the forestry industry will adapt itself to the proposed downsizing. It is very evident, however, that for towns whose principal economic activity takes place in the context of harvesting and processing lumber (there are more than 150 of them in Quebec), the consequences will be no less dramatic.

Rate Scale:

The Minister of Natural Resources intended to abolish the rate scale that currently regulates payment for silvicultural practices, in order to expose them to free market forces beginning in April 2005. The AETSQ learned in February that the Minister had decided to listen to our organization's recommendations and to maintain the rate scale for the 2005 season, allowing the silvicultural industry to prepare itself for an eventual return to a free market in April 2006.

However, one change has been made in the legislation. Until now, the government rebated 100% of the amount listed in the rate scale to the holders of wood supply and silvicultural work contracts to cover silvicultural projects. Beginning in April, the Minister will require contractors to assume 10% of the amounts allocated to silviculture, which implies that the government will reimburse only 90% of the silvicultural costs.

During the coming weeks, the Minister of Natural Resources should set up a committee charged with preparing the silvicultural industry for the withdrawal of the rate scale in April 2006. The AETSQ expects to take an active part in the work of this committee. Moreover, one of the projects that will facilitate the return to a free market situation is the creation of a system for accreditation of silvicultural companies. This question received major support from the Commission and we have every reason to hope that it will become a reality over the next twelve months.

NEW BRUNSWICK

AGFOR REPORT

by Gaston Damecour

Every Week Should be National Forest Week

A small francophone business think tank made up of private practice foresters and business people in New Brunswick has been quite active lately. I mention francophone because most francophones live and work in rural New Brunswick and rurality is a recurring theme for this group. While government is attempting to establish a position on the important question of long-term wood supply, a more immediate issue is the general well being of our rural communities.

AGFOR's People Land & Markets describes the key elements for balanced development and prosperity. Some elements can be developed, imported and moved from one region and even country to another, but in the end they all have to come together for development to succeed in a region.

Rural communities, with a few exceptions, have lost a once strong and vibrant interest in the forest sector. This is reflected in a decrease in employment, business activity and ultimately in an exodus of the younger population. The lack of interest is also reflected in a general decrease in post secondary enrollments across Canada and the sector's difficulty in attracting a younger work force. This is not unique to New Brunswick.

In the last issue, we mentioned the closure of the Sainte-Anne Nackawick hardwood pulp mill and the pending and now confirmed closure of UPM's pulp operations in Miramichi. These closures have had an impact in every part of the province. Other recent fiber transfers and closures continue to send a somewhat negative message.

It would seem that before embarking on an aggressive wood supply program, we would need to regain the trust and enthusiasm of our communities that should have the most to gain (or lose). Their support and conviction are perhaps the most crucial ingredients to achieving prosperity in an industry that is by nature very rural and even remote.

Every week should be national forest week, and every person and business should make it a point to communicate that message to everyone that they work and live with. Good news can be small news, such as a hiring, a new piece of equipment, a successful bid, the start of a new season, or a new market for our businesses. No matter how small, this positive news can contribute to generating a glass is half full attitude while sharing information that our local people can relate to.

We see this kind of public information in the agriculture sector with real farmers giving the public a head's up on the next crop, which creates anticipation and demand.

Every week should be National Forest Week.

PEI FOREST IMPROVEMENT ASSOCIATION

by Wanson Hemphill, Manager

Longer sunny days, freeze and thaw, and weight restrictions describe spring on PEI. February to April is the time of many meetings, discussions and planning among those remaining on PEI. This is the "season between seasons" of mud, weights and maple sugar. Bills still keep coming, costs still keep rising and longer hours are needed to keep ahead.

The Forestry Policy Discussion Paper on the role and policy of PEI government in public forests is now complete. Province-wide meetings were held with much discussion and a wide variety of opinions on both the 13% public land and the 87% private land. Very interesting reading on public interests and ideas regarding the values and uses of forests can be found on www.gov.pe.ca (search forest policy). Clearcutting, plantations, education, value-added, and the need to set a good example on public forests are the main topics, but many other suggestions are also presented. The Public Forest Council will sift, consolidate, discuss and forward recommendations to PEI government that will decide on which recommendations to bring forward to a new PEI Forest Policy.

Forest Certification is moving along slowly on PEI. Excellent presentations from Jennifer Landry and Tommy "the talker" Harper were heard at the PEI FIA Annual Meeting in March. Workshops on certification were conducted by the PEI Model Forest Network Partnership Ltd. in April.

Due to substantial WCB rate increases, forest employers are trying to reduce huge WCB bills by complaining, sub-contracting, mechanizing, laying off employees, downsizing and most importantly, focusing on reducing injury claims. Will it be more cost effective to simply pay an injured employee to stay home than make a claim, as is already the case with auto insurance where it seems cheaper to pay for accidents than go through insurance money makers?

A PEI Forest Sector Council is coming closer with an opportunity for industries to plan their own human resource needs. Many other sectors on PEI are also busy planning their own Sector Councils with great help from the PEI Association of Sector Council.

Please be careful in work and play. If we accept that all injuries can be prevented, then the extra time spent considering "what could happen if I do this" pays off big and might even save a life.

Focus on Safety

by Joachim Graber

Promoting Health & Safety

A baseline assessment of attitudes and behaviours in the silviculture industry was conducted in the summer of 2004 by Jordan Tesluk as part of his Master's thesis. Jordan has been planting trees in BC for 11 years, thus bringing a first hand understanding of the work with him.

The survey was extremely well received by 34 contractors and their work forces, indicating a strong interest in health and safety issues. The participation rate within the worksites was very high, with an overall response rate of 85%.

Work locations were visited in the Interior and on the Coast, with a mixture of camp, hotel, and commuter crews included in the coverage.

The following summarizes the more important observations of the study and provides some recommendations to improve the practices found in the workplace.

1. Supervisors who perceive that other supervisors conform to regulations are more likely to conform themselves.

It is important for supervisors to set positive examples for each other in regard to health and safety performance in the workplace. Supervisors, even more so than planters, have a tendency to make choices that are consistent with their perceptions of others. Examples of supervisors acting in accordance with health and safety regulations should be recognized to encourage others to do the same.

2. Planters expect more non-conforming behaviour from other planters. They also felt that considerable risky behaviour among planters may be going undetected.

Employers and supervisors need to ensure that they are doing an adequate job of monitoring the workers they are responsible for. More consistency in correcting problems within companies and among companies would be helpful in improving the performance of an industry where turnover is high and

workers frequently move between crews and companies.

3. Supervisors attach more importance to correcting unsafe behaviour than planters do.

Supervisors must better communicate the importance of avoiding unsafe behaviour to planters, and explain why correcting such behaviour is key to ensuring a safe workplace.

4. Supervisors are substantially more likely to correct planters for unsafe behaviour than planters themselves expect.

There appears to be a gap between planters' and supervisors' expectations of how unsafe behaviour will be responded to. It is important for supervisors to effectively communicate the way in which unsafe behaviour will be treated. Supervisors cannot simply announce consequences for unsafe behaviour. They must follow through on them.

5. Supervisors attach more importance to refusing unsafe work and reporting unsafe work by others than planters do.

Supervisors need to inform planters of their duty to report unsafe behaviour. Health and safety is a shared responsibility in the workplace. Workers must also perceive that such activities are likely to be undertaken by other workers.

6. The workforce may be younger and less experienced than previously believed, and this issue may be more important than ever.

Problems with health and safety should not be attributed to younger or less experienced workers and their particular attitudes and behaviours. However, younger workers do require appropriate training and need to be provided with the necessary information to navigate their workplace in a safe and healthy manner. This includes informing them of their rights and duties according to the Occupational Health and Safety Regulation.

7. The performance levels of camp-based workers are substantially lower than those of their motel and commuter-based counterparts.

Employers running camp-based operations need to ensure that they are committing sufficient energy and resources to compliance assurance programs within their workplaces. Such workplaces frequently have difficulty reaching medical aid so improved performance is a duty of due diligence.

8. A great range in practice was observed.

Greater consistency in health and safety practices throughout the industry assists companies integrating new workers into their operations. With approximately one third of the workforce reporting to be in their first year with a company, there would be greater efficiency if health and safety practices were consistent between workplaces. This requires information sharing and agreement on best operating procedures.

This study was conducted with the encouragement of the WSCA. The Association has embarked on its BC Safe Silviculture Project to reduce the incident of workplace injuries.

Joachim Graber is a safety advisor and trainer and can be reached at safety@jokat.ca

Recent Developments in SILVICULTURE

By John Innes and Anne-Hélène Mathey

Faced with identifying some of the most interesting recent developments in silviculture, it is inevitable that a few people will feel that their favourite topic has been omitted. This feeling may be aggravated by this article being written by two researchers involved with forest management rather than silviculture. However, the very fact that people involved with forest management could be writing about silviculture perhaps represents one of the most significant changes that has occurred in forestry within the past 20 years – the trend for increasing interdisciplinarity amongst those teaching, researching and practising forestry.

Globally, the whole profession of forestry has been undergoing major transformation, and some of these changes are beginning to be felt. While forestry could be said to be undergoing constant evolution, the changes that are currently occurring appear particularly marked and far-reaching. Forestry has moved from being a biophysical science to being a social science, and the role of the traditional biophysical components is decreasing. Some disagree with this perception or believe that this is just a passing fashion, whereas others realize that the changes are part of broader societal changes that increasingly demand higher stands of professional accountability, whether from a professional forester dealing with a bottom-up consultation process over desired future forest conditions or in the form of greater corporate social responsibility from industrial forestry enterprises.

Forestry is increasingly about meeting the needs of people, and those needs extend to forest management at the stand level, traditionally the domain of silviculture. This is evident in the growing strength of organizations such as the Forest Stewardship Council, which in many parts of the world advocates particular forms of silviculture (especially continuous cover forestry). In BC, this general trend is reflected in the increasing use of variable retention systems, particularly on the coast, where the logging of old-growth forest remains a highly contentious issue.

Silviculture is also changing, with the nature and extent of that change varying in different parts of the world. For instance, European and North American forestry paradigms both aim at generating timber and non-timber values from their forests. However, Europe appears to be further ahead in this area, with the emphasis being very much on the derivation of multiple values, whereas in many (but by no means all) forests in North America, the focus remains on the production of commodities. North American forest managers and forests are changing, and we can expect to see some of these changes reflected in silvicultural regimes.

An array of silvicultural techniques has emerged to achieve management goals better or faster. Uneven-aged silvicultural systems (i.e. individual or group selection, shelterwood or coppice regime) are typically used in Europe to achieve multiple-use forest management. Thinning (both pre-commercial and

commercial) and long rotations are frequent silvicultural treatments. With the growing emphasis on biodiversity, the use of thinning has also been adapted to increase vertical and horizontal structures, thereby emulating old growth conditions in relatively young forests. Many stands of even-aged Norway spruce and Douglas-fir in central Europe are in the process of being converted to multiple-aged stands, and "close-to-nature" silviculture has become almost standard practice in countries such as Germany. These silvicultural adjustments are the direct consequence of the increasing role that the public plays in specifying the type of forest that it wants to see and visit.

In other regions (such as northern Sweden, New Zealand and

the southern USA), silviculture is aimed at producing sawlogs clear of branches and defects through even-aged systems (i.e. clear-cutting). Several commercial thinnings and at least one fertilization are typical treatments with intensive silviculture. This type of silviculture can also be applied to short-rotation plantations of hardwoods, such as eucalyptus plantations in Brazil, aimed at the rapid production of pulpwood. In such cases, treatments also include fertilization, herbicide use and sometimes genetically improved stock. As part of this trend towards increasing the productivity (and profitability) of plantations, the use of genetically modified (GM) stocks is being considered. If the biosafety of GM trees can be assured, there are a number of potential benefits. Bark-beetle resistant lodgepole pines, weevil-resistant Sitka spruce, and general resistance to Armillaria and other diseases are possible, although not necessarily desirable from an ecosystem perspective. Perhaps a little less controversial would be the modification of the quality of trees, including the production of larger and/or denser (higher grade) homogenous (higher recovery factor, better dimension mix) lumber.

Over 60% of the annual harvest of wood in the world is used for biofuels, primarily for cooking. Much silviculture in developing countries is related to the establishment of forest

there will be
challenges
for silviculturalists

on denuded land, and the rehabilitation of degraded forests. An increasing number of mechanisms are being established to finance such work, many related to the so-called Kyoto Mechanisms. The use of wood to fuel bioenergy at an industrial scale has been explored in countries such as Sweden, and short-rotation coppice and other forms of management are being explored with this in mind.

The incorporation of carbon into silvicultural thinking is underway, not only in developing countries but also in the developed world. By increasing carbon sequestration compared to natural or extensive regeneration methods, intensive silviculture improves tree carbon acquisition. The use of intensive silviculture is often associated with shorter rotations, which might thus detract from using silviculture to increase carbon sequestration (that is if long-term storage keeps on not being included as sink). Still, when plantations are managed for pulp, intensive silviculture applied to fast growing species is likely to enhance carbon storage compared to standard silviculture. Increased sequestered carbon through the use of myccorhizal associations or fertilizer may then be used towards 'carbon credits'. In addition, the use of plantations in IFM may be used to facilitate the migration of tree species to their new range under warmer conditions.

As featured in the last issue of Canadian Silviculture, the large-scale fires experienced in BC in 2003 provided a forceful reminder to foresters and the people of BC that fuel loads in many interior forests have become excessively high as a result of successful fire protection programs. This problem, recognized south of the border 10-15 years ago, is one that will challenge Canadian silviculturalists. The issue is particularly difficult when considering that fuel reduction in forests will involve reductions in coarse woody debris (reduction on a biodiversity value) and reductions in forest carbon storage.

There will be challenges for silviculturalists and forest managers in Canada as they work together to meet the needs of forest stakeholders. The stakeholders will have diverse needs, and the traditional focus on the maximization of industrial commodities and minimization of any "constraints" (such as biodiversity and clean drinking water) is likely to require the re-thinking of many silvicultural techniques. Silviculturalists will see traditional disciplinary boundaries broken down, new methods tested, and new skills developed. An awareness of what is happening in other parts of the world will help meet these demands, and silviculturalists need to make the effort to keep abreast of these global developments.

John Innes is FRBC Professor of Forest Management at the University of British Columbia (UBC). Anne-Hélène Mathey is a PhD candidate in the Sustainable Forest Management Research Group at UBC.

The Bas-Saint-Laurent Model Forest

by Jacques Robert

Historical Background

The Bas-Saint-Laurent Model Forest (BSLMF) is part of the Canadian Model Forest Network (CMFN) established in 1992 by the Canadian Forestry Service (CFS) and extended in 1997 for another five-year period. Like the other ten model forests belonging to the Network, it is committed to testing and adopting integrated resource management approaches abiding by the principles of sustainable development. But, from the onset, it has been given the additional objective of achieving this on an inhabited land base with two management formulas (forest communities and forest tenant farms) aimed at economic development in a rural environment. Of the two management formulas, forest tenant farming has become the "trademark" of the BSLMF.

The forest tenant farms idea was developed from the quest for improvement of the small local communities. By the 1970s, forest management, largely developed by pressure from the people, was seen as a way to counteract the closing of villages deemed as marginal at the time. In Quebec this led to the creation of joint management agencies as well as a provincial assistance program

for private forests depending on these agencies. This forest management structure has proven itself over the years and has expanded to include timber owners on an individual basis. The ongoing provincial assistance program was (and still is) restricted to private lands. However, people were looking for a formula that could be applied on public forest lands.

The objective was to consider ways to provide access to the public forest surrounding the communities for individuals who could earn a living there under a tenancy formula. Such access appeared impossible as all of the public forest was already allocated to the forest industry as part of Timber Supply and Forest Management Agreements (TSFMAs). This deadlock meant finding large enough territories to experiment with the formula and prove its sustainability, and it depended on getting agreement from existing tenure holders. Subsequently, Abitibi Consolidated was asked, and agreed, to provide two large areas of private (freehold) lands, which it owned in the region: the Seigneurie du Lac Métis (33,933 ha) and the Seigneurie de Nicolas Riou (13,687 ha).

The BSLMF project

Emboldened by this support, the original project instigators, namely the Syndicat de producteurs de bois du Bas Saint-Laurent (Lower St. Lawrence Wood Producers' Syndicate), the Groupement forestier de l'Est du Lac Temiscouata, the Department of Forestry and Geomatics (Université Laval), and Abitibi Consolidated developed their ideas of forest tenant farms, and included them in the Model Forest proposal to the CFS. By becoming members of the Model Forest Network, they had the opportunity to test their project, associated with an increased effort in joint management and diversification of the activities on the territory of the Groupement forestier de l'Est du Lac Temiscouata.

Thus the BSLMF Corporation was created under the responsibility of a Board, consisting of a representative from each of the original project participants and the CFS, and agreed on management delegation for both seigneuries of Abitibi Consolidated where the forest tenant farming experiment was carried out. The BSLMF has an annual budget of approximately $1.6 million. Of this amount, the Model Forest Program contributes $500,000 and the rest originates from funds from partners and existing programs.

How forest tenant farming works

Inspired by the past but adapted to the present, forest tenant farming consists of allotting a tract of land (tenant farm) to a tenant (tenant farmer) who is committed to managing and harvesting it, provided the revenues (royalties) are shared with the owner of the land. Both seigneuries have been subdivided into tracts of approximately 1,000 ha each, allocated in order to take into account the condition and the successional state of the forest as well as the working capacity of the tenant farmer. Consequently, 27 tracts were offered as tenant farms. Recently harvested areas have not been allotted to individual tenants because these lands do not have sufficient mature timber to be commercially viable, and such land instead is being reforested, brushed, and otherwise managed by the forest tenants cooperative.

The original selection of the tenant farmers was carried out through a call for applicants across the country and more than 350 applications were received. The applied selection criteria included entrepreneurship, leadership, attitude towards innovation, teamwork, social involvement and forestry experience. The selected applicants also took part in an integrated 10-week training course, where their knowledge in various fields (silviculture, safely, management, accounting etc.) was upgraded. Each winter they have the opportunity to receive further training.

Forest tenant farmers have signed a 10-year individual agreement with the BSLMF determining their rights and responsibilities. These agreements treat them as entrepreneurs and not as employees. As such, they are not entitled to claim employment insurance benefits, for example, and are responsible for their own financing and insurance arrangements. The forest tenant farmers are responsible for managing timber and harvesting wood resources on their farms and must jointly manage the other resources (hunting, fishing and tourism) territory-wide. Therefore, a co-operative has been established in each seigneurie, in order to provide recreational services according to a formula similar to outfitting operations. Tenant farmers live in the small villages close to the seigneuries, not on their holdings. Some holdings have chalets for fishermen and hunters, and the seigneurie cooperative is responsible for organizing outdoor recreational potential. Landscape-scale habitat requirements are spelled out in the multi-resource management plan prepared by Model Forest staff, and the cooperative and individual tenants must adhere to those requirements.

Resource management

Before addressing land management, the BSLMF adopted a code of ethics, which acts as a safety net. Even though this code is lengthy, it outlines the principles

Figure 1.

Land Use Zoning in Bas-Saint-Laurent Model Forest

Resource Conservation	- no forestry intervention permitted
Resource Protection	- some forestry interventions excluded, particularly from sensitive sites
Special Management	- forestry conducted according to site-specific requirements, reflecting higher level objectives related to wildlife and other values; and
Regular Management	- standard forestry practices followed according to the code of ethics, with room for extensive recreation and other land uses allowed but not constraining forestry practices.

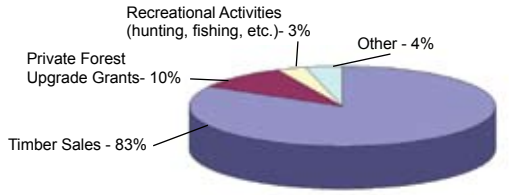
BSLMP 2003

of sustainable development and sets two specific rules, namely a prohibition on the use of chemical herbicides and a size limit of 4 ha for individual cutblocks. For each territory, the BSLMF eventually developed a multi-resource management plan with its partners and the local population. These plans outline four designated zones according to the level of protection that should be applied (Figure 1).

Beyond this zoning, the BSLMF has developed a management strategy for each of the resources on the territory in order to maintain biodiversity, improve resource production capacity and ensure the sustainable development of the forest environment. These strategies include goals and approaches, for each of the territories, for forest biomass, wildlife, water, and landscape aesthetics. Individually, each tenant farmer has a management plan for his tenant farm that is compatible with the multi-resources management plan. An intervention plan is submitted each year to the BSLMF and once it has been approved it becomes an operating license.

Silvicultural activities are supported by the regional private forest upgrade program, which provides guidelines, advice, and financial support. Tenant farmers can access this program, in the same manner as timber owners across the province of Quebec. But the context of the BSLMF has bred innovation pertaining to techniques and methods suitable for working on a small scale and in forests with diverse uses and users (i.e. low density reforestation, scarification under a partial canopy). Technical advice in forest development is provided by a team, which consists of a forester and two technicians. The BSLMF uses a biologist who monitors the integration of different aspects outside the scope of timber development (wildlife, water and aesthetics values).

2003-2004 Revenue Sources



Revenues and royalties

The tenant farming formula requires revenues be shared with the owner – in this case as a royalty on all timber harvested and sold. Abitibi Consolidated agreed to reinvest these revenues in the project due to the experimental context of the model forest. The Model Forest Corporation uses these funds to pay property taxes, protect against fire, insects and disease, and develop major road systems and other infrastructures. BSLMF set up a compensation fund available to tenant farmers for property improvements. This financial compensation beyond the revenues they derive from their work is like building equity. Finally, some of the royalties are returned to Abitibi Consolidated through a process of annual negotiation between the company and the tenants cooperative.

Tenant Farmer Revenue and Income 2003-2004

Total Sales Lac-Métis Seigneurie	$423,000
Total Sales Seigneurie de Nicolas Riou	$327,000
Average Tenant Farmer Revenue	$151,378
Costs	$110,147
Net Income	$ 41,231

Assessment and monitoring

The experiment has also been subjected to a socio-economic sustainability study by an economist from Natural Resources Canada (Masse 2001). The tenant farming formula and the joint management groups were evaluated according to four criteria: the viability of tenant farms; costs of general supervision and technical support; concrete socio-economic impacts generated at the local and regional levels; and the potential for extending the tenant farming model to public forests adjacent to municipalities. The results of five studies were summarized from the perspective of these evaluation criteria, and the principle issues raised in testing and extending the forest tenant farming approach were identified. The report concluded that this management system is socio-economically viable (Masse 2001).

The degree of interest and support for this alternative form of tenure is a great indicator of its success. When some of the first tenant farmers were replaced in 1998 (following resignations or breaches of contractual provisions), there were 105 applicants for only five available positions. We now look forward to seeing the forest tenant farming model being implemented elsewhere in Canada and around the world.

Jacques Robert is with the Canadian Forest Service in Rimouski QC. This article is an exerpt from his book Towards Sustainable Management of the Boreal Forest.

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