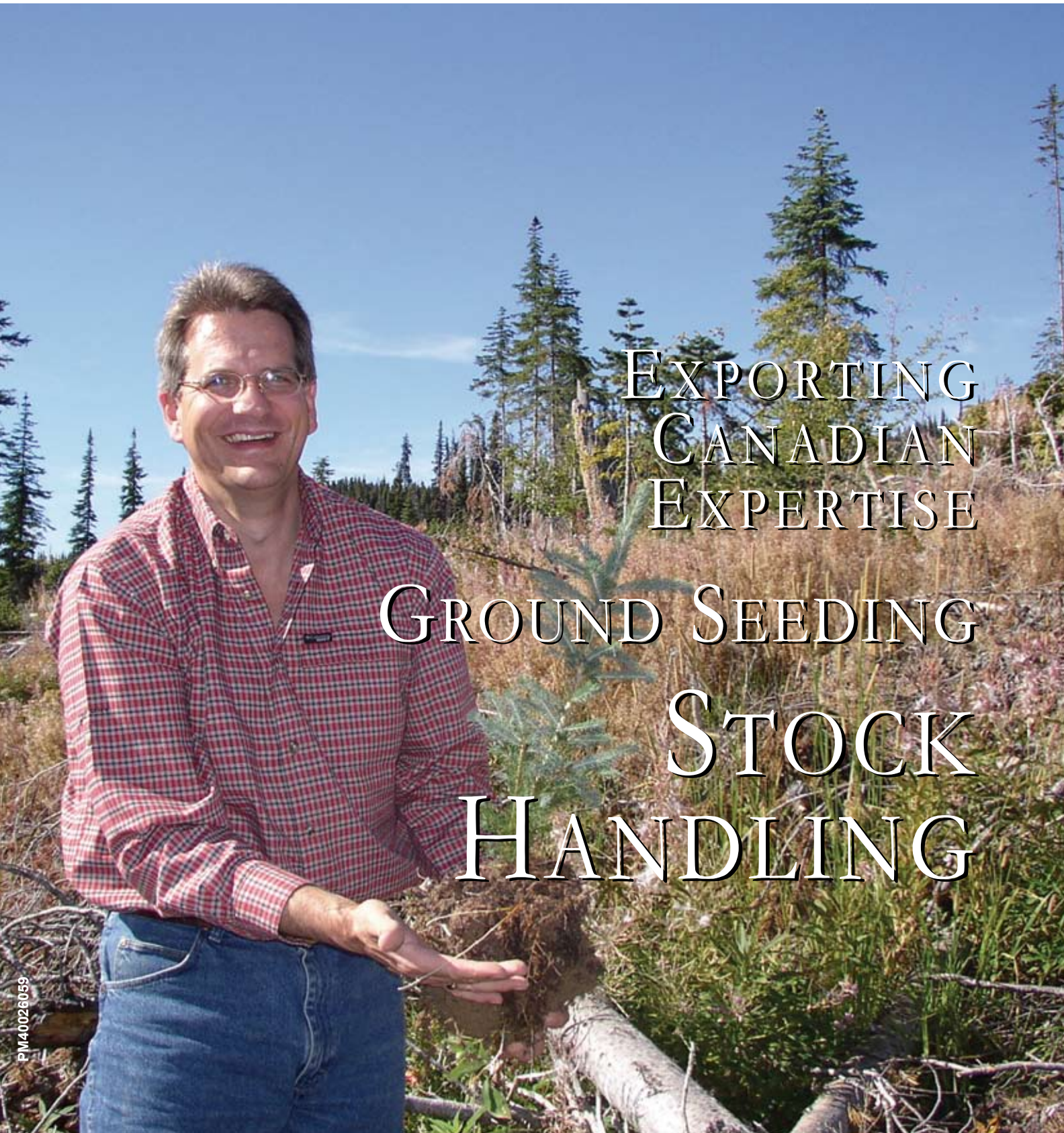
CANADIAN
SILVICULTURE
MAY 2006



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Editorial

Visualizing a Healthy Planet

by Dirk Brinkman

Recently I revisited the first stand I planted in 1970 via Google Earth. A few minutes of virtual flying re-confirmed the predominant impression of my last visit in 1987 - the 3 planted spruce stands are still surrounded by unregenerated area. The virtual tour reinforced my sense of reforestation's essential role.

Google Earth's 3-D contoured virtual globe with its recently superimposed images integrated from over 100 data sources of aerial and satellite photos are so elegantly engineered that navigation is easy. The image tilts to allow a helicopter tour. This spatial free-ware like NASA's slower World Wind and the soon to be released ArcGis Explorer are arriving just in time. Nothing mobilizes the brain's capacity for problem solving like visualization. These may be essential tools for solving the greatest problems humans have created for themselves.

The geophysical forces of human development degraded earth's ecosystems and wiped out plant and animal species, precipitating the sixth great extinction of geological history. The rate of biodiversity loss has been seen as the greatest problem human kind has faced, but this rate is gradually being slowed down by forest ecosystem managers using professional GIS-based planning tools and ecosystem-based management.

Now we can share this challenge with the rest of the world. Using a format known as keyhole mark-up language, multiple users can update Google Earth in real time. The Global Biodiversity Information Facility is making millions of species distribution data spatially available to Google Earth. Forest ecosystem managers can link historic natural disturbance patterns to harvest patterns for virtual tourists. Habitat and other land use conflicts can be layered into an online consultation process that shares resource decision-making.

But the challenge of reversing the human tide of physical ecosystem degradation is being overshadowed by an even greater problem - the geophysical changes that civilization is making to the atmosphere and climate.

Tim Flannery, 'Australia's best exporter of reasonable propositions,' has given us an easy tour of the controversial concepts underpinning the climate challenge in The Weather Makers: the History and Future Impact of Climate Change. His book clearly lays out the volatility of previous interglacial climates, and the vulnerability of this uniquely stable interglacial period to the more normal interglacial pattern of switching continental climates. He documents recent ecosystem devastation from ocean temperature increases and issues a clear call to action to protect human well-being and the future of life.

I flew over the Arctic on March 22nd wondering about the ice break-up evident on both sides of Baffin Island. Retracing the flight on Google Earth and linking through the Internet to the Arctic Climate Impact Assessment Report it became apparent how much power the spatial visualization tools have for someone who has never visited an area. The report predicts the collared lemming will be gone in this century, wiped out by the natural reforestation of its tundra habitat. Flannery writes, "Perhaps all that will be left then will be a folk memory of the small, suicidal rodents. But the real tragedy will be that the lemmings didn't jump. They were pushed."

Over 30% of the world's annual greenhouse gas emissions come from the main refusenik of the international Kyoto Protocol - the world's unpopular global super-power. Imagine if Google Earth was the US government's virtual earth as Al Gore first visualized it in 1998, and that George Bush was its gatekeeper. Happily, bureaucracies fail complex challenges and entrepreneurs have taken the lead.

The benchmark climate year of 1990 followed the signing of the North American Free Trade Agreement in 1989. Successive warm winters since NAFTA resulted in a super-infestation of the Mountain Pine Beetle and an unanticipated abundance of 8 million ha of dead pine. As continuing warming trends permit the beetle to chew its way gradually across the Rockies to threaten Canada's remaining pine, the Canadian countervail negotiators will have to remind the US that we are not dumping our forests - they were pushed.

Some of Google Earth's biggest global warming flags are the red and grey zones of the Mountain Pine Beetle. As managers of ecosystems that are being pushed north, whose off-site species are under stress or dying, we have to dig in our heels and take an uncompromising stand against the 'Weather Makers' of climate change. If we release our imaginations and communicate through this household tool of virtual globe-ware, we may catalyze unexpected support, mobilize critical change, and yet save our suddenly easily accessible and obviously limited little planet. Of course, for those of us who plant trees, we will do it with reforestation.

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June 1, 2, 3, 2006

Letter to the Editor

Two articles in the Canadian Silviculture, February 2006 issue appear to require a response.

Greg Morris appears to believe that forest health in Canada "will require the removal of huge quantities of residues" when we are gaining an increasing appreciation for the ecological role played by standing decadent trees and their contribution to course woody debris when they drop. He also speaks of "open burning" (which I assume concerns harvest slash burning to prepare the site for easy tree planter access - a practice increasingly frowned upon by soil scientists) and "landfilling of wastes" (when a recent survey reports that almost all forestry manufacturing wastes in Canada are already being used for energy generation). I am particularly dismayed that Morris appears to believe that non vigourous decadent, dying and old-growth,legacy, full-cycle seed trees that are not generating commercial wood product ("overgrowth in Canada's forest") need to be removed from the ecosystem because "forest overgrowth can have negative consequences for fish and wildlife," when just the opposite is true.

Although David DeYoe does say that his argument "does not include non-market or ecosystem values that are equally important to the social, economic and environmental fabric of sustainable development," his "biomass possibilities" include removals of "harvesting slash, high nutrient pre-commercial thinnings, and un-merchantable logs" that are important in maintaining ecological integrity and thus long-term productivity.

Peter Salonius
Research Scientist, Natural Resources Canada ,
CFS Fredericton, NB

Focus on Safety

By Dean McGeough, RPF

Wildlife Tree – Safe or Dangerous?

The forest industry of BC has a variety of worksites throughout our province's woods, and whether it is harvesting or silviculture there is one common thread throughout - wildlife trees. Regardless of forestry activity, protecting wildlife habitat is an important forest management objective. In virtually every worksite there are wildlife trees to be managed - whether retained as single trees, in patches, or simply as part of the treed perimeters.

Wildlife trees are defined as standing live or dead trees with special characteristics that meet the habitat needs of wildlife (e.g. feeding, nesting, denning, roosting, or perching). The complication for forestry activities is that some wildlife trees can pose a safety hazard to forest workers. To reduce the potential conflict between conserving wildlife trees and ensuring a safe worksite, the Wildlife Tree Committee of BC (WTC) developed the Wildlife Danger Tree Assessor's Course (WDTAC). This 2-day course teaches participants to identify valuable wildlife trees, assess retained trees to determine their safety rating, and prescribe the actions necessary to ensure worker safety. This process is applicable to all work activities in forested settings, and is recognized by WorkSafe BC as the standard of care for evaluating suspect trees.

The WDTAC teaches how to evaluate a tree in its surroundings and determine whether tree defects have exceeded the safe operating thresholds for a planned forestry activity. If a tree is dangerous, the appropriate safety procedures need to be undertaken before the workers arrive - remove the tree, remove the dangerous defect, or install a no-work safety zone.

A dangerous tree is defined by WCB regulations as "any live or dead tree that is hazardous to people or facilities because of:

- Location or lean
- Physical damage
- Overhead hazards
- Deterioration of limbs, stem or root system, or
- A combination of the above"

As the definition states, a dangerous tree could range from being a healthy live tree with only a large broken limb suspended in the crown, to a very rotten, dead tree that is ready to fall. A common misconception is that all dead trees (snags) are dangerous, and that all live trees are safe. Truthfully, all trees (live or dead) have the potential to cause harm to forest workers under the right set of circumstances.

Trees can fail, whole or in part, when disturbed beyond their ability to resist the forces exerted upon stem, branches, or roots. Failure can occur due to forestry activities jarring the tree or a change in weather (wind, snow loading). Disease or fire can also weaken a tree so that the force of gravity alone will bring it down. The WDTAC process is a method to filter the range of tree conditions encountered at a worksite, find the trees with defects that present an unacceptable risk of failure, and take action to protect the workers.

To conserve valuable wildlife trees and protect forest workers, the tree assessment process needs to be applied. At each worksite supervisors must know when the danger tree assessment was performed, what safe work procedures apply to the worksite, which circumstances would warrant a reassessment, and how to identify suspect trees. Tree assessment must be documented and the safety plan communicated to the workers.

It is important for workers to understand that a danger tree assessment is a pre-work requirement for the job site. Whether the worker is planting, pruning, or harvesting trees there is an expectation by WorkSafe BC that the worksite is safe. It is not acceptable to simply hope there are no dangerous trees - someone must check prior to workers entering the site.

There are three modules of the WDTAC, dependent upon the context of activities: the Forest Harvesting and Silviculture module, the Parks and Recreation Sites module, and the Wildland Fire Safety module. For more information, visit the WTC website at www.for.gov.bc.ca/hfp/training/00016/index.htm.

Dean McGeough, RPF, is the Wildlife Tree Coordinator for the Wildlife Tree Committee of BC. He can be reached at 604-642-2666.

STOCK HANDLING

by David Lloyd

Stock handling prescriptions are designed to minimize stresses to seedlings in the transition time between growth in nurseries and plantations. Stresses are cumulative, so sequential stresses magnify their effects as more are encountered. Seedlings' sensitivities to stresses change according to their status in their annual growth cycle.

Stresses exhaust seedlings, causing their metabolic rates to increase. This process will increase consumption of the seedlings' vital storage sugars, which should be reserved for early establishment functions in the field.

Plants consist of 3 communities working together for overall success. Roots collect the water and minerals required for growth, and send them to the tops. Tops photosynthesize the minerals and water, in combination with carbon dioxide and light, into sugars that are sent to the roots. The transportation system, xylem for water and phloem for sugars, are critical to the communication between tops and roots.

Stress causes breakdowns in these community systems. Any loss of efficiency affects the whole plant. Repair of these systems is time and energy consuming. The short growing seasons of our coniferous growing areas leave little time for failure. Vegetative competition on our forest sites requires full use of the seedlings' energy reserves and productivity systems to keep themselves in full light.

Understanding the annual growth cycle of seedlings is important in designing your stress minimization program. We handle seedlings in 2 seasons - spring and summer/fall. In the spring, seedlings are moving from deep rest, their most stress-resistant time of life, to bud break, their most stress-sensitive time of life. In the summer/fall season, the seedlings are moving from their summer stress resistance, a moderately resistant phase, toward deep rest, a strongly resistant time.

So in the spring, seedlings are moving from most resistant to most sensitive. It is impossible for us to visually determine

root growth must come before stock growth

to prevent planting shock

where the seedlings are on the phase spectrum, since their appearance is unchanging until bud break begins. A strong stress may be irrelevant to the seedling immediately after thawing, but can become debilitating at bud break. Frosts and droughts are examples of stresses that will produce little effect at deep rest, but can kill the seedlings at bud break.

In the summer/fall season seedlings are moving through a "quiescent top" period of moderate and increasing stress resistance following bud set. Their appearance changes dramatically as buds and needle waxiness develop. Seedlings planted earlier in this window often establish more effectively, since there is more growing environment (growing degrees) left in the season to repair and complete the growth systems prior to winter dormancy.

Root growth must come before top growth to prevent planting shock. If top growth begins before root growth, the allocation of metabolic resources can be dominated by the top, greatly restricting root colonization of the soil resources required to sustain the seedling. If so, top growth can be shortened for 1 or more years. Stresses force the seedlings foreword on the growth curve, and tend to lessen root growth power.

There are many causes of handling shock for seedlings, both in this transition period and in your plantations. Following are the most common problems and how to avoid them:

1. **Jarring -** This has different impacts depending on the phase status of the seedlings, but, to be safe never drop seedlings more than 10 cm.

2. **Temperatures in transition -** Keep stored seedlings cooler than 10oC and warmer than -2^{o}C, as metabolic activity is reduced during this range, storage sugars are maintained and damage risk is low.

3. **Duration in transition -** Rotate stock in a first in, first out basis to minimize the time that seedlings are in this fragile transition period.

4. **Duration in closed boxes -** Plant seedlings within 7 days from site arrival. Seedlings are in a quiescent period during shipping and can tolerate a moderate period of darkness, provided temperatures are in the reduced metabolism range.

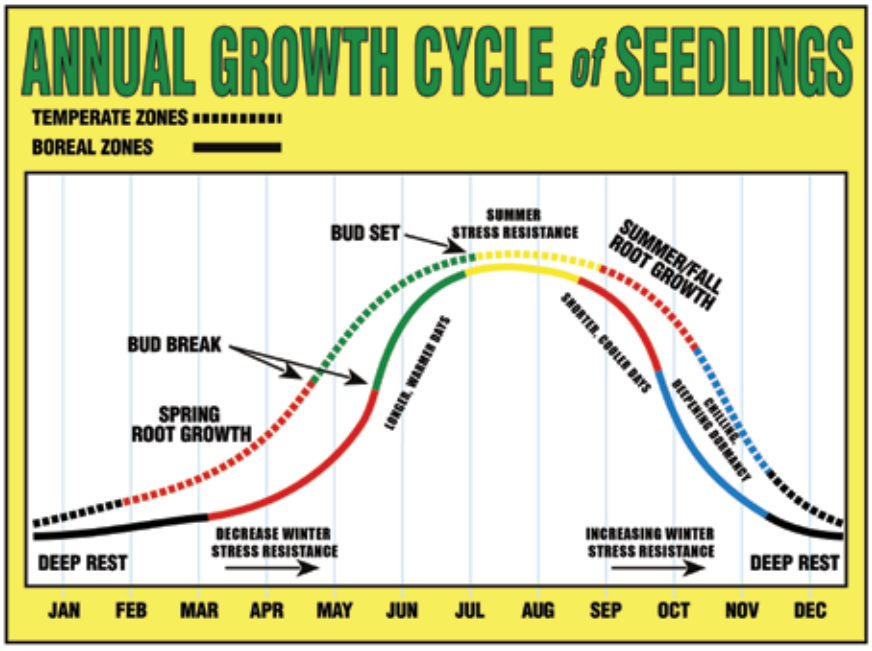
5. **Thawing frozen trees -** Avoid exposure to light or temperature stresses. Frozen seedlings can be thawed quickly by separating bundles, and covering seedlings with a "silvicool" tarp. The plant tissue itself is not frozen; only the free water outside the seedling in the plugs is frozen. Seedlings will not be damaged by fast thawing, provided no temperature, light, or moisture stresses are incurred.

6. **Sunlight on roots -** Avoid exposure of white root tips to light (less than 3 seconds). Root tips have no natural protection against

sunlight and can be severely damaged by very short exposure. This is particularly important in summer/fall planting.

7. Water maintenance - Water seedlings only sufficiently to maintain the box weight delivered from nursery. This is only needed for summer "hot lift" seedlings that are transpiring actively. Watering should be done in the early mornings, to allow foliage to dry by evening, maintain stomatal effectiveness, and prevent mould buildup while in the boxes.

8. Drowning/asphyxiation of roots - This occurs if water ponding appears in boxes without drainage. This could happen if seedlings are sitting in bags or in sealed boxes. Never over-water stored seedlings.



Planting Spot Selection Determines Growth Potential

Planting spots are not all created equal. The best spots (crop tree spots) are not uniformly distributed, so regimented spacing may be ineffective. It may be best to utilize the best spots, regardless of spacing, to establish the fastest-growing, well-stocked plantations possible.

Crop tree spots must provide effective soil oxygen, temperature, drainage, moisture, and minerals to support seedling growth on a timely basis. Seedlings should be established in warm places, with root access to both fermenting organic and mineral soil materials. High, warm spots are much more effective than cold, wet spots. Rooting soil temperatures should reach 20°C 2 weeks prior to bud break. Little root growth occurs at less than 10°C.

Planting Faults

Planting faults will negate all of the efforts in stock handling care. Common planting faults are:

1. J'd roots - Any bending of the plug's root seems to reduce root growth for at least one year. Planting holes should be made 1½ times deeper than plug length, and wide enough to place the plug vertically against one side for gentle back filling.

2. Compression of plugs - Compression prevents root growth

on the compressed surfaces. This includes both boot-stomping effects, back-cutting and forcing the plugs against obstacles, rocks, roots or stems, within the soils.

3. Inadequate closing of hole surfaces - A vapour seal of 5 cm deep is required to prevent the seedling root system from drying in the hole. Narrow seedling holes, effectively closed with 5 cm of fermenting material at the surface, will easily maintain sufficient relative humidity and oxygen access for strong root growth.

4. Deep planting - Seedlings require no more than a 1 cm cover of organic material to protect the relative humidity of the soil below. Deep planting can place the root system into cool soils where root growth is inhibited.

5. Drowning/asphyxiation of roots - This occurs wherever roots are in water during the growing season. Such seedlings are certain to die. Temperatures are generally always colder than 5°C. Roots must breathe at their growing tips. Planting trees where water swished in the bottom of the planting hole is a mortal sin.

6. Frost heaving susceptible seedlings - Heaving occurs when water puddles on the soil surface around the seedling on freezing nights. The puddle freezes, expands and locks onto the seedling's stem, then ice crystals form from capillary soil water below the surface plate, and lift it and the seedling from the ground. Frost heaving can be prevented by planting on raised surfaces and by spreading a 1 cm layer of organic material around the seedlings to break the capillary water connection.

Stock handling care is extremely important. BC is planting 280 million seedlings in 2006. At $1 per seedling planted, that equates to a $280 million yearly investment in regeneration alone. Stress-induced plantation failures from poor stock handling could easily total 10% of that value. Such losses are unacceptable. We must treat our seedlings well. The most important 10 seconds in a forest's life may well be those between the planter's seedling bag, and the closing of the planting hole.

David Lloyd, RPF, is Manager, Product Research Education at PRT and can be reached at 604-465-5411.

Industry News

Jiffy Introduces New Product and Manufacturing Centre

Jiffy has a new 70mm forestry pellet added to its selection of other soft-walled pellets. The 70mm pellet expands to a 72mm diameter and 100mm height (405 ml). It works well for large seedlings (hardwoods or conifers) requiring the container and media as one unit to allow for easy, quick handling without the worry of a root plug.

Jiffy will be opening a manufacturing centre and warehouse in BC for its "HortiPlug" product line. This unique media mix and 100% plugable alternative will be readily available for forestry and horticulture in the BC marketplace. The center is slated to open in June 2006. For further information contact Don Willis, RPF at 705-495-4781.

Forest Health

by Janice Hodge, RPBio

Western Spruce Budworm

Western spruce budworm is a cyclical defoliator of western coniferous forests that periodically reaches outbreak levels in BC. The larval stage feeds primarily on the new growth of Douglas fir, but it will also feed on other conifers such as spruce, subalpine fir and western larch. Trees of all ages are susceptible although mature forests are preferentially attacked. Mortality is most often associated with suppressed or intermediate trees, particularly in multi-layered stands. Mortality can also occur in mature trees, depending upon the longevity and severity of the outbreak and the general vigour of the stand. Growth reductions, top-kill and/or stem deformities may occur in all tree layers. Defoliation may also predispose trees to other forest health factors, such as Douglas fir beetle and root diseases, armillaria ostoyae and phellinus weirii.

Outbreak duration appears to be dependent upon climate, and host and stand suitability. The first recorded outbreak in BC was on Vancouver Island in 1909. Subsequent outbreaks have been almost entirely recorded in the southern interior, with approximately 8 outbreaks recorded since 1916 in the former Kamloops Forest Region (KFR). A historical overlay analysis, completed by the Ministry of Forests of the former KFR, found that over 1.6 million ha have been defoliated with up to 9 consecutive years of defoliation in some areas. The analysis has also found that the dry-cool and very dry-hot sub-zones of the interior Douglas fir zone have experienced the longest outbreaks, while the wetter sites have witnessed fewer outbreaks that have been of shorter duration. Portions of the current outbreak have moved northward into susceptible forest types near Williams Lake and Clinton where defoliation has not been previously recorded. Ongoing dendrological studies in these areas will provide some insight into historical western spruce budworm outbreaks, both in terms of frequency and duration. Similar studies by the USDA in the Pacific Northwest have found that outbreak frequency and severity have increased over the last century as a result of fire exclusion, grazing and selective harvesting.

Forest management to reduce the potential losses includes both short and long-term strategies. In BC, short-term strategies consist of aerial application of a biological insecticide (bacillus thurigiensis var kustaki) to suppress populations in areas where high levels have been predicted and/or where silvicultural investments have already been undertaken. Stands with a history of selective harvesting, or disturbances leading to multi-layered stands, are those most likely to possess high hazard attributes and are therefore considered a higher risk for future losses. Recent studies by Dr. Vince Nealis at the CFS in Victoria have demonstrated that changes in foliar chemistry before bud-burst may alter a tree's susceptibility to damage. This screening method could supplement the overlay analysis findings by identifying stands or trees that are more likely to sustain higher levels of damage. Preventative measures include modifications to existing stand structures, regeneration of species mixes, and/or use of even-aged silvicultural systems for future forests. Thinning, including the use of underburning, could be used as a silvicultural tool to reduce density and increase vigour of the remaining trees. Fertilizing has also been suggested to increase tree and stand vigour. While western spruce budworm itself acts as a thinning agent, the pattern of mortality tends to be quite patchy and poorly distributed. However, this pattern may be well suited to meet other non-timber objectives.

The recent trend towards ecosystem restoration in BC has, for the most part, focused on dry interior forests with a history of stand-maintaining fires. A portion of these stands has been defoliated at some point. Since one of the objectives of ecosystem restoration is fuel reduction, it is important to not only consider the historical range of variability of natural disturbances, but also the current century western spruce budworm outbreak history, existing stand hazards, and potential future hazards resulting from restoration activities. Outbreaks may lower the fire crowning potential by reducing the amount of ladder fuels, and/or they may increase the surface flame length and intensity by contributing to higher-than-normal fuel loads.

In the future, there may be an increased emphasis on the management of susceptible forest types, due to the unprecedented lodgepole pine losses sustained as a result of the current mountain pine beetle outbreak. The challenge to forest managers will be not only presented by western spruce budworm, but also integrating all other resource needs and demands of these lower elevation Douglas fir/ponderosa pine forests.

Janice Hodge owns and operates JCH Forest Pest Management, a forest health consulting firm in the Okanagan. She can be reached at 250-547-6452 or at jch@cablelan.net

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ADVERTISING FEATURE

Today's Solutions for Tomorrow's Forests

As reforestation becomes more and more sophisticated, so does the equipment available to assist foresters managing their projects. JRP Solutions began in 1992 as a forestry consulting company. 10 years later, JRP had focused its business solely on providing software to gather and manage data collection in the field while streamlining data management in the office, increasing data accuracy, and saving hundreds of hours for foresters, nurseries, and silviculture contractors.

The company now has 5 commercial products available, 4 of which utilize hand-held PDA technology. With the advent of the PDA and GPS technology, JRP is able to improve the efficiency and effectiveness of delivering reforestation services. Recording data in the field has always been a major component of the work done in the industry. Ensuring data accuracy and being able to transfer data back to the office environment has always been a significant challenge. By having reference materials available on a hand-held PDA and being able to enter data directly in real-time, foresters are now able to utilize technology like never before to manage projects cost-effectively.

Plant Wizard was the first product available and remains the flagship of JRP's product lineup. Plant Wizard is an administration software package designed to help foresters, nurseries, and planting contractors with their specific challenges in the reforestation process. From automatic seed and stock allocation, sowing requests, production and cost tracking, reporting, inventory management, and data digital data exchange with other systems, Plant Wizard has it all covered. Three editions of the software are available: Forester Edition, Nursery Edition and Tree Planter Edition. The software is currently used to manage the planting of more than 300 million seedlings annually.

Foresters use the PDA software to record seedling audits, detailed planting prescriptions, planting audits, and final plantation numbers while being able to view seed and seedling suitability for each site. Contractors typically use the same software on the PDA to track seedling shipments and deliveries, assess quality, and record planter tallies in the field. In short, the PDA allows nurseries, foresters, and planters to eliminate both time consuming, duplicate data entry and the unavoidable errors that result.

Back at the office, the software forecasts seed and seedling needs into the future, tracks seed and seedling inventories, automatically allocates seed and seedling inventories to planned plantations, budgets all aspects of planting projects, shares detailed planting prescriptions and schedules with the nursery and planting contractors, produces maps, and outputs a huge variety of reports including a payroll report for planters, and import files for corporate systems. Online, plantwizard.com manages seedling inventories and shipping. With one click, foresters can view, ship, retrieve details, and update inventories for all of their seedlings, at all locations. Both nurseries and foresters can post their surplus seedlings online, or search for suitable surplus seedlings when they are short.

Survey Wizard is a silviculture survey administration software package designed to help foresters collect, compile and report silviculture survey data. Some key highlights of this software include managing multiple types of surveys organized in one database, providing flexible reports in Microsoft Excel, data collection and data sharing, cost analysis reporting and customized reports.

Cruise Wizard is designed to increase productivity in the field with easy-to-use, touch screen functions to record your data. Data accuracy is improved since it doesn't need to be transcribed - all data transfer from the first entry is done electronically!

Two new products are currently being introduced: Forest OPS and Nursery OPS, which are both scaleable enterprise solutions for the detailed management of inventory.

Clients are able to purchase all of these software solutions outright, or they can subscribe to the service, which includes support packages and automatic updates.

While the majority of time-savings will be realized in the office, contractors benefit more from accuracy and efficiency in the field. Clients find that switching to an automated software solution reduces the potential for errors. Online and in-person customer care and support services ensure easy migration to the software and in most cases return on investment is realized within a matter of weeks.

It will soon be very rare that data collection is done manually. As GPS and GIS systems improve, software solutions such as Plant Wizard and Survey Wizard will provide more integration and streamlined operations. The real benefit to users is that the focus can now change from data collection to sound data analysis, returning more value, and ultimately higher yields and profits.

For more information on JRP Solutions, visit www.jrpltd.com or call toll-free at 1-800-535-2093.

Simultaneous Site Preparation and Ground Seeding Systems

by Laird Van Damme

Direct seeding is used on 1 - 2% of the area harvested annually in Canada. The vast majority of these sites are aerially seeded to regenerate jack pine, and to some extent, black spruce. Seeding conifers has several advantages over planting:

- Reduced cost
- Natural root systems
- Higher initial densities capture the site from competing vegetation and improve wood quality
- Shallow, bedrock sites and boulder till sites that are hard to plant can be easily seeded

Figure 1 - Bracke three row scarifiers

However, normally achieved higher densities reduce diameter growth rates and some sites may require spacing and thinning to achieve better growth rates. Both stocking and density can be highly variable with aerial seeding. There is a perception that seeding is less reliable than planting. For these reasons, the preferred regeneration method for conifers on upland sites in Canada is to plant seedlings. However, in both Scandinavia and Canada there appears to be renewed interest in seeding in order to achieve natural system emulation, wood quality improvements, and lower costs.

Simultaneous site preparation and seeding is an alternative that deserves some consideration. The Bracke seeding system consists of a cable skidder and Bracke three-row scarifier (Figure 1). Three seeder boxes are mounted on each row of the scarifier. Each box holds a seeder. The seeder is cast aluminum with a seed hopper, diaphragm, push rod and seed rod. The push rod is activated by a cam on the scarifier mattock axle that moves the seed rod back and forth. Notches in the seed rod collect seeds from the hopper and move them to an exit hole. The number and size of the notches control the seed rate. The rod movement is timed by the cam placement to drop seeds on the scalp created by the mattocks. The push rod also activates the diaphragm to generate air pressure to deliver the seeds and keep the exit hole free of dust and debris. A brush fits over the seed rod to prevent seed damage from the seed rod movement. This air-assisted seeder is a significant improvement over Bracke seeders developed in the1970s that relied upon gravity and slider plates. The plates damaged seeds and become clogged with debris.

The success rate using the Bracke seeder is 99% on 20,000 ha of Abitibi's freehold and public lands treated near Thunder Bay, Ontario (Figure 2). Success depends on a number of factors, the most important being trained, knowledgeable operators who understand the importance of travel speeds and regularly monitoring seed delivery. The system has several pros and cons compared to aerial seeding.

Pros:

- Requires less seed.
- Seedling density is controlled, lower, and less variable, hence spacing and thinning costs are also lower.
- Seedling spacing is more consistent, also contributing to lower spacing and thinning costs.
- Cutovers can be treated up to one year ahead of aerial seeding because site preparation and seeding is simultaneous. This can be an advantage on competitive sites. We have seen this method replace planting on a wide range of sites with considerable savings.
- Intermittent patches reduce erosion and do not interfere with the alignment of coarse, woody debris. The patch emulates natural wind-throw pit/mound microsites, making this method a more environmentally friendly and natural form of site preparation compared to the long, continuous furrows created by drags and trenchers.
- Grasses tend to colonize intermittent patches less aggressively than in trenches, hence less herbicide is required.

Cons:

- Site preparation. costs can be higher, depending on spacing.
- Quality control measures are necessary to ensure seed is being delivered properly.
- Bracke repairs can be time consuming if operators are not properly trained.
- Seeding is limited to early spring and late fall.

Figure 2 - Jack pine regenerated by simultaneous seeding

The benefits of Bracke seeding are enhanced if operating areas are also scheduled to include Bracke site preparation for planting. This method is more environmentally friendly compared to trenching, and can improve seedling growth performance if planters are trained properly to plant the appropriate microsite (slope or mound).

Trenching is still the most common form of site preparation in Canada. It successfully aligns slash and improves planter access. Improved utilization has reduced slash loading, making many sites more suitable for Bracke site preparation and mounding - the most common site preparation method in Sweden. Mounding can further enhance seedling growth and reduce reliance on herbicides.

Bracke seeding often results in seedlings growing in clumps on microsites produced by the Bracke. Spacing costs can be reduced further by reducing the spacing time to 5 years after seeding. Dominants

in clumps will be easy to identify and retain, with the remainder of seedlings removed using equipment that is easier and safer to operate than motor or manual thinning saws. Since Bracke scarification results in evenly distributed patches across the cutover, retention of dominants is the only task required, and spacing between retained seedlings is a function of Bracke spacing.

Despite its success locally, simultaneous seeding practices have not advanced elsewhere in Canada. Forest renewal specialists tend to adhere to familiar methods that they know are effective. New practices may be introduced in demonstration sites or through controlled experiments. Pressure to reduce costs and herbicide use may stimulate more interest in testing alternative silviculture treatments.

Experiments have shown that compacting the soil in the scalp improves seeding results significantly. The development of a compacting wheel that can withstand the harsh environment of site preparation in the boreal forest proved challenging. A prototype failed to meet the requirements, and the growing success of the air-assisted seeders cancelled the commercial development of this tool. Recent experiments of seeding and site preparation for aerial seeding in the winter have resulted in good regeneration (Figure 3), although deep snow can hinder these operations.

Figure 3 - Winter site preparation for aerial seeding

Several new systems are emerging in Finland and Sweden. Most of these systems are highly specialized. New Forests' SeedGun offers several air delivery systems that can be mounted on a variety of site preparation tools. Bracke Forest has produced a Bracke Seeder S35a that can be mounted on different types of site preparation equipment including mounders (Figures 4 and 5).

Figure 4 - Seeding system mounted on a processor frame

With some patience, experimentation, and commitment, simultaneous seeding can become an integral part of a forest renewal program that reduces costs, improves wood quality, and emulates nature.

Figure 5 - Braacke S35a seeder and a mounder

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WESTERN SILVICULTURAL CONTRACTORS' ASSOCIATION

by Tony Harrison

Capacity Jitters, Industry Image and Creative Scheduling

Workforce capacity was a hot topic at many of the winter industry conferences this year. The current mountain pine beetle forest health crisis in BC has precipitated increased budgets for silviculture, therefore we need more workers. Needing more workers has its challenges in the context of a recent history of declining wages in the silviculture sector and competing job opportunities in booming local and national economies.

The contracting community is excited about the increase in opportunities, so why the questions over our collective ability to rally the troops? The last 5-year period in forestry has been defined by shrinking silviculture funding and the related shrinking of workforce, wages, and profit. This environment has not been conducive to a healthy silviculture industry. In the current expanding market there will be plenty of incentives to get the right people in place. If young workers get a fair shake, working in the bush is still more attractive than the oil patch or construction. This is especially true for women and First Nations, two important demographics.

Another means of increasing capacity is through creative scheduling. One of the challenges of retaining a stable workforce is offering enough work throughout the year to form a critical mass of yearly income. Our workforce is in the contradictory position of being over-worked at certain times of the year, yet under-employed on the whole. This would indicate scheduling issues as opposed to capacity problems. Market forces will reward the client who can work with their contractor to expand the season through creative scheduling. This may include re-visiting interior fall plants, using anti-desiccant applications on seedlings later in the season, and better stratification of low risk blocks to plant in June/July.

At the moment, the WSCA is conducting a poll among its members to quantify the trends forming this year around worker capacity. John Betts is gathering information to quantify some efficiency and cost calculations implicit in replacing a workforce with less experienced workers. The WSCA has also compiled some figures on contractor costs and profitability. Last year one of the sector's longest-standing firms went out of business - something which can't be ignored. All this information will be shared with industry clients.

There are four broad themes being discussed:

1. What immediate strategies and tactics are available and practical to address capacity problems in the short-term, as soon as this spring?

2. What longer-term strategies could mitigate the effect of capacity difficulties, particularly in the light of anticipated increases in tree planting activities?

3. What effect have forest company practices in service procurement had on competition and the market for silviculture contracting?

4. How much price correction is it reasonable to expect as the industry adjusts to a higher percentage of untrained workers as well as rising fuel costs and increasing workplace safety expectations?

As an industry we are up for the task. There are some changes that will clearly have to be implemented, but on the whole contractors look at the next few years as an opportunity to evolve and rise to the challenge.

For more information on the WSCA capacity issue survey and report, go to www.wsca.ca

ONTARIO FOREST RENEWAL CO-OPERATIVE INC.

by William F. Murphy, RPF General Manager

Everyone hopes that the beginning of spring is the beginning of a new era in the woodlands industry. It usually means new harvesting, new renewal and new staff. For some forestry students, this may be the start of a new career, while others are facing job losses, reorganization and cutbacks.

Forestry is a cyclical industry with highs and lows dependent on the markets the mills serve. The forest is also cyclical with Mother Nature playing a large role in its continuation. Today that is being limited by sophisticated woodlands protection groups and environmental organizations that consider themselves experts in the field. Meanwhile, life in the forest continues to change and still requires continual renewal.

At the passing of the Crown Forest Sustainability Act (CFSA), the health of the forest was put in the hands of the forest companies. Today, there are only so many woodlands industries that are available to continue monitoring this renewable resource. In the past year, the state of the companies has not been affected by the state of the forest, but by the state of affairs. Have we ever considered how important these businesses are to the world economy and to forest health?

In the past 40 years in Ontario, outbreaks of the spruce budworm, acid rain in the south, emerald ash borer, jack pine budworm, fires and blow-downs have dominated the health of the boreal and the Great Lakes St. Lawrence Forest. It was the work of the Ontario Ministry of Natural Resources (OMNR) that slowed down the onset of poor forest health. However, it was the forest companies that took it upon themselves to harvest and utilize wood of poor quality from remote areas, so losses in yield on crown land would be minimized. It was at a great cost. There was some stumpage reduction benefit, but it had to be fought for.

So where do we go from here? What happens when we have the next big fire or the next big blow-down? The next big budworm epidemic is now epicentred in the Espanola area and jack pine budworm is already in the Atikokan area. Who is going to be there for the final clean up? Will there be the summer jobs or even continuation of permanent jobs? Ontario's mills are shutting down - permanently or temporarily - with outcomes still up in the air. Will environmental groups and the OMNR jump in and start to harvest? There is a dark scenario brewing that could change the renewability of our forest.

We need some positive influences on our forest health. Everyone wants to be involved in saving the forest, but who will actually do the work? Give support and everyone will benefit.

par Anne Moisan-Lapointe, responsable des communications, AETSQ

Le programme de formation des travailleurs sylvicoles

Depuis deux ans, la Commission Coulombe a fait couler beaucoup d'encre dans l'industrie forestière du Québec. Nos derniers articles en ont longuement fait état et comme mentionné dans ceux-ci, il reste encore beaucoup de recommandations qui devront être mises en place dans les prochains mois. Il est tout de même important de mettre en lumière les recommandations qui ont déjà été mises de l'avant, entre autres, une qui a un effet immédiat pour contrer la pénurie de main-d'œuvre : l'élaboration d'un programme de formation de travailleurs sylvicoles en entreprise.

En effet, en 2004, l'AETSQ avait proposé de mettre en place un programme de formation en entreprise, pour amener un complément aux programmes déjà existants dans les centres de formation professionnelle. La Commission Coulombe a bien reçu cette proposition en faisant une recommandation et le gouvernement a décidé de mettre en place, dès 2005, ce programme qui vise à soutenir la formation de nouveaux travailleurs sylvicoles dans les entreprises.

Fonctionnement

Ce programme s'adresse aux personnes sans expérience mais intéressées à exercer un métier sylvicole en débroussaillage ou en abattage manuel. Tout au long de son apprentissage, chaque travailleur reçoit, à l'aide d'un formateur qualifié, le soutien nécessaire pour parfaire sa technique et augmenter graduellement son rendement. Ainsi, ce programme permet à l'entreprise de répondre à son besoin de renouveler sa main-d'œuvre qualifiée, tout en assurant au travailleur une formation d'une durée de 12 à 18 semaines. Au cours des premières semaines, le travailleur reçoit un salaire horaire, ce qui lui permet de mettre l'emphase sur l'apprentissage de sa technique de travail et de sécurité. Graduellement, à mesure qu'il prend de l'expérience et augmente sa productivité, son salaire progresse vers un taux forfaitaire, au même titre que les travailleurs des équipes régulières. Au terme du programme, la majorité des travailleurs est apte à exercer son travail tout en gagnant un salaire convenable. Les travailleurs sont donc en mesure de joindre les équipes régulières à la saison suivante.

Bilan 2005

En 2005, neuf entreprises membres de l'AETSQ ont bénéficié d'une aide financière pour mettre sur pied leur programme de formation. De ce nombre, sept étaient en débroussaillage et deux autres en abattage manuel. En tout, près de 70 personnes auront reçu de la formation dans le cadre des programmes 2005 et un grand nombre d'entre eux pourront intégrer les équipes régulières lors de la saison 2006. Suite à un sondage effectué auprès des entreprises ayant profité d'un programme de formation au cours de l'année, nous avons pu constater que celles-ci étaient toutes très satisfaites et ont grandement apprécié la légèreté administrative ainsi que la souplesse de ce programme.

Perspectives 2006

Pour la saison 2006, le gouvernement a reconduit le programme, au grand soulagement des entreprises sylvicoles. Cette année, l'AETSQ croit pouvoir doubler le nombre de travailleurs formés. Avouons que dans la situation actuelle, ce programme vient mettre un baume sur les difficultés vécues dans le milieu sylvicole. La pénurie de main-d'œuvre n'est pas encore chose du passé, mais nous pouvons regarder vers l'avenir avec un peu plus d'optimisme. Reste à voir comment les autres recommandations du Rapport Coulombe seront mises en place.

QUEBEC TRANSLATION

by Anne Moisan-Lapointe, Communications Co-ordinator, AETSQ

A Training Program for Silvicultural Workers

For the past 2 years, the Coulombe Commission has been the subject of much comment in the Quebec forestry industry. Our recent articles have dealt at length with the topic, and, as we have pointed out, there are still many recommendations requiring implementation in the coming months. It is nevertheless important to highlight the proposals that have already been put forward, including one that has an immediate effect on the shortage of forestry manpower - the development of a training program for forestry workers already employed.

As early as 2004, the AETSQ had proposed setting up an on-site training program to complement the programs already in existence in professional training centres. The Coulombe Commission was favourable to this idea, and included it as a recommendation. In 2005 the government decided to establish a program designed to encourage the training of new silvicultural workers during their employment.

Operation

The program is intended for unskilled individuals interested in working in a forestry setting doing brushing or manual cutting. Throughout his (or her) apprenticeship, each worker receives, with the help of a qualified trainer, the necessary support to perfect his technique and gradually increase his yield. Thus the program allows the company to satisfy its need to renew its personnel, while assuring the worker of a training period lasting from 12 to 18 weeks.

During the first weeks, the worker receives an hourly wage, which allows her to concentrate on learning work and safety techniques. Gradually, as she acquires experience and improves her productivity, her wages move towards a fixed rate, like that of members of normal working teams. At the end of the program, most workers are equipped to do their work and to receive an appropriate pay cheque. Such workers are able to join regular crews the following season.

Balance Sheet 2005

During 2005, 9 member-companies of the AETSQ received financial support to launch their training programs. Of this number, 7 were in brushing and 2 in manual cutting. Overall, nearly 70 employees received training in the program framework of 2005, and a large number of them will be able to join regular crews in the 2006 season. After a study carried out among firms having benefited from a training program during the year, we were able to conclude that all the companies were very satisfied and expressed great appreciation of the administrative ease and flexibility of the program.

Prospects for 2006

The government has reintroduced the training program for 2006, to the great relief of the forestry companies. This year AETSQ thinks it possible to double the number of workers trained, relieving some of the problems encountered in the forestry sector. The manpower shortage is not yet a thing of the past, but the future can now be contemplated with a little more optimism. How the other recommendations of the Coulombe Commission will be implemented remains to be seen.

NEW BRUNSWICK
DEPARTMENT OF NATURAL RESOURCES

by Craig Frame, Silviculture Forester

From the 1960s to the 1990s New Brunswick crown land plantations were mostly planted with a single species, predominantly made up of black spruce, jack pine or white spruce. During the past 10 to 15 years there has been a trend towards the creation of multiple species plantations. In the early 1990s only 10% of plantations contained multiple species, and these tended to be combinations of spruce with black spruce predominating. More often than not, the different species were separated into sections within the same plantation rather than mixed across the planting site.

Today, about 35% percent of the 13,000 hectares of annual crown land plantations are planted with multiple species. Today's multi-species plantations are very different from those of the past. An evolution over the past 10 years has involved heightened recognition of the importance of various species (such as red spruce, eastern white pine, and eastern white cedar) in the future managed stands being created. These species have played an important role as minor components within the New Brunswick forest, and this ecological and economic role is being recognized in today's plantations.

Apart from the intentional planting of multiple species is the natural regeneration of both softwood and hardwood species that commonly occur in plantations. While the goal of treating young 10-12 year-old plantations with herbicide and/or brush saw cleaning is to promote the free-to-grow status of planted trees, naturally regenerated species are still present and even promoted within plantations. The average composition of crown land plantations after cleaning is approximately 7% hardwood, 16% natural softwood and 77% planted species. This mix of species is seen as an advantage as it provides increased options when considering commercial thinning in these managed stands.

The move towards the planting of mixed species within plantations requires an understanding of species ecology from the nursery through to the final stand. Tree improvement programs provide seed of high genetic quality that are well adapted to sites where seedlings are planted. Improved planning processes and tools are being developed to ensure a better match of species to site conditions, and to provide subsequent care to ensure that desired species mixes become part of the future managed stand.

Tree nurseries are impacted by these changes. Required multi-species plantation mixes are often created by mixing single species seedling trays either at the nursery before shipment or at the planting site. However, recently the provincial government's Kingsclear Forest Tree Nursery and the J. D. Irving Limited Juniper Nursery have begun to sow multiple species within a single tray. Examples of mixes currently being used are:

- White spruce (95%) and white pine (5%)
- White spruce (60%), red spruce (35%) and white pine (5%)
- Black spruce (50%) and red spruce (50%)

There are advantages to both single and mixed species seedling trays. The single species trays work well for species that cannot be grown together (e.g. black spruce, white pine and white cedar) and a single species crop is simpler for a nursery to manage. The mixed species seedling trays eliminate the need to mix trees at the planting site and ensure that desired proportions of species are found within the finished plantation.

Regardless, planning and forethought are vital. The more you know, the better job you can do.

NOVA SCOTIA
SILVICULTURE CONTRACTORS ASSOCIATION

by Alan O'Brien

The Department of Natural Resources (DNR) has concluded its 5-year assessment of forest sustainability regulations. They have been examining the 7 categories of eligible silviculture treatments: (1) Natural regeneration establishment; (2) Established plantation; (3) Early competition control: plantation & natural; (4) Plantation: density control & release; (5) Natural: density controlled & released; (6) Commercially thinned; and (7) Quality improvement: crop trees released & pruned, and selection managed. Changes will be made to 2 of the 7 categories in response to proposals to the Forest Technical Advisory Committee (FTAC). The committee is composed of interested stakeholders including representatives from landowner groups, registered buyers, silviculture contractors and consultants, and environmental groups. The changes will likely take effect in 2007 if they meet Cabinet approval, and will affect categories 2 and 7 (establishment plantation and quality improvement - uneven age management). Although the silviculture representatives put forth several proposals that were felt to be well thought-out and positive, the committee ultimately rejected them. These included proposals for change to 3 of the categories:

1. A raise in the credit value from 50 to 75 points for natural re-gen establishment was proposed. The rate of 50 is 1/13 the value of plantation credits. The large difference in rate values has led to certain forested areas appearing on the provincial GIS grid twice. The area in question is recorded as a nature site by one registered buyer, and may also turn up again as a planted site. In other words, someone can potentially bring in site gear, run down the natural trees and then plant the area. This cannot really be called silviculture, but merely survival for the contractor. The bottom line is that a planted area yields more money and credits.

2. It was proposed that the planting rate for larger planting stock be raised. This prescription is followed where chemical release is not an option. The larger stock is planted in hopes that it will beat the competing vegetation skyward.

3. A raise in the rate for pre-commercial thinning was also proposed. The silviculture reps asked for a $50/ha increase. Numerous high-density jobs have not been getting done, largely due to simple economics. It takes a worker more time to cut more stems.

Unfortunately, none of these proposals were considered by the DNR, which leaves me wondering about the efficacy of our representation on this committee. The 2 proposals going forward will speak to an increase in rates and a change in technical standards, which will be discussed in a future article.

On a political note, the Honourable Brooke Taylor has been appointed the new Minister of Natural Resources for the province. We look forward to working with him to advance the industry in Nova Scotia and provide more opportunities for silviculture contractors.

PEI

DEPARTMENT OF AGRICULTURE & FORESTRY

by Ken Mayhew

Since its heyday in the late 1980s and early 1990s, PEI's silviculture sector has been in a long and steady decline. Contributing factors include the federal government's withdrawal from the Forest Resource Development Agreements, but the biggest shift was probably due to the sudden and dramatic expansion of the commercial softwood harvest in the mid 1990s. As markets for studwood, sawlogs and other softwood products expanded, contractors began to look for greater operational efficiency and productivity. They needed strategies to address concerns such as forest worker training and retention, soaring liability insurance, and escalating Workers Compensation rates. Many Island contractors felt that the only way to deal with these problems was to do away with manual felling crews and mechanize their operations.

Over the last few years, softwood harvest levels have eased due to mill closures and shutdowns. Increasingly, Island producers are competing for what seem to be smaller and smaller markets, so many of them are also looking for opportunities elsewhere in the forest sector. Landowners are also starting to look at other forest management options, but limited funding levels for silviculture programs, combined with a lack of skilled manpower, have impeded recent attempts to encourage more silviculture on private lands.

One potential growth area is cleaning or thinning of thousands of hectares of plantations established on cutovers over the past 25 years. The backlog of sites requiring PCT treatments is growing, but there are significant problems with the suitability of most of the existing mechanized equipment and/or finding and retaining trained silviculture workers. Landowners are often unaware that their plantations need thinning or how to proceed, so connecting mills which can use the wood to landowners with suitable plantations could help to get these stands managed, and ensure that public and private sector investments are preserved.

It is estimated that 60% of Island homes use fuelwood for at least some of their space and water heating requirements, and demand is expected to increase if oil prices continue to climb. PEI made major investments in district heating infrastructure in the 1980s, and most of it is still operating. Although the primary energy source has been oil for the last 10 years, there could be renewed interest in wood chips for these heating systems. Connecting wood energy demands and forest management may create opportunities to use poor quality materials as fuel while using the revenues generated to offset the costs of a variety of management options. The key is getting landowners involved, building a trained and available workforce, and ensuring appropriate harvests that improve forest quality.

Demand for high quality hardwood for value-added production has grown in recent years but problems with quality and supply continue to dog the sector. While a few landowners have started to manage individual trees such as yellow birch, white ash and sugar maple within the stand and produce high quality individuals, most forest owners are either unaware of or are uninterested in this approach.

Efforts are underway in western PEI to strengthen business connections between private woodland owners and local wood-using businesses. The Wood West Initiative is working with support from the PEI Model Forest Network to develop a Virtual Wood Yard, where buyers and producers can connect online to develop local markets and business links for timber and non-timber forest products. By keeping locally produced wood in the area, they hope to benefit the economic and social development of their small rural communities.

Last year, 18 Island contractors or their employees received Sustainable Forestry Initiative certification through a course offered by Birchwood Environmental of Fredericton, NB. The Island's SFI certification process falls under the umbrella of the New Brunswick SFI committee.

TREE PLANTING 101:

Commitment is the Only Prerequisite

by Steven Mueller

I started planting trees more than a generation ago. The year was 1980. I remember that first day as if it were yesterday.

Day 1: A cluster of 22 wide-eyed rookies scuff the ground with their shiny corks as they are lectured on screefing, spacing, plots, naturals, bonus trees and excess percentages. The foreman demonstrates how to boot screef to mineral soil, open the hole, shovel tuck the bare roots and stomp it shut. Take 3 steps and repeat. It looks easy. With our training over, we hear him say, "OK, grab your box and hump down the road. I'll cut you in. Plant good trees or you don't get paid. Eat lunch while bagging up. No wanking. Don't get hurt. Quit at 6. Did I say no wanking?"

Day 2: All of us rookies replant our trees from day 1. J-root, duff shot, red rot, close, wide, deep, shallow, leaner, air pocket… the checker's plots reveal the lexicon of our incompetence. Numb, we settle into a daily routine: plant for 6 hours, replant for 6, sleep, dream and repeat.

Day 10: Still planting fewer than 500 trees a day. I contemplate quitting or even faking an injury like some of the others.

Day 15: The company owner comes to the block and - in a surreal, profanity-laced tirade - fires the entire crew. Yee haw! But before we can even pack our gear, he rehires us. Stubbornly, I stick it out.

Day 52: I plant 2,000 trees for the first time and graduate from greener to veteran.

Day 53: The season ends, and I'm 1 of only 6 planters left on my crew.

Thankfully, only a few new planters in 2006 will have to endure a rookie season like mine. Most planting companies now conduct some basic level of planter training and safety orientation. However, that training is often still lacking in both quality and substance. My own experience as well as discussions with numerous silviculture contractors reveals a number of contributing factors at work:

1. Enormous pressure is placed on contractors to get crews to work as early as possible in order to meet timelines, particularly in the spring season.
2. Every day spent in training is seen as a lost production day.
3. Tight margins don't allow workers to be paid for extended training time.
4. Employee turnover or mobility results in a loss of training investment.
5. Foremen or crew leaders are often promoted because they are high-ballers, not because of their ability to train or mentor other workers.
6. Company owners don't recognize the need or the benefits of improving their employee training or safety programs.
7. Tree planting has an entrenched culture of risk-taking and machismo not always receptive to a focus on health and safety training.
8. The lack of available information regarding industry-wide safety measures, including suitable tools to use in educational or training activities.
9. Existing training methods are often informal, and vary in quality from crew to crew.
10. Employee training is not documented adequately.
11. Worker understanding and competency is not evaluated or documented.
12. A minimal understanding of legislated requirements is lacking.

Silviculture contractors are facing many huge challenges in 2006, including an extremely competitive labour market. The future well being of our sector will - in large part - depend on our ramped-up ability to recruit, train and retain employees. I believe the successful silviculture companies of the future will be characterized by several key elements:

Commitment - Only those companies that make a sincere managerial and financial commitment to improved worker training will enjoy the benefits of their investment.

Health and Safety Certification - Contractors who have a solid training program will be prepared to meet the demands of various provincial audit certification programs. Safe companies will be preferred by both clients and employees. The Alberta COR program has already significantly reduced injury rates among participating contractors. BC is launching the SAFE Companies initiative and other provinces are taking note.

Silviculture-specific Training - Quality training materials and courses that address the unique realities and hazards of silviculture are being developed by the BC Safe Silviculture Project, under the direction of the Western Silvicultural Contractors' Association. Training initiatives such as Resource Road Driving, ATV Operation, Supervisor Skills, Emergency Response Planning, and a Silviculture Worker Health Manual are well underway and will be made available to contractors (for more details go to www.wsca.ca).

Technology - Online education can maximize training opportunities and reduce costs by reaching out to workers before they even arrive on site. Planter-oriented training resources such as the pioneering www.tree-planter.com or www.replant.ca are already providing hundreds of new workers with basic planting information as well as initial health and safety orientation each season. The Ontario Forestry Safe Workplace Association offers online tree-planting courses at www.safeplanting.com. Dr. Delia Roberts' well-regarded pre-season fitness and nutrition programs for planters are available for free download at www.selkirk.ca/treeplanting. Forward-thinking contractors can begin building a basic new worker orientation curriculum by pulling together various components of these web-based tools.

Innovation - Companies that develop and implement innovative training programs for both their green and veteran planters will enjoy the benefits of increased production and quality. At least one planting company I know of employs video analysis of their planters' techniques to improve both safety and production. More companies are hiring professional safety consultants to develop and deliver their safety programs and training requirements. Reduced operational costs, increased worker satisfaction, and loyalty will justify these initial investments.

Supervisor Training - Management and field supervisors have a legal responsibility to due diligence when planning for the safety of their workers. Supervisor skills training and certification of field supervisors will soon become mandatory. As supervisors receive advanced safety and management training, they will in turn become trainers for their employers.

More than ever, it should be clear to all silviculture contractors that increased and improved worker training is a critical determinant for production, quality and safety.

My last word goes out to all the green planters starting their career in 2006:

One roll of duct tape: $1.49
Orange cork boots: $69.95
Shovel, bags and tarp: $173.50
1973 Volkswagen van with hand-painted flowers and peace sign: $1,200.00
Getting hired by a company that will train you: Priceless

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A Root-Bound Index for Container-Grown Pines

By D.B. South and R.G. Mitchell

Root-bound seedlings have been a concern of nursery managers for more than 4 decades. When container-grown seedlings are root-bound (or pot-bound), survival, growth or stability might be reduced after outplanting. In some cases root-binding might not affect survival or early growth, but it might adversely affect stability. Initially the concern over root-binding was concentrated on root-spiraling, which could result in "root-strangulation" and early toppling.

Our definition of root-bound is a plant grown too large for its container, resulting in a reduction in field performance or root growth potential (RGP). We contend field performance of pines will be reduced before the roots become tangled or matted, and that nursery managers need a method to estimate when this begins to occur.

Only a few indexes have been proposed to evaluate root-binding in the nursery. Hiatt and Tinus proposed a "strangle-angle" index to evaluate the degree of root spiraling in container-grown seedlings. Due to concern over root spiraling, changes were made in container design and now most solid plastic containers have ridges, which greatly reduce the amount of root spiral. For this reason, the "strangle-angle" index is rarely used as a predictor of seedling quality. However, there still is a need for a simple, easy-to-use "root-bound index" (RBI). A RBI would be useful when nursery managers and regeneration foresters evaluate stock quality prior to outplanting.

A RBI can be based either on a subjective score (based on the appearance of the root-plug) or on an objective value (such as root mass). In addition, the RBI could be determined with destructive or non-destructive measures. We wanted to develop a RBI that was both objective and non-destructive, therefore, root-collar diameter (RCD) was selected as the seedling attribute to measure (since it is often related to root mass). We calculated RBI as a ratio of either container diameter or volume. The objective of this study was to develop a RBI that would help nursery managers estimate the percentage of root-bound seedlings prior to shipping. We wanted to test the hypothesis that: (1) RBI was related to outplanting survival; and (2) independent of RCD, outplanting survival is related to the length of time stock is kept in the hardening phase.

Materials and Methods

Four separate studies were used to test the effects of RBI on survival. The first study was conducted in the US on pinus palustris (seedlings) whilst the other three studies were conducted in South Africa on pinus patula (seedlings and cuttings) and the pinus elliottii x pinus caribaea hybrid (cuttings).

Discussion

Overall, the largest-diameter stock in the pinus palustris and pinus elliottii x pinus caribaea study did not survive as well as pines that were closer to the median size. These findings suggest that a small proportion of operationally produced container stock may suffer symptoms of root-binding. For example, survival of the large container-grown pinus palustris seedlings (RCD of 12-13 mm) exhibited much lower survival than seedlings with a RCD of 8-9 mm. These findings cast doubt on the belief that only small diameter container-seedlings need to be culled.

A bell-shaped curve was apparent for pinus palustris seedlings and the curve for pinus patula seedlings could be considered to be a truncated bell-shaped curve. This study may be the first to demonstrate this bell-shaped, survival-response curve for container-grown pine seedlings. Previous authors have warned against root-binding of seedlings, but data showing the relationship between root-binding and field performance are rare. In some cases planting date and plant age are confounded, which casts some doubt on the conclusions.

Age or size?

Some warn against growing seedlings too long in the container. For example, 6 month-old pine seedlings grown in paper pots survived better than 18 month-old seedlings. Brisette and others say, "Adverse root forms increase rapidly with the length of time seedlings are grown in containers." They suggest that if pinus palustris seedlings are kept in containers only 3 to 4 months, there should be no problem if the containers are properly designed. Others say the optimum seedling age in South Africa is between 5 and 7 months. However, stock size and stock age are confounded. As a result, RBI increases as seedling age increases.

Since root-binding is a function of both seedling size and container size, then plant age should not be the sole criterion for determining stock quality. The pinus palustris data suggest that 26 week-old seedlings may perform satisfactorily in >90 ml containers if the RBIvol is within the 8 to 10 range. Of course young, 1 month-old pinus palustris seedlings do not survive in the field as well as 2 month-old seedlings.

Reduced RGP

The mechanism that explains why root-bound seedlings have lower survival is not known. Lower survival from root-bound seedlings might result due to a reduced RGP and a lower root-weight ratio. Our data along with data by others suggest the older root-bound

seedlings have lower RGP than smaller non-bound planting stock. Smith and McCubbin found RGP of E. grandis seedlings was cut in half as seedlings increased in age from 16 weeks to 21 weeks. We observed a 20% reduction in RGP when comparing 10 mm diameter pinus palustrius seedlings with 9 mm seedlings. When hybrid cuttings with a limited RCD (3.1 to 3.5 mm) were selected, age still had a significant effect on seedling survival. In this analysis, 6 month-old cuttings had 94% survival while 13 week-old cuttings only had 84% survival. This suggests a decline in RGP may occur after hardening practices are initiated to slow root development.

When top-pruning is not employed, seedlings held too long in the nursery will sometimes produce an unbalanced seedling. Even when hardening techniques are employed, the growth in root mass is sometimes limited by the container while shoot mass continues to increase. Therefore, the root-weight ratio will sometimes decline over time.

Conclusions

Root-binding of container stock can result in reduced survival of both seedlings and cuttings of pine. As pine roots become root-bound, their ability to produce new roots decline. To avoid root-binding, most managers ship seedlings by a certain age. In some situations, they will reduce water and fertilization to slow root growth and prolong the time before many roots become root-bound. Keeping seedlings too long in the hardening phase can reduce RGP and seedling performance.

Some tree planting guides provide minimum specifications for the diameter of planting stock but do not include a maximum RCD limit. We propose that RBIvol maximums be determined for each species. When planting guides cover a range of container types, a maximum RBIvol value can provide some indication of when root-binding might reduce plant quality. At time of shipping, nursery

managers could report both the percentage of plants that exceed the RBIvol value and the number of weeks the stock has remained in the hardening phase (since both can affect outplanting survival). Additional research needs to be conducted to determine if RBIvol will be useful for non-pine genera.

This article is an excerpt from a presentation made at the Thin Green Line Symposium held earlier this year in Thunder Bay. D.B. South is with the School of Forestry and Wildlife Science, Auburn University, AL and R.G. Mitchell is with Sappi Forests Research, Ngodwana, South Africa.

Exporting Canadian Expertise

New Markets in Need of New Thinking

by Jean Cinq-Mars

Reports in the media about the state of the forest sector remind us of the cyclical nature of this industry, which is currently on a downward slope. Simply weathering this downturn and waiting for an upswing is an option. However, it might be timely to explore new and upcoming markets to diversify the forest sector. This can be achieved by exporting Canadian expertise through the establishment of enterprises in other countries, or by exporting Canadian goods and services that satisfy a global demand.

Our basis for exploring today's new markets is, on one hand, to examine mega global trends that are impacting all aspects of the environment, the economy, and society, and, on the other hand, to consider the full spectrum of benefits that can be derived from forests. Some key trends include:

- Degrading ecosystems, resulting in 60% of the vital services provided by earth's biodiversity being either overexploited or degraded. This will have serious consequences for human life in 35 to 40 years.
- A growing global population that will reach 9.3 billion by 2050, equivalent to a 50% increase from today's level. By 2030, 2 billion people will be added, almost all of them in the cities of Africa, Asia and Latin America.
- 5.8°C by 2100, if greenhouse gas emissions continue to grow unabated.
- Accelerated economic development in Asia Pacific - Export Development Canada estimates the GDP growth for this region at 7.0% in 2006.

These trends will force us to change how we conduct our business. Considering the expertise that Canada has gained in managing vast forests and our natural resources, how can we attempt to address these issues while developing a niche for Canadian forest experts and enterprises?

Restoring Ecosystems

The first approach that comes to mind is to build on Canadian expertise in the restoration of ecosystems to maximize the production of ecological services. Many examples have demonstrated that positive economic benefits can be achieved. Perhaps the best-known example is the decision made by the city of New York in 1997 to make changes in the agricultural and forestry practices in its upstream watershed in order to preserve its drinking water quality. The city decided to pay for the protection of the rural nature of the Catskill Mountains, from which New York gets most of its water. The city is paying farmers $100 million a year to adopt environmentally acceptable farming practices, and it has bought land at the cost of $250 million to prevent development. These measures will minimize water pollution. Without this ecological intervention the city was faced with an investment of $4-6 billion to refurbish the water treatment plant as well as $250 million per year in operating costs. The decision was financially and ecologically sound! In Costa Rica, hydroelectric power producers and water consumers pay $57 million a year to landowners to conserve their forest and protect the landscape so that stream-flow regulation and erosion control allow for the continual production of energy and drinking water.

Perrier-Joutel, the well-known French mineral water bottler, has reforested parts of the watershed where its source of water is located. The company is also paying farmers to modernize their installations and to adopt organic farming to preserve the quality of its water. In Columbia, Costa Rica and Nicaragua, the GEF has initiated a project that creates mechanisms to pay land users for the global environmental services they are generating.

There are several ecosystems in need of restoration in the world. The expertise gained in the management and restoration of large Canadian forested ecosystems could be applicable in foreign countries facing degraded environments. Traditionally these types of projects have been supported by aid/development agencies, but local governments are now realizing the economic and social benefits of well-functioning ecosystems for the provision of water, erosion control, clean air and other essentials. These programs also indicate an increase in the importance and in the economic valuation of public goods.

Greening Buildings and Urban Environments

Canadian expertise can also be leveraged to help alleviate pressures resulting from population growth.

The expected global population growth will occur mostly in Africa, Latin America, and South-East Asia, concentrating in urban areas. Economic development will follow this population growth. The desired level of GDP growth is 4-6% annually in order to maintain social and political stability. This growth will provide opportunities to develop and implement solutions, but it can also put additional pressures on the environment resulting in water shortages, air as well as water pollution and many other forms of contamination.

Addressing ecosystem degradation requires numerous economic and social changes, but it also includes a fundamental paradigm shift in the management of urban ecosystems as well as the way we consider our infrastructures. The infrastructures of our society must be redesigned to include ecosystems and ecological functions, not only to reduce their ecological footprint, but also to act as providers of ecological services. Many Canadian architectural and engineering construction firms are leading in the construction of sustainable buildings, designed according to LEED or other sustainable building standards. Adapting our already successful prefabricated housing sector to meet the new sustainable standards, and adapting it for multiple housing buildings, could be a way to provide housing to a fast-growing population in a sustainable way while making use of Canada's various commodities including wood and its cutting-edge green construction expertise.

Sustainable buildings can surely help, but their efficiency is often limited to the building's structure. Changes in urban planning are essential. In fact, cities can actually clean their air by using vegetation in their design and thereby counteract the heat island effect (urban areas are actually a few degrees higher in temperature than the surrounding region). According to Tree Canada Foundation, 100 trees remove 5 tons of carbon dioxide plus 1,000 lbs of pollutants, including 300 lbs of solid matter such as soot. Trees also provide shade and wind proofing for nearby buildings, thereby reducing cooling costs by up to 30% and heating costs by 10 - 25%. It is therefore possible to improve upon the haphazardly arranged patchwork of municipal parks, urban forests, landscape lawns and streams to augment nature's ability and capacity to provide ecological services, and help cities reduce their ecological footprint. A long time ago ecological engineers proved that wetlands provided the best systems for purifying water; other ecosystems such as urban forests, streams and gardens should be put to the task. A great number of Canadian land-use planners, silviculturists and arborists have the expertise to enhance a city's ecosystems and provide ecological services to its population. Combining their expertise with the architects and engineers specialized in sustainable buildings could be very attractive to fast growing cities.

An interesting partnership has recently been established between the cities of Hamburg and Shanghai. "Ecobuild Shanghai 2006" aims to promote the concept of ecological building through raising awareness of ecological building concepts and technologies while creating a market for German environmental and building products as well as services. (Go to http://www.green-shanghai.com/eng/background.html for more information.) Several sites in various districts have been selected to demonstrate energy efficient, environmentally friendly technologies and concepts through demonstration projects. The buildings are designed to save 75% of energy compared to the average consumption in Shanghai. Innovative water and wastewater infrastructures will be integrated. This includes water recycling, fertilizer recycling, energy efficiency and recovery in Circular-Material-Flow-Systems. These systems are designed to use renewable energy. The final goal is zero pollution. The Chinese developers of those projects benefit from technical assistance from German experts in terms of design, quality control, training, monitoring, evaluation and certification. With a booming construction sector in China, Germany has put in place a promising strategic alliance. Could Canada offer such expertise? Yes, and in fact we also have all the commodities and building components required for turnkey projects.

Developing Biomass Fuel

The need to find more secure and less environmentally damaging sources of energy has prompted several industrial sectors to look at new types of fuels including energy from organic materials. As a result, interest in biofuels is growing dramatically - global ethanol production has grown from almost zero in the 1970s to 10.2 billion gallons/year today. Canada's biofuel sector is expanding as well, with the expertise and raw materials to become a major producer worldwide and to export to numerous markets.

An excellent article by Dr. David DeYoe in the previous issue of this magazine covers

this topic very well. This is certainly an area of Canadian expertise and a market niche in expansion. A new EU strategy has been developed to address the growth of greenhouse gas emissions, and aims at increasing the amount of transport fuel produced from organic material. This market is supported by the 2003 Biofuels Directive that sets an indicative target for EU-wide biofuel use of 2% by December 2005 and 5.75% by December 2010. Recognizing the importance of this emerging movement, UBS and Lausanne-based Diapason Commodities Management have joined forces to launch the first commodity-based biofuel index. In the US, some states have biofuel legislation and tax credits supporting it. The recent Clean Fuels Development Coalition signed by President Bush requires that transport fuel sold in the country in 2006 include 4 billion gallons of biofuel, increasing to 7.5 billion gallons in 2012. In the Caribbean and Latin America, several international organizations have launched project FORMA to provide support and accelerate Clean Development Mechanism on reforestation/aforestation and bioenergy initiatives (http://www.cifor.cgiar.org/carbofor/_ref/projects/forma/index.htm). These are just a few examples of programs that support the development of bioenergies. It is a growing field that will continue to expand and one that Canada should actively pursue.

These three approaches are aimed at addressing global sustainable development issues through ecosystem interventions. They offer significant potential to improve the quality of lives around the world as well as to stimulate significant economic opportunities for Canadian enterprises and experts. Obviously they rely on not one but multiple fields of expertise. Markets for the exports of timber and pulp will continue to exist, but the global issues of today and tomorrow require complex solutions that incorporate an assemblage of products and services derived from sophisticated knowledge and insight. Combining technologies, expertise, business models, foreign market savvy, and policies now drives innovation. One of the challenges of establishing these combinations or clusters comes from the geographical spread of our various resource industries as well as business, technology, construction, and ecosystem experts. Recent communications and information, coupled with supply chain management technologies, have to be harnessed to bridge the distance gap between the experts and the source of natural resources. What is required is a new microeconomic model for Canada that will satisfy a global economy and adopt a knowledge-based Canadian economy considerate of the environmental limits of our planet.

Developing new products and services is certainly more ambitious than a tweaking of traditional sectoral policies, or developing another subsidy program. Some would argue that Canada has a commodity-based economy. This is the unfortunate truth, as we do not have any comparative advantages in other sectors, nor have we made any significant inroads into emerging markets like the Asia Pacific region. We are highly dependent on one major customer - the US - and this market is starting to find Canadian products more expensive than those from other countries. We are probably close to the top of the cyclical commodities market – thus it is a crucial time to start moving to other sectors. This is one challenge that cannot be overlooked if Canada desires to have its place in the export of knowledge-based products and services in the world. We possess this expertise and are well-positioned to play a significant role in emerging markets, especially when one considers the distinct advantages that we derive from our bountiful natural resources, including energy. The question is: are we going to stay well positioned or are we going to become a global leader in new markets?

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