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AUGUST 2007

Land Use Planning

- Somatic Embryogenesis Technology
- Stock Handling Innovations
- Adaptive Forest Management in BC

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Canadian Silviculture is published four times a year by EMC Executive Marketing Consultants Inc., 6058 187A Street, Surrey, BC V3S 7R6. Phone 604-574-4577
Fax 604-574-2196
Email silviculture@emcmarketing.com
www.canadiansilviculture.com

Subscription rates: 4 issues per year - $30.00 & GST

PUBLICATIONS MAIL AGREEMENT NO. 40026059
RETURN UNDELIVERABLE CANADIAN ADDRESSES TO
CIRCULATION DEPT EMC PUBLICATIONS
6058 187A ST
SURREY BC V3S 7R6
email: info@emcmarketing.com

RISING TO THE CHALLENGE

by Larry Innes, photos by Garth Lenz

Doubts about the global significance of Canada's boreal forest have been dispelled by the recent reports of the Intergovernmental Panel on Climate Change. In a world where deforestation contributes approximately a quarter of global CO_2 emissions, the value of intact forests can no longer be ignored.

As Canadians, we also have an unprecedented opportunity to become global leaders through wise stewardship of our boreal forest, which is not only one of the largest intact ecosystems on the planet, but also the single largest terrestrial storehouse of carbon. Over 67 million tonnes of carbon is contained in boreal trees, soils, and wetlands. The boreal region plays a vital role in both sequestering and storing massive amounts of carbon dioxide from the atmosphere.

From a biodiversity standpoint, Canada's boreal forest is also home to internationally significant populations of birds and wildlife. It filters and stores more fresh water in wetlands and lakes than anywhere else in the world. Culturally, the boreal continues to sustain hundreds of aboriginal communities, and in economic terms, it generates billions of dollars in natural resources from timber, energy, and mineral resources.

The opportunity is clearly before us. However, to date, we have collectively failed to meet the challenge of managing a large-scale, largely-intact ecosystem in a truly sustainable way.

As a rich, developed country, Canada contributes disproportionately to the problem. We rank as the third worst emitter of greenhouse gases (GHG) among the 30 member countries of the OECD, and our rate of deforestation is among the highest in the world.

One of the key obstacles to sustainability is that resource allocation and land use decisions continue to be made in silos. Federal and provincial agencies are divided on both jurisdictional and sectoral lines, resulting in a complex maze of resource

Dehcho Land Use Plan

The final draft of the Dehcho Land Use Plan was released in June 2006 by the Dehcho Land Use Planning Committee, comprised of representatives of the Dehcho First Nation, the government of Canada and the government of the Northwest Territories. The area covered by the plan includes all the Dehcho territory except the Nahanni National Park Reserve and existing community boundaries. The plan has been approved by the Dehcho Assembly, but has not yet been adopted by either Canada or the government of the Northwest Territories.

As mandated under the Dehcho Process, the purpose of the plan is "to promote the social, cultural, and economic well-being of the residents and communities in the Dehcho territory, having regard to the interests of all Canadians". The draft plan reflects a balanced approach between development opportunities and social and ecological constraints. It is unique in taking into consideration the principles of respect for the lands, as understood and explained by the Dehcho Elders, and the principles of sustainable development in a modern context to provide for the conservation, development, and utilization of the land, waters, and other resources in the Dehcho territory.

An entire section of the draft plan is dedicated to water monitoring and management, with the recognition that "water is the most important resource" to the Dehcho Dene, who are also working with other Aboriginal communities in the NWT, Saskatchewan, Alberta, BC, and Alaska to protect water quality in the Mackenzie watershed, which is under stress from energy developments, including the Alberta tar sands. The Dehcho are proponents of the Keepers of the Water Declaration, which recognizes water as both a human and an aboriginal right, and asserts that aboriginal people have responsibilities to protect water quality as well as to guide responsible development within their traditional territories.

For more information visit www.dehcholands.org.

in a region as

diverse

as Canada's boreal...

tenures and regulations where decisions are made for individual resource sectors or projects. Little consideration is given on how one sector affects another, or more importantly, how it affects the environment as a whole. Compounding this problem is the fact that decisions are often made in a top-down fashion, with little or no consultation with local communities that may be affected. Nowhere is this more apparent than in resource-rich Alberta, where a laissez-faire approach is resulting in serious ecological, cultural, and economic challenges.

There are signs of change. Since 2003, an alliance of companies, First Nations, and environmental organizations has been working to advance a suite of solutions known as the Boreal Conservation Framework. Endorsed by a diverse collection of timber and paper product companies, outdoor outfitters, financial companies, publishers, and, most recently, by more than 1,500 leading scientists from around the world, the Framework seeks to achieve a balance between the imperatives of conservation, the needs for sustainable resource development, and the rights of aboriginal peoples.

One of the most important mechanisms for achieving this balance on the ground is land use planning. Land use planning as a means to ensure sustainability is not new - it was a critical recommendation of the landmark Berger Inquiry in the mid 1970s. It is a requirement under many modern land claims agreements, and it has emerged internationally as a key element for the implementation of the United Nations Convention on Biological Diversity.

The rationale for land use planning is simple: Ecosystems, communities, and economies are, by their very definition, complex and interconnected. But there are also clear dependencies - economies

...solutions will vary

exist to support human communities, which are in turn supported by natural ecosystems. These fundamental interdependencies, reflected in both conservation science and traditional knowledge, mean that our first priority should be to determine what we need to protect in order to sustain ecosystems, which in turn sustain us. Sustainable resource development can then occur within those limits.

This fundamental insight is often lost in the competitive, fragmented approaches to land tenure and resource allocations, which dominate policy and decision-making. Apart from environmental concerns, decisions made in silos require complex dispute-resolution mechanisms to solve competing claims between various industries, and often lead to conflicts with other stakeholders. Most significantly, the absence of prior consultation forces First Nations into the courts, creating further uncertainty in sectors like mineral exploration, which are already subject to significant risks.

One of the best examples of how the goals of the Framework can be achieved is the Dehcho Land Use Plan released in May 2006. Under the Dehcho Plan (which has yet to be approved by the territorial and federal governments) approximately half of the Dehcho region (located in the southwest corner of the Northwest Territories) would be set aside for conservation and traditional uses. Special management zones where resource activities would be constrained by regulations designed to maintain wildlife habitat and other values would provide additional protection while permitting a range of industrial uses. General management areas with few additional restrictions would make up the balance. Even with such large protected areas, the Plan ensures that 88% of the forestry potential, 64% of the oil and gas potential, and 69% of the agricultural potential are still available for development.

The Dehcho Land Use Plan is a brilliant model, but it is by no means the only way to meet the challenges and opportunities for sustainable development. In a region as diverse as Canada's boreal, solutions will vary depending on national and regional objectives, ecological and economic priorities, and the mix of existing industrial allocations, land tenures as well as the status of First Nations and treaty rights.

Canadians are counting on our governments to meet the environmental and social challenges of the 21st century. We believe that this can and must be done, but it means that they must open the door and allow the vision and wisdom of First Nations, the innovation and stewardship of the resource sector, and the knowledge and passion of conservationists to help find the way.

Larry Innes is Executive Director of the Canadian Boreal Initiative (CBI), an independent organization that brings together diverse partners to create new solutions for boreal conservation, and acts as a catalyst by supporting a variety of on-the-ground efforts across the boreal by governments, industry, First Nations, conservation groups, major retailers, financial institutions, and scientists. Larry can be reached at 613-230-4739.

Forest Health

by Don Cameron, RPF

Brown Spruce Longhorn Beetle

Be on the lookout for this nasty imported beetle.

The saga of the Brown Spruce Longhorn Beetle (BSLB) continues. This little beetle has caused many problems since it was first positively identified in 1999 in Point Pleasant Park along the Halifax waterfront.

This is the only known location where BSLB was found onland in North America although it has also been found in solid wood packaging at the ports of Montreal and Vancouver.

It is believed that the pest was shipped to the area before 1990 via infested wood packaging materials brought from Europe through the port of Halifax. It is not difficult to imagine how the beetle would make its way to the nearby large potential feeding area - Point Pleasant Park - which is immediately next to the port.

With all the fuss surrounding the beetle, one may wonder why it is such a problem. This woodboring beetle is native to northern and central Europe and western Siberia. It poses a potential serious problem to the forests of Nova Scotia and potentially the rest of North America as it has no known predator or natural mechanism to keep the population in check. This little beetle is able to kill large spruce trees over a single year.

It is known that the BSLB attacks healthy spruce trees, dying trees, and recently felled trees, such as those downed by strong winds. If a spruce tree is under some sort of stress such as insect infestation, over-maturity or drought, it is even more susceptible to BSLB attack. Research indicates that although any spruce tree of 10cm or more in diameter may be attacked, mature spruce trees in excess of 30cm diameter tend to be the favourite menu item of choice.

Evidence indicates that our Halifax BSLB will make a meal out of a variety of spruce trees that grow in Nova Scotia. Along with the commonly found damage to red spruce, the pesky beetle has also attacked white spruce, which is also a favourite target for our native spruce bark beetle, black spruce, and the exotic and fast growing, Norway spruce. The wide-scale blowdown of spruce trees during Hurricane Juan, created additional prime feeding areas for the BLSB.

Because of established patterns in Europe, scientists believe that pine, fir, larch, and even some deciduous tree species may be at risk here as well. Due to the Canadian climate and nationwide coniferous forest, there is a possibility that the BSLB could create a widespread infestation westward toward the much more famous Mountain Pine Beetle, which is feeding its way eastward from BC and Alberta.

The actual tree damage caused by the BSLB is a result of the larvae feeding under the bark in the cambium and phloem, which is the growing tissue that transports nutrients. The larvae form meandering feeding tunnels through this critically important tissue. Once they make a complete circle around the tree, it effectively girdles it leading to a quick death. Trees can also be damaged over time by repeated attacks, which do not cause complete girdling. After feeding, the adult bores out through the bark, creating exit holes of about 4mm across.

These holes soon are running with resin that streams down the bark, creating an obvious symptom of problems within.

The Canadian Food Inspection Agency (CFIA) is the federal agency responsible for preventing pests of quarantine significance from entering Canada.

Once the BLSB was found, in an attempt to eradicate the pest, the CFIA undertook a large survey and infested tree removal program. A Ministerial Order was issued in October 2000 that established an 828 square kilometre part of Halifax Regional Municipality as a regulated quarantine zone. Under legislation, this authorized the CFIA to restrict the movement of high infestation risk materials to be moved outside of the regulated area without the agency's formal approval.

Regulated materials included wood of all species, in the form of logs, trees, lumber, wood with bark attached, nursery stock, wood mulch, wood or bark chips, and firewood. Obviously, this situation caused many challenges for woodland owners and the forestry sector in and around HRM.

In April 2007, the CFIA announced that it was extending the containment zone to include central Halifax County and smaller adjacent parts of Hants and Colchester counties. It also created new guidelines for handling and moving higher-risk products, such as spruce logs, bark and large wood chips. The new regulations were worked out in consultation with industry stakeholders. The expanded zone now includes several sawmills, which means that there are now more possible markets for woodlot owners and industry to direct their harvested timber within the zone.

It is practically impossible to accurately predict what long-term impact the BSLB will have on our forests. It is imperative that we make all efforts to slow the spread of this foreign pest.

For further information see www.gov.ns.ca/natr/protection/ipm/Sheets/bslbeetle.pdf or cfs.nrcan.gc.ca/index/bslb2.

Don Cameron, RPF, is Regional Forester for the Nova Scotia Department of Natural Resources, as well as Information Officer for the Nova Scotia Section of the Canadian Institute of Forestry.

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SOMATIC EMBRYOGENESIS TECHNOLOGY

by Steven C. Grossnickle and John Pait

Nursery production of CellFor Inc. bareroot loblolly pine somatic seedlings growing at Jesup nursery, PlumCreek

The use of improved seed is an effective way of bringing genetic improvement to forest regeneration programs. Seed orchards are currently producing seeds in large commercial quantities from trees having desired genetic traits. However, improved seed does not provide a method to multiply specific varieties that have desirable traits. Vegetative propagation techniques from full-sib seed provide the best means for doing varietal forestry by multiplying the improved genetic resource developed from tree improvement programs.

Two criteria are considered important for the successful implementation of vegetative propagation systems within an operational forestry program. First, the system must have the ability to preserve superior candidate varieties, so it will require the capacity to maintain varieties in a form capable of regenerating after the minimum period of 5-10 years required to test and select varieties in the field. Second, the propagation system has to be able to multiply selected varieties in large enough numbers at a reasonable cost. If these two criteria can be reasonably met, the selected systems can be implemented.

There have been major advances over the past 50 years in the development of operational vegetative propagation systems for conifer species used in plantations. These systems provide a means of bringing new genetic material into forests through the capture of a greater proportion of the genetic gain inherent within a selected tree species. They also provide a method for multiplying superior varieties and/or families identified in tree improvement programs. Systems utilize one of the following approaches:

Rooted Cuttings - Currently, rooted cuttings are a propagation technique that is available on an operational level to multiply specific varieties that have desirable traits. The primary use of rooted cutting technology is for bulk production of genetically improved materials. This technique is used worldwide to produce tens of millions of rooted cuttings for forest regeneration programs.

Micropropagation through Organogenesis Tissue Culture - Organogenesis is a tissue culture system that relies on the multiplication of shoots or the de novo formation of organs originating from either unorganized callus, preformed shoots, or induced buds. Shoot propagules are placed in an optimal rooting environment and treated in a similar manner as cuttings. This technique has been used in New Zealand forests on radiata pine.

Somatic Embryogenesis - Somatic embryogenesis (SE) is a tissue culture approach where proliferative embryo suspensor masses are established from non-meristematic cells and subsequently cultured to produce organized somatic embryos possessing shoot and root meristems. The term somatic refers to embryos developing asexually from vegetative (or somatic) tissue. This method has been used in horticulture and agriculture on a limited basis, and is now being used to a greater scale in forestry.

SE is the only vegetative propagation technology that provides long-term preservation of the selected genetic component of a conifer species that can be used for extended timeframes within an operational forestry program.

Basic Laboratory Protocols for SE

In general, the SE process is divided into several laboratory steps, which are performed under sterile conditions to prevent microbial contamination.

Culture initiation - mature zygotic embryos are dissected from the seed and placed onto semi-solid medium containing plant growth regulators.

Proliferation - maintenance of embryonal suspensor mass, which is characterized by the presence of early-stage somatic embryo structures that are analogous to those occurring during normal seed development. This is followed by a multiplication step when the tissue multiplies and develops as early-stage somatic embryos. Embryogenic cultures can be proliferated in a juvenile form for long periods of time to produce unlimited numbers of propagules from the same variety. At this point tissue can be allowed to continue to grow or it can be placed into long-term storage.

Figure 1

Cryopreservation - a means whereby germplasm can be stored. The embryogenic tissue is treated with cryoprotectants, frozen

Figure 2 - Six year-old thinned plantation with an average height of 35 ft.

to -35ºC under a controlled freezing rate, and then subsequently stored in liquid nitrogen (-196ºC) (Figure 1). Cryopreserved tissue can be stored indefinitely and then regenerated within a few weeks after a simple thawing pro**ce**ss. This long-term storage option offers a distinct advantage of somatic embryogenesis tissue culture over rooted cuttings and organogenesis tissue culture.

Maturation - advances the development of somatic embryos by exposing tissue to phyto hormones and controlled environmental conditions. Within a period of a few months, they are transformed into mature somatic embryos that are analogous to zygotic embryos.

In vitro germination - final lab step in which embryos are placed on germination media under controlled environmental conditions. In vitro germination occurs within a week and proceeds to the development of true needles. At this point young somatic seedlings can be transferred to ex vitro nursery conditions.

Nursery and Field Performance

From the early 1990s until the present, germinants from SE technology have shown continued improvement in their development into high-quality somatic seedlings in the nursery. Somatic seedling propagation technology has also been successfully integrated into both the bareroot and container seedling production systems. The initial response of germinants to the nursery environment will have a profound influence on subsequent morphological development. Recent nursery performance of somatic seedlings has shown that a proper nursery cultural environment (nutrients, temperature, and moisture) during the initial establishment stage will result in normal morphological development of seedlings. Reforestation site trials have found that somatic and zygotic seedlings have comparable field performance as a stocktype.

Integration into Tree Improvement Programs

SE technology provides an opportunity to capture value-added traits at the individual tree or family level. Testing of progeny from selected parents will capture additional gain for improved performance such as growth and yield, wood quality, plus stress, pest, and disease resistance. Thousands of varieties can be produced for field trials from selected families having desirable genetic traits. Embryogenic cultures from these varieties can be cryopreserved for long-term storage until field selections are made. Ultimately, a population of varieties, large enough to ensure genetic diversity, can be selected based on field performance criteria. From this type of selection program, seedling suppliers can offer elite varieties of loblolly pine seedlings with yield improvement averaging 42% (Figure 2). The selected varieties are removed from cryostorage and produced as somatic seedlings in the tens of millions, and are then deployed operationally to reforestation sites as diverse genetic mixtures.

during the past decade

significant progress

has been made

Operational SE Production System

Commercial acceptance of a novel technology such as SE requires the ability to develop and implement a successful operational use for the technology. The following key components must be addressed during this stage:

- Development of a cost-effective manufacturing process
- Delivery of high-quality products that provide predictable and reproducible performance
- Technology validation and promotion in the marketplace

During the past decade, significant progress has been made towards developing reliable, high-volume, cost-effective SE production systems. Organizations are working on commercialization programs for spruce species, Douglas fir, loblolly pine and radiata pine.

The Future of SE Technology

Forestry companies, advance seed production companies, and government organizations around the world are currently working on bringing tissue culture technology to a point where it can produce conifer somatic seedlings, on a cost-effective basis, with desired genetic characteristics. In the southeastern US the returns on planting elite varieties of loblolly pine seedlings produced from tissue culture technology are evident in more tons per acre grown per year, with fewer diseased stems, higher quality, and straighter logs with small knots, which will command the highest prices in the market. A southeastern US landowner can expect to realize a 10-18% return on investment in seedlings produced from these elite loblolly pine varieties, and harvest revenues that may be 75% greater in terms of 2006 dollars (net present value) than revenues from traditional orchard stock.

In the North American forestry market, CellFor Inc. and Arborgen are the two companies currently using SE technology to produce conifer seedlings for the commercial marketplace. For the 2008 planting season, CellFor Inc. will produce 10 million seedlings, while Arborgen will produce 500,000 to 1 million seedlings of southern yellow pine. In the southern US, the current market for southern yellow pine seedlings is 1.2 billion seedlings on an annual basis. It is projected that the marketshare of elite varieties of yellow pine will be 5% within the next 2-3 years.

With a supply chain and potential economic returns, SE is now a viable system for producing elite varieties of conifer species for the forestry industry.

Steve Grossnickle is a Senior Manager at Cellfor leading an effort to integrate somatic embryogenesis propagation technology for conifer species into nursery operations. Steve can be reached at 250-544-0492 ext. 223 or sgrossnickle@cellcor.com.

Supervisor Course Responds to Industry Demands

In response to an industry-wide demand for standardized safety training for supervisors, the BC Forest Safety Council is launching the sector's first supervisor training program that will lead to certification of forest supervisors. The first of two in a series of courses is the Basic Forest Supervisor course and is open to anyone who instructs, directs, and manages forestry workers, or anyone who aspires to be in a supervisory role. It is the foundation and pre-requisite program for a two-day specialized Faller Supervisor training course. Completing both earns a supervisor the opportunity to be certified as a faller supervisor after further evaluation by the Council.

"These courses fill a huge gap identified by industry," says Steve Mueller, Director of Worker Development for the BC Forest Safety Council. "Time and time again, research found supervisors had not received adequate health and safety training, and didn't understand their responsibilities. These programs help to address that problem."

Steve says the issue has surfaced in several ways since the Forestry Safety Task Force recommendation in 2004, which called for the implementation of uniform training and certification standards, beginning with supervisors. In a Council survey, nearly 1,200 experienced, certified BC fallers identified supervisor training as a top forest safety need. A WorkSafeBC inspection of 300 forestry work sites last year found one-fourth did not have a designated supervisor at all, and two-thirds of the supervisors who were present were not properly trained to oversee the work they were responsible for. Also in 2006, a coroner's inquest in the death of falling contractor "Turbo" Ted Gramlich led to a recommendation to design and implement a supervisor certification program. Finally, in January 2007, BC Forest Safety Ombudsman Roger Harris detailed the need for proper supervisor training in his first report, *Not Out of the Woods*.

As a result of this industry-wide call for more standardized training, the Council developed and piloted the courses that will eventually grow into a comprehensive program formally certifying forest sector supervisors. By the end of next year, the Council plans to be running other specialized supervisor training. When taken with the basic course, these specialized training programs would lead to certification of supervisors in mechanized harvesting, log hauling, silviculture, and other specialties.

"Well-trained supervisors make for a safer workplace," says Vincent Russell, WorkSafeBC's Director of Industry and Labour Services. "WorkSafeBC was pleased to be able to assist with the development of this course, which will help people understand the legal obligation supervisors have to ensure worker safety."

Forestry veteran Werner Dolling, one of the 200 workers who recently completed the courses, says supervisors would be ill-equipped in the woods if they didn't participate in the training. "It's a must," says Dolling. "If they're going to effectively manage people and keep workers safe on the job, they have to know all the rules and regulations in their workplace."

The Basic Forest Supervisor course costs $585 and the Faller Supervisor Endorsement course is $390. The courses are held at the Council's new Nanaimo office, which officially opened its doors in May.

To find out more information about the supervisor training programs, visit the Council's website at www.bcforestsafe.org or call 1-877-741-1060.

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SILVICULTURAL CONTRACTORS' ASSOCIATION

by Steve Mueller

Safety training that meets real-world needs

Last spring, *Canadian Silviculture* covered BC research into tree planting safety that brought mixed news for silviculture (see the article "Safety is a powerful tool for worker retention" in the May 2007 issue). Comparing work site attitudes and behaviours in 2004 and 2006, the study found generally safer behaviour, some persisting unsafe conditions, and indications that recruiting and retention of tree planters could be affected by their growing intolerance for risk.

The following statistics were especially interesting to me, because of the work I do now after spending 22 years in the silviculture industry:

Tree planters and on-the-job safety	2004	2006
Expected supervisors to correct unsafe behaviour	22.0%	37.2%
Actually had supervisors correct unsafe behaviour	33.3%	41.7%

Workers want more and better supervision, and they're starting to get it. Credit for this change, and for generally improving safety attitudes, belongs to WSCA and its members.

A silviculture supervisor training.program is being developed by the BC Forest Safety Council. Until the program is ready, contractors should take advantage of another council program introduced this year to train supervisors in all areas of the forest sector.

The bare-bones description of our Basic Forest Supervisor course is two days of classroom instruction and a written exam, followed by one day of applying those lessons in the bush. But what's truly important is that it meets practical, real-world needs. We focus on what supervisors must have to function effectively and protect workers. What would be "nice to know" isn't part of our training - not only because that would mean producing a college course, but also because staying safe doesn't need to be complicated.

Here are the simple facts:

• Supervisors are legally obligated to ensure their workers' safety and to know the safety legislation and regulations covering the work being supervised. Given the human and financial costs of injuries, this is a moral obligation and a business imperative.

• Satisfying those obligations isn't as hard as it seems. In BC, most supervisor responsibilities are spelled out in WorkSafeBC forest safety regulations. They're the backbone of the council's supervisor training.

This emphasis surprises some supervisors, but only until they see how it lets them take a regulatory requirement and make it work on the ground. The regulation should work for you, not the other way around, but you need to know how to use it.

A guided tour teaches supervisors to pinpoint and apply regulations relating specifically to their work. Think of it as translating what looks like regulatory theory into real-world practice. For instance, take the broad requirement for regular inspections "of all workplaces, including buildings, structures, grounds, excavations, tools, equipment, machinery, and work methods and practices, at intervals that will prevent the development of unsafe working conditions." The course helps supervisors figure out what this means to a tree planting operation with a few dozen young workers.

This is useful, potentially life-saving information, and at the very least a starting point for getting clarification. It's always better to ask a hypothetical "how to" question than explain what happened after an injury. In that sense, the council's supervisor training meets everyone's real-world needs.

- Employers have a concrete way of demonstrating due diligence.
- Trained supervisors can meet their own legal obligations and be more valuable employees.
- Silviculture workers can count on able supervision improving their odds of going home in one piece.

I don't know anyone who can argue with that.

Steve Mueller is Director of Worker Development at BC Forest Safety Council. Council training and other initiatives are described at www.bcforestsafe.org. The research reported last May can be accessed at www.wsca.ca.

ONTARIO

FOREST RENEWAL CO-OPERATIVE INC.

by William F. Murphy, RPF General Manager

Showcasing Our Best

Listening to your customers' needs and providing consistent, innovative solutions makes good business sense. Kevin van Duyn of Hill's Greenhouses in Thunder Bay, Ontario has applied these principles and it's paid off. On May 2, the 32 year-old tree seedling grower captured the "Best Local Supplier" award from Abitibi Consolidated at a gala awards ceremony in downtown Montreal. The award is even more impressive considering that Abitibi has roughly 15,000 suppliers worldwide and Kevin's receipt of the award marks the first time a seedling grower has been recognized with such an honour. Kevin will tell you his principles of success were learned from his father, Herman. The elder van Duyn has never been afraid of change, watching the seedling industry undergo many shifts in technology in the past few decades. "I started in 1978 with an order for only a few thousand trees and not much [technical] help," Herman explains. As the orders grew into the millions, the MNR initially provided expertise, and eventually the local seedling growers formed their own research co-op (Forest Renewal - formerly LUSTR).

After 29 years and 300 million seedlings, Kevin van Duyn and Hill's Greenhouses are counting on high-quality local service and home-grown solutions to keep their future and our forests looking green.

Northern Ontario has many top growers like Hill's and part of their strategy involves growing genetically improved seedlings to be planted on crown land. Ever since the mid 80s, when the first seed orchards were established by the Ontario Ministry of Natural Resources (OMNR), orchards have been developed with the expertise of forest company foresters and Forest Genetics Ontario. This organization is working with the forest companies in northwestern and northeastern Ontario to provide genetically improved seed for tomorrow's forests through first generation seed orchards. Last year, in the northeast, 14,476,800 or 39% of all the jack pine and black spruce seedlings planted were products of improved first generation seed. This involved 13 out of 16 different management units that reported on their first generation seed success. In all, they planted a total of 36,876,300 greenhouse-grown tree seedlings. In the northwest, 11 out of 12 management units on crown land reported planting a total of 15,808,400 or 61% of the jack pine and black and white spruce seedlings from improved stock. A total of 25,750,300 greenhouse-grown tree seedlings were planted in the northwest last year.

Forest Genetics Ontario is now pursuing second generation seed orchards that have been developed through a series of grafting the best first generation selections. We should see results from second generation seed orchards within the next 10 years, and until then we are looking forward to seeing an increased use of genetically improved first generation seed.

We are fortunate to have a great community in Northern Ontario that is committed to providing the highest quality seedlings for our future forests. We need to showcase these efforts to the world, highlighting our local growers and their allied organization as they provide home-grown solutions in a global marketplace.

QUEBEC

ASSOCIATION DES ENTREPRENEURS DE TRAVAUX SYLVICOLES

par Audrey Harvey, Responsable des communications, AETSQ

Un nouveau ministre, une nouvelle vision

En avril dernier, les citoyens du Québec ont décidé d'élire un gouvernement libéral minoritaire. Le premier ministre Jean Charest a dû constituer une nouvelle équipe de ministres. Monsieur Charest a démontré l'importance du dossier des forêts en nommant M. Claude Béchard au poste de ministre des Ressources naturelles et de la Faune, le ministre sortant Pierre Corbeil n'ayant pas été réélu. M. Béchard était auparavant ministre du Développement durable, de l'Environnement et des Parcs. Les quelques entretiens qui ont déjà eu lieu avec la nouvelle équipe en place laissent entrevoir un avenir plus prometteur pour l'industrie sylvicole. En effet, le statu quo ne semble pas une option envisageable pour M. Béchard et son équipe. Le ministre a eu une première occasion d'annoncer ses couleurs au congrès du Conseil de l'industrie forestière le 10 mai dernier. Son message était on ne peut plus clair : « l'industrie forestière traverse une crise sans précédent et tous les éléments sont en place pour revoir notre régime forestier en profondeur. » Parmi les mesures envisagées pour remettre nos forêts sur pied, le gouvernement a l'intention de lancer le plus vaste programme de reboisement jamais effectué jusqu'à maintenant. M. Béchard a affirmé son intention d'aménager la forêt au-delà de ce qui est déjà prévu dans les plans d'aménagement et de faire en sorte que cette ressource, si chère aux yeux des Québécois, se régénère de façon à redonner du bois de qualité et en quantité suffisante à ses citoyens.

M. Béchard a réitéré cette volonté tout récemment alors que les principaux intervenants du secteur forestier se réunissaient dans le cadre des travaux préparatoires au Sommet sur l'avenir du secteur forestier québécois. Au moment d'écrire ces lignes, les discussions battent leur plein à la Forêt Montmorency, cette dernière étant la forêt école et expérimentale de l'Université Laval. Le ministre, lors d'une allocution prononcée pour l'occasion, a réitéré que les attentes étaient grandes concernant les résultats attendus du Sommet. Cette crise nous force à faire des changements. La réorganisation est inévitable et devra se faire en minimisant l'impact sur les communautés locales et les travailleurs, a-t-il mentionné.

Bien qu'il soit trop tôt pour dévoiler le contenu de ces discussions, on sait toutefois que les orientations vont dans le sens de ce qu'avait annoncé le ministre. En effet, les gens autour de la table s'entendent pour dire qu'on doit passer en mode solution. Au cours de son intervention, le ministre a demandé aux personnes présentes de considérer la situation d'un tout autre point de vue : « Si le régime forestier n'existait pas aujourd'hui, on le bâtirait de quelle façon ? », a-t-il demandé. Il a appelé les intervenants présents à garder cette idée en toile de fond lors de leurs discussions pour laisser toute la place à l'imagination.

Enfin, M. Béchard a invité les personnes présentes à formuler des suggestions et à proposer des modifications à apporter au régime forestier actuel, des mesures qui permettraient de faciliter la restructuration de l'industrie à court terme. Comprenons-nous bien, ces modifications permettraient d'enlever l'incertitude dans les communautés et les gens qui y habitent en attendant le nouveau régime forestier. Présentement, le ministère a identifié quatre critères pour procéder à la réorganisation soit la rentabilité économique du projet, la transparence envers le travailleur, associer les communautés à la démarche et minimiser les pertes d'emploi. Le grand rendez-vous est toujours fixé à l'automne 2007.

by Audrey Harvey, Communications Coordinator, AETSQ. Translated by David Hayne

A New Minister, A New Vision

Last April, the citizens of Quebec decided to elect a minority Liberal government. The Premier, Jean Charest, had to form a new ministerial team. Mr. Charest underlined the importance of the forestry portfolio by naming Claude Béchard to the post of Minister of Natural Resources and Wildlife, the previous minister, Pierre Corbeil, having not been reelected. Mr. Béchard's former post was Minister of Sustainable Development, of the Environment, and of Parks. The few conversations that have already taken place with the new team suggest that the future may be more promising for the silvicultural industry. In fact, the status quo does not appear to be a serious option for Mr. Béchard and his team. The Minister had his first opportunity to announce the new approach at the Council of the Forestry Industry conference on May 10th. His message was perfectly clear: "The forestry industry is going through an unprecedented crisis and all the elements are in place for a thorough reexamination of our forestry administration." Among the measures contemplated to reestablish our forests, the government intends to launch the largest reforestation program ever undertaken. Mr. Béchard stated his intention of managing our forest beyond what is already foreseen in the present management plans, and proceeding in such a way that this resource, so precious in the eyes of Quebeckers, can regenerate itself and provide wood of sufficient quality and quantity for its citizens.

Mr. Béchard repeated his intention very recently when the principal stakeholders in the forestry sector met in preparatory sessions for the Summit on the Future of the Forestry Sector in Quebec. As these lines are being written, discussions are in full swing at Montmorency Forest, the forestry and experimental school of Laval University. The Minister reiterated that the results expected from the Summit have aroused great expectations. "The current crisis forces us to make changes," he added. "Reorganization is inevitable and it will have to be carried out with minimal impact on local communities and workers."

Although it is too early to announce the results of these discussions, it is nevertheless known that the initiatives will follow the path indicated by the Minister. Indeed, the participants around the table agreed that we must move on to the solution stage. In the course of his presentation, the Minister asked everyone to consider the situation from a fresh point of view: "If the present forestry administration didn't exist, how should we create it?" He appealed to the stakeholders in attendance to keep this idea in the back of their minds during the discussion, in order to give free rein to imagination.

Finally, Mr. Béchard invited attendees to make suggestions and to propose modifications to present forestry policy, i.e. measures designed to facilitate the restructuring of the industry in the short term. It is understood that such modifications would remove uncertainty in the communities and among their residents while we await the new forestry administration. For the present, the Minister has identified four criteria to guide the reorganization: the economic viability of the project, its transparency for the workforce, involvement of the communities, and the minimizing of job losses. The overall meeting is still scheduled for the fall of 2007.

AGFOR REPORT

by Gaston Damecour, RPF

Monitoring for Value and Compliance

Monitoring of publicly funded silviculture meets public accountability requirements and the intended silviculture results. Some time ago, AGFOR conducted a review of silviculture monitoring practices on private lands in three provinces. The practices ranged from visiting every treatment site - because public funds were involved - to a results and process-based monitoring using a limited sample (in the 10-20% range). AGFOR used a risk-analysis approach to compare the results. AGFOR found that a limited sample, combined with a comprehensive review of the entire process from prescription to execution, proved to be more cost-effective and yielded better compliance and silviculture results. In addition, it provided valuable feedback on the process.

Here's what pre- and post-treatment monitoring on crown lands looks like under New Brunswick's new $19 million silviculture program.

Objectives 1) Value of the province's investment as measured against a set of standards; 2) Reliance on licensee reporting; 3) Cost-effective deployment of departmental resources.

Process - At one time, the New Brunswick Department of Natural Resources examined every treatment area. Today this practice has been replaced with a 10% random sampling by treatment type within batches of silviculture work submitted by the licensee at the pre- and post-treatment stages. In this manner, the process extends from the prescription to the completed treatment, which is consistent with AGFOR's earlier findings on private lands. Each batch can represent about 25% of a licensee's annual program, so that results are distributed over the entire silviculture season to ensure that the quality of the program is consistent throughout the season, and that the department and the licensee get prompt feedback.

Pre-treatment monitoring - Once the silviculture treatment blocks have been submitted in batches by the licensee to the department, they are considered to be engaged in the process and may be selected as part of the random pre-treatment sample. Monitoring occurs after submission of a proposed site for treatment before the actual work begins. In the case of planting, this is done before site preparation. Pre-treatment monitors a licensee's pre-assessment with respect to a treatment's appropriateness and is part of the overall sampling, contributing to the end-of-season reconciliation. There is, therefore, significant financial incentive at play as the selection of the appropriate prescription is just as important as a competent execution.

Post-treatment monitoring - The completed sites/blocks, by treatment type within a batch are randomly selected and verified in their entirety for area and against predetermined standards. The sample results are rated against the claims made by the licensee for those sites/blocks.

The licensees' invoices for completed treatments are processed promptly with no questions asked. The results of the entire season's pre- and post-treatment samples for each treatment type are compiled for reconciliation against the submitted invoices. Any difference greater than 2% over the season's samples for a treatment type is cause for reconciliation and is pro-rated over the entire season's silviculture program, for that type, on a crown license. Most reconciliations are less than 10% and can be either positive or negative. Pro-rating the combined sample results over the entire program creates an important financial incentive.

The results are later followed up with five and ten-year post assessments to ensure that treatments meet intended targets - this is outside the post-treatment monitoring. Once the initial silviculture program has been completed and reconciled, it is up to the licensee to produce the intended result, be it stocking levels or free-to-grow status. We should see stronger integration of harvest planning and silviculture in the future.

Gaston Damecour, RPF, NB & NS, is the principal of AGFOR Inc, a forestry business consulting firm based in Fredericton. He can be reached at 506-462-0333 or gdamecour@agfor.nb.ca.

by Ken Mayhew

Promoting Forest Diversity through Planting Programs

PEI has a long history of planting trees on public and private lands. The first plantations were established in the late 1930s on old farm fields in what is now the PEI National Park in Dalvay. Red pine was the primary species, but a few rows and patches were planted with white pine, white spruce, Douglas fir, and maple. The Second World War put an end to this effort, but in the mid 1950s, the province created its first forest service and tree seedling nursery. They worked to plant harvest sites, abandoned fields, hedgerows and shelterbelts for a variety of social, environmental, and economic needs.

For the most part these early efforts focused on softwood species - native and non-native - because they were relatively easy to produce, stood up well to the Island's growing conditions, and produced a wide range of usable products. This practice continued on a small scale until the early 1980s, when federal funding supported an expansion of planting programs, along with other forms of silviculture. While the emphasis was still on species such as spruce, pine, and larch, work also began on developing planting strategies for shade tolerant species such as sugar maple, yellow birch, ash, and oak.

In the early 90s, the federal government withdrew funding, and at the same time, softwood harvest levels began to skyrocket. Faced with limited funds but high demand from public and landowners for reforestation of large harvest sites, the province and industry chose to support a softwood planting program. However, the reliance on planting as the only method of forest management led to concerns that too much emphasis was being placed on a few tree species, and that this was leading to a simplification of the Acadian forest ecosystem. This sentiment was expressed many times during the recent forest policy hearings by landowners, value-added forest products sector, environmentalists, nature conservancy groups, and the public.

PEI has responded by making a commitment to increase the diversity of species available for planting on private and public lands in its new forest policy. This will result in a decreasing emphasis on the production of species such as white and black spruce, and an increasing emphasis on species such as red oak and white pine, which are better suited to the predicted warmer, drier climate.

Currently, forest managers combine planting with natural regeneration by designing openings in the forest which mimic natural disturbances. Enrichment planting options for shade tolerant species are being explored in natural stands and older plantations to provide seed sources for the forest of the future. Plantings in riparian zones can utilize many different species; each suited to specific growing conditions and needs for the sensitive ecological zones.

The challenge has been and continues to be the successful and cost effective establishment of these species on typical forest sites, and ensuring adequate side shade to prevent the development of unwanted branches along the trunk. Side branches can dramatically lower the value of some hardwoods for high value products such as veneer. Researchers have tried planting species such as red oak and yellow birch in dense plantations of several thousand seedlings per hectare, or have interplanted them with fast growing species such as larch, to prevent the development of unwanted side branches. Both approaches show promise but are expensive to implement.

Research indicates that tolerant hardwoods can be established successfully when time and attention are paid to encouraging suitable natural regeneration, planting a mix of species suited to the successional stage, and providing protection where and when needed. The intent is to provide landowners with a wider selection of tree species, which enhance the forest, meet a great range of ecological needs and goals, and create more opportunities for landowners, industries and society.

Ken Mayhew is Information Officer, Forests Fish and Wildlife Division, PEI Dept of Environment, Energy, and Forestry and can be reached at 902-368-6450.

NOVA SCOTIA

SILVICULTURE CONTRACTORS' ASSOCIATION

by Alan O'Brien

Summer finds the Nova Scotia Silviculture Contractors' Association heading in a new direction as we plan for our annual general meeting in August. The Association has hired an executive assistant to take the lead on a number of proposed initiatives, which our volunteer board simply did not have the luxury of devoting the necessary time to deal with.

In the spring, a survey was developed and mailed to all contractors in the province. Our high response rate was a strong indicator that we need to continue to strive to affect change in a number of areas and act as a voice with stakeholders in the industry. The compiled results of the survey will be presented to members at our meeting in August and will help guide our plan of action in the coming year.

Industry funding has all been allocated for 2007, forcing many contractors to carryover completed projects into 2008. This has placed an enormous financial burden on many contractors and again highlights the need for ongoing discussions and change within the industry.

The issue of stand tending has been brought to the attention of the Association by several contractors. The concern is that the majority of private land plantations are not receiving any follow-up competition control (herbicide treatment). Perusal of the data provided on the Department of Natural Resources' website would suggest this to be the case (see tables). During the period of 2001-2005, there was only one year (2005) when more competition control than planting took place on a per hectare basis. A list of possible limiting factors might include public sentiment regarding the use of herbicides, proximity of residential property, and the rate of compensation paid to the applicator.

Media has painted an extremely negative picture of forestry herbicide practices, leading many landowners to question the application of chemicals to their woodlots. When spray block perimeters are within 500 metres of residences, the occupants must be notified, in accordance with Department of Environment regulations. Many contractors are uncomfortable treating any areas where notifications must be sent out. In addition, payment for such work has not increased in ten years, leaving only a few select contractors doing the herbicide jobs.

Since the industry requires a minimum number of completed silviculture hectares to comply with regulations, the predominant treatment used is tree planting. Plantation establishment has accounted for over 40% of all silviculture work carried out in Nova Scotia during the past five years. From a public relations perspective, it is much more favourable to plant trees than to spray them.

The reality is that plantations established without necessary vegetative management are limited in their volume growth potential, and in some cases their survival. There needs to be a more concentrated effort by industry, landowners, and contractors to see that all management tools are being utilized and stands in question reach their full potential.

	2003		2004		2005	
CATEGORY	AREA TREATED (hectares)	%	AREA TREATED (hectares)	%	AREA TREATED (hectares)	%
1a Natural Regeneration Establishment < 500/ha	7141	22	5651	16	3001	9
1b Natural Regeneration Establishment > 500/ha	94	<1	3	<1	42	<1
2. Established Plantation	8382	26	9735	28	10858	31
3. Early Competition Control: Plantation & Natural	5257	17	6579	19	11318	32
4. Plantation (2): Density Controlled & Released	3829	12	5412	16	3653	10
5. Natural (1): Density Controlled & Released	4518	14	5033	15	5068	14
6. Commercially Thinned	2029	6	797	2	516	2
7. Quality Improvement:						
(a) Crop Tree Released	204	<1	233	<1	67	<1
(b) Crop Trees Pruned	278	1	220	<1	180	<1
(c) Selection Managed	120	<1	795	2	512	2
TOTAL AREA	31852		34456		35215	

Source: Department of Natural Resources' website

Focus on Safety

by Dr. Martin E. Alexander, RPF

Surviving a Wildland Fire Entrapment or Burnover

Would you know what to do if you were caught in a forest or grass fire? With an average of 8,600 wildfires fires in Canada annually, the danger of being entrapped or burned over by a wildfire is a real threat for people living, working, or visiting in rural areas and wildlands.

There are four main survival options if you ever become trapped by a wildfire:

- retreat from the fire and reach a safe haven,
- burn out a safety area,
- hunker in place, or
- pass through the fire edge into the burned-out area.

In considering these options, bear in mind that synthetic clothing (including undergarments) can readily melt and ignite.

If you are caught in the open and about to be entrapped or burned over by a wildfire you may have no choice but to "hunker in place".

A person's initial reaction when faced with being entrapped or overrun by a wildland fire is to run, which is one of the available survival options - retreat from the fire and reach a safe haven. A safe area is an area with light or no fuels, such as a rocky surface, marsh, or recently burnt area. This option only works if the distance between the fire and safety area is short, the fire is advancing slowly, and it is easy to reach the safe area (i.e., there are no obstacles that would impede foot travel).

Fire travels more quickly than most people realize and can reach rates of 200 metres a minute (12 km/h) in forests, and nearly twice this rate in grasslands. Even the fittest person cannot outrun a fire for long.

If there isn't a safe area close by, another option is to burn out a safety area. Carrying wind-resistant matches is a good safety precaution when visiting rural or wildland areas. This option only works well in a grassy area and when there is sufficient time to burn out a safety area.

Burning away light fuels, such as grass, will provide a safe area for surviving being overrun by a wildfire. However, this option does not work well in forested locations because of the generally heavier fuel conditions, which in turn lead to prolonged smouldering combustion.

When there is no way to reach a safe area or create your own, another option is to hunker in place. This involves trying to find an area that has little or no fuel - the bigger the better. It is important to lie completely flat, with your nose to the ground while the fire is burning over and around you. Lying flat will minimize body exposure to radiant heat.

Radiant heat is the "invisible heat" emitted from the flames of a fire. It will usually kill you long before flames directly reach you.

When a fire passes over and around you, heating of body tissues from thermal radiation can be unbearable. Staying calm and not getting up until the fire has substantially dissipated is critical. During the burnover, remember the following:

- Protect yourself from radiant heat at all costs
- Protect your airways from heat and minimize smoke exposure
- Try to stay as calm as possible

Although one will likely receive serious burns, many people have survived using this technique even under extremely arduous conditions. The alternative is almost certain death. People commonly use their hands to protect parts of the body from radiant heat - especially the face, neck, and ears. Thus, wearing leather gloves will decrease the severity of the burns suffered by the hands and in turn lessen the tendency to get up and aimlessly run about.

Survivors of entrapments and burnovers have commonly concentrated on thinking about their family in order to get through the ordeal.

The fourth option to escape an entrapment or burnover by a wildland fire is to pass through the fire edge into the burned-out area. Generally this technique should not be attempted if the flames are more than about 1.5 metres in height or depth. While running through the flame front of a fire is considered dangerous, people have survived by picking their spots and avoiding areas of uniform flame development.

The survival options as outlined here are not presented in any particular order. Circumstances may dictate that you try more than one or all of them. Wildland fires are precarious phenomena and each situation is different. Use the best option that will, ultimately, get you out alive. Don't ignore the obvious - safety could be nearby.

These wildland fire survival options are explored more fully in a chapter entitled "Wildland Fires: Dangers and Survival", that appears in *Wilderness Medicine*, a textbook for medical emergency responders published this spring by Mosby, Inc.

Dr. Marty Alexander is a Senior Fire Behaviour Research Officer with Natural Resources Canada's Canadian Forest Service stationed at the Northern Forestry Centre in Edmonton, Alberta. He can be reached at 780-435-7210.

Adaptive Management in BC: Learning from Our Forests

by Jim Snetsinger

Dr. Fred Bunnell, honourary professor in UBC's Department of Forest Sciences, is often quoted as saying, "Forestry isn't rocket science - it's much more complex." This statement has special relevance in BC, Canada's most ecologically and biologically diverse province. BC's forests are economically important and support countless values treasured by people at home and around the world. The complexity and importance of our forests has led us to invest a great deal of time into studying and understanding them.

We welcome valid processes and tools that help us deal with this complexity and the uncertainty that accompanies it. That's why the BC Forest Service has been involved in adaptive management for more than 10 years, and has taken a lead role in developing adaptive management capacity in the forest sector.

Today, we're exploring possible new applications as we prepare for a changing climate and life after the mountain pine beetle (MPB) infestation.

What is Adaptive Management?

In 2001, stakeholders in central BC were concerned that timber harvesting was modifying or damaging terrestrial lichen communities that northern caribou need for survival. A project team of foresters, biologists, and statisticians from government and industry developed an adaptive management project aimed at maintaining lichen cover, and began by measuring the impact of harvesting on lichen.

Adaptive management is one management tool being applied to address uncertainty in British Columbia's mountain pine beetle infestation.

Before the project started, a retrospective study found that lichen communities on blocks harvested at various points in time had recovered 20 years after harvest. Unfortunately, this information had limited value because researchers did not know what treatments had been done on the sites.

hrough the adaptive management project, forest harvesting treatments and follow-up silviculture treatments were applied on three sites over different seasons. As is often the case, conceptual models were used to test a theory about likely outcomes and to ensure everyone in the project team had a common understanding of how the managed system works.

The monitoring is still underway but interim findings have already led to changes in the local ungulate winter range policy. As time goes on, there will be more data to support future decisions related to the management of terrestrial lichen and ungulate winter ranges.

As this example shows, adaptive management applies scientific rigour as we create and maintain sustainable resource systems through partnerships of managers, scientists, and other stakeholders. The term "adaptive management" can be understood from a range of vernacular and technical perspectives, and at multiple scales. It has been described as learning by doing, building on common sense, encouraging flexible decision-making, responding positively to change, a process of change management, a tool to both change the system and learn more about it, and a systematic process for continually improving management practices over time.

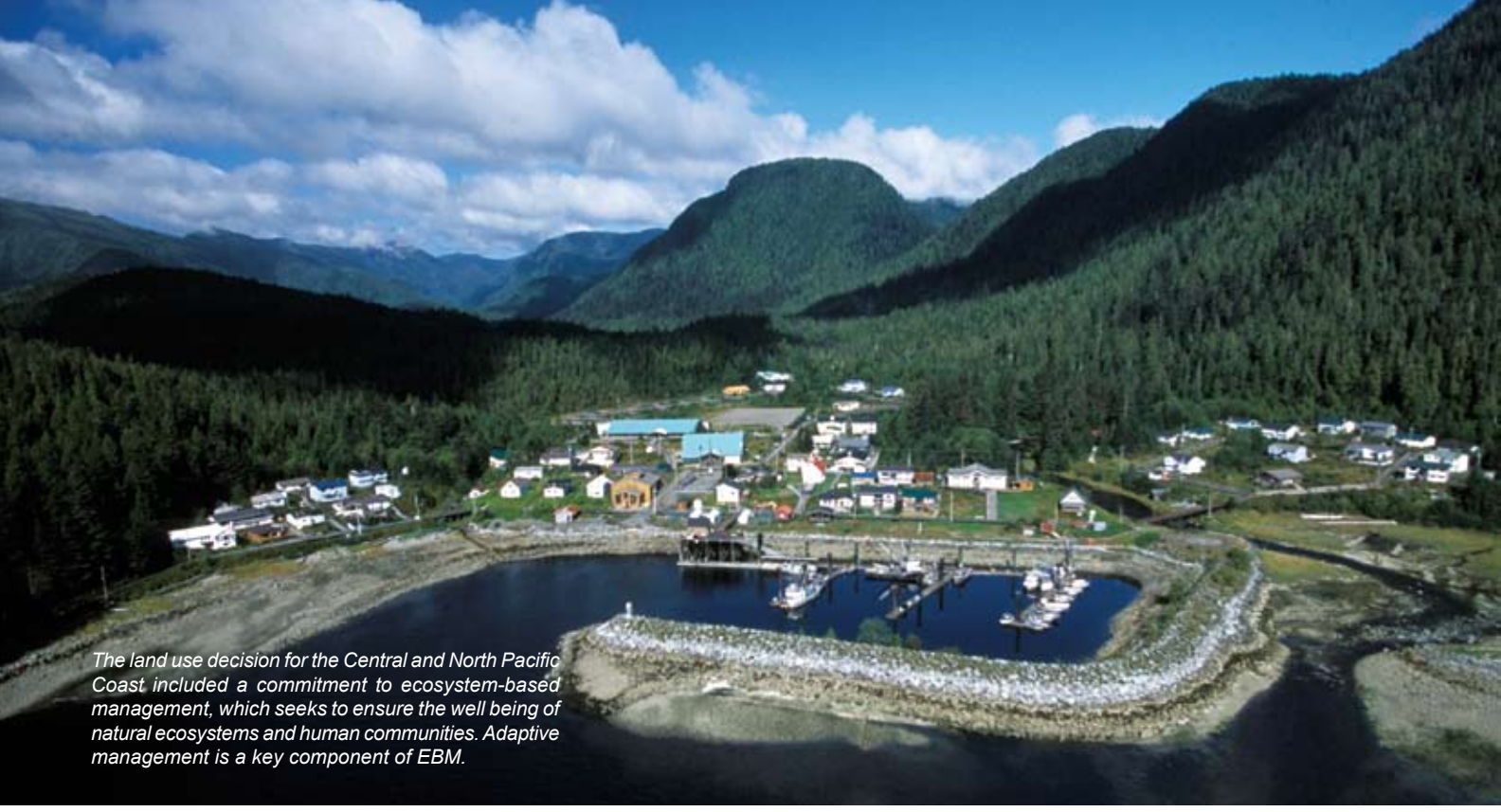
In the 1990s, the BC Forest Service created a standard working definition:

"Adaptive management is a systematic process for continually improving management policies and practices by learning from the outcomes of operational programs. Its most effective form – 'active' adaptive management - employs management programs that are designed to experimentally compare selected policies or practices, by evaluating alternative hypotheses about the system being managed."

There are several consistent basic principles of adaptive management. It is a structured, collaborative scientific approach - it is not trial and error. True adaptive management requires more planning, more documentation, more scientific rigour, more careful measurements and analysis, and more comfort with change than most of us bring into our daily responsibilities.

Applying adaptive management offers many benefits. It is flexible, it provides an opportunity to experiment, it allows us to accept change and uncertainty, and it encourages creativity. There are also challenges. These include the need for a long-term commitment by participants at all levels and by those providing funds. The problem must be clearly defined, the scope must be appropriate, and decision-makers must be willing and able to take the recommendations and implement change.

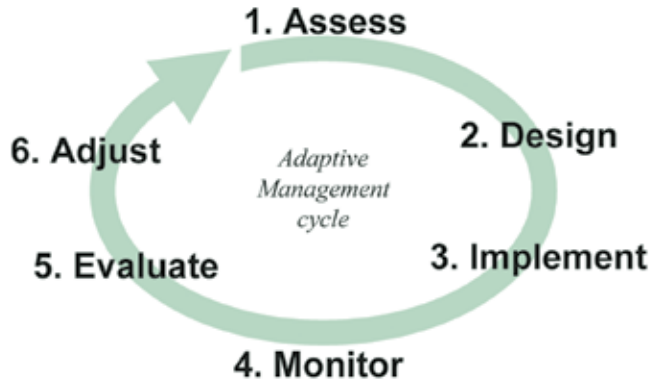
The BC Forest Service has identified six critical steps in the adaptive management process. It begins with a thorough analysis of



The land use decision for the Central and North Pacific Coast included a commitment to ecosystem-based management, which seeks to ensure the well being of natural ecosystems and human communities. Adaptive management is a key component of EBM.

the problem, setting management objectives, and predicting outcomes. Next it involves designing a rigorous plan to test alternatives, implementing one or more of these alternatives, monitoring key response indicators, evaluating the outcomes, and sharing results to update knowledge and adjust management actions.

Six Steps of the Adaptive Management Cycle



Adaptive management can be an important supplement to forest research programs, especially where demands for change do not allow the luxury of intensive, process-level research before new approaches are implemented. It is an approach that enables resource professionals to proceed systematically and responsibly with preliminary information.

Mountain Pine Beetle

Adaptive management is being applied to BC's MPB infestation - the largest ever recorded. The infestation has led to uncertainty about how to best manage impacted forests to provide economic benefits now and in the future, while considering forest values such as biodiversity, wildlife, and water.

BC's Forests for Tomorrow is a long-term silviculture program designed to improve the future timber supply in areas outside of industry's obligation. It will plan and pilot an adaptive management project this year to identify the best strategies to reforest unharvested beetle-killed stands so commercially viable forests are re-established within a reasonable time frame.

The adaptive management approach will address silviculture uncertainties, such as how different light levels affect the survival and growth of the planted understory trees, the impacts of small mammal population cycles on the timing of planting, and the viability of protecting natural advanced regeneration. The results will guide the way silviculture is carried out in these stands.

Forest and Range Evaluation Program

BC is one of the first jurisdictions to move to results-based forest legislation. The Forest and Range Practices Act recognizes that forestry requires innovation and flexibility, and sets out to achieve this through a results-based approach that maintains high environmental standards.

To ensure that the Act is working as it was intended, in 2003 the government initiated the Forest and Range Evaluation Program (FREP), a comprehensive monitoring and evaluation program built on the principles of continuous improvement. FREP integrates ecological knowledge into policy development by using science-based indicators and statistically valid sampling techniques. The goal is to assess how well the legislation achieves stewardship of the 11 key values identified in the Act, such as biodiversity, timber, water, wildlife, cultural heritage, and soils.

FREP provides the information needed for decision-making and continuous improvement of forest practices, policies and legislation. The information and data is widely available so it can be used to improve guidance, policies, and legislation as well as local, regional, and provincial forest practices.

Although FREP may not meet the strict definition of adaptive management, the results can be used to identify and test alternative practices. FREP shares many of the same principles with adaptive

British Columbia's Forest and Range Evaluation Program integrates ecological knowledge into policy development by using science-based indicators and statistically valid sampling techniques.

management, such as feeding results of analysis to decision-makers and "closing the loop".

Ecosystem-based Management

Adaptive management is also part of the North and Central Coast land and resource management planning processes, which recently generated international headlines.

It took 10 years of dedicated work by many stakeholders and partners to achieve the consensus that led to discussions between BC and First Nations with interests in this globally significant region, part of which is also known as the Great Bear Rainforest. In February 2006, the province and First Nations announced a shared vision for public lands along the north and central Pacific coast, followed by the signing of government-to-government agreements. This was a clear affirmation of the commitment to sustainable environmental management.

The agreements protect more than one quarter of the two coast regions. Where resource extraction is allowed, it will be in accordance with ecosystem-based management (EBM), which seeks to ensure the well-being of natural ecosystems and human communities.

The land use decision included a commitment to implement EBM by the end of March 2009, and called for an EBM Working Group, co-chaired by the province and First Nations. This working group will oversee technical and scientific work, and make recommendations related to the further development and implementation of EBM along the central and north coast.

An independent, multidisciplinary scientific body that facilitated the coast land use planning process developed an approach to EBM and defined it as "an adaptive approach to managing human activities that seeks to ensure the coexistence of healthy, fully functioning ecosystems and communities".

A key component of EBM is adaptive management that addresses both ecosystem integrity and human well-being. The EBM Working Group has established an adaptive management sub-committee in support of this objective. There are also plans in place to conduct a workshop to plan the design of an adaptive management framework that is tailored to EBM for the coast regions, and to build a common understanding of the approach. What EBM ultimately looks like will come from this on-the-ground learning through adaptive management.

Changing climate

As stewards of BC's crown forests and rangelands, we need to make sure our forest management approaches anticipate a changing climate. Our management practices should be designed to help ecosystems adapt, and to the greatest extent possible, remain resilient to stress and disturbance.

BC has already experienced challenges typical of those we expect in a changing climate, including the MPB infestation, more intense fires and water shortages, and flooding. There is also potential for maladaptation of tree species to their environment that may reduce productivity and increase susceptibility to insects and disease. The climate in many of today's ecosystems is likely to become quite different within this century. We will need to develop strategies for managing forests under changing environmental conditions. One way we are doing this is through the Future Forest Ecosystems Initiative (FFEI), which is examining how we can adapt our forest and range management policy framework so that plans and practices will be effective well into the future.

FFEI had its start in 2005 when representatives from government agencies, universities, First Nations, forest and range industries, and environmental organizations came together in a symposium to explore environmental and ecological changes and their implications for forest management. We brainstormed ways to adapt our approach to forest management, which resulted in a collection of strategies for building ecological resilience in BC's forest management policy.

A team of specialists then developed FFEI, and they are working on a three-year implementation plan that will identify priority projects. One of the objectives under FFEI is to evaluate a range of existing and new approaches to forest and range management for their ability to maintain and enhance ecological resilience and ecosystem services, products, and benefits under changing ecological conditions. The projects implemented under FFEI to achieve this objective will include adaptive management trials that combine monitoring of ecosystem changes with evaluation of various policy options.

Ultimately, managing for climate change will be directly incorporated into a wide range of everyday business activities for the BC Forest Service.

Summary

If ecological and social systems were stable and predicable, there would be no need for new policies and practices - and no need for improvement processes and tools like adaptive management.

The reality is that our work is becoming even more complex. Government needs science that is practical, collaborative, and can be readily applied, science that pulls together knowledge to address important issues clearly and thoroughly.

An adaptive management approach can be a strong tool for forest resource managers as long as it is not viewed as the solution for everything. If the scope is too wide, it becomes difficult to analyze all the information and initiate changes that can be firmly linked to the results of the adaptive management trials.

The full benefits of adaptive management require a commitment to a long-term process - there are seldom quick fixes when it comes to forestry. There also must be appropriate support at all levels. This includes leaders who are committed to the approach and provide adequate resources as well as operational staff who are willing to learn new techniques, invest extra time and effort, and work with partners.

In BC, we will continue to watch for opportunities to apply adaptive management techniques and increase our understanding of how it can strengthen resource management.

Jim Snetsinger is BC's chief forester with leadership responsibilities for the Forest Stewardship Division, BC Ministry of Forests and Range.

STOCK HANDLING INNOVATIONS

Foresters have successfully planted billions of frozen winter stored trees over the years by thawing them at cold storage facilities and then planting them promptly during the spring season in efforts to minimize the loss of carbohydrate reserves prior to planting. The silviculture industry is continually looking at ways to improve and streamline the planting process, and during a recent roundtable discussion with key industry professionals, innovations to stock handling were discussed and the new development of planting frozen seedlings utilizing individually wrapped or unwrapped, frozen plugs was explored. The participants in the conversation included Dale Likes from Canfor, Dan Livingston and Dave Swain from PRT, Clare Kooistra from Conifera Consulting, and Dirk Brinkman from Brinkman and Associates.

Operational Impacts

Planting seedlings with frozen plugs can potentially eliminate the difficulty of coordinating temperature management between the contractor's field schedule, which can vary with unpredictable production factors, and the cold storage facility's thaw schedule. Although cold storage facilities annually carry out this thawing activity, it is very challenging to deal with the logistics of thawing hundreds of thousands of seedlings in a short period of time.

Cold storage operations would benefit from the elimination of the lead time required to thaw the seedlings and reduce the risk of exposing the seedlings to undue storage stress from premature thawing. Experience has shown that planting schedule notification can be reduced from 10 days to 3-5 days or possibly less. In theory, response time could be completely eliminated as trees could be moved out of freezer storage right into planting trucks, although seedling orders are not necessarily readily accessible in freezers, so some stock movement and lead time may still be needed.

Planting frozen seedlings may permit planting contractors to experience less downtime from response lags in thawing seedlots as cold storage facilities or the coordinating forester adjusts to schedule changes. In planting operations, frozen seedlings may also lead to reduced j-roots from planting rigid, frozen plugs.

Planters like using frozen plugs since it decreases the chance of planting faults and could result in productivity gains. Contactors may be able to use less experienced planters during this period of labour shortage, since less damage could occur to frozen plugs and roots. It's also easier to place frozen plugs in the ground, so there may be less risk of planters unnecessarily compressing the soil around the seedling. How firmly the plug is planted may change as the seedling thaws after planting, but that shift in a quality indicator used by some auditors can be accommodated.

Managing foresters, cold storage personnel, and planting contractors would no longer have to manage the risks of thawed stock being held longer than scheduled before planting. There may also be some growth benefits due to the thawing process taking place in the ground, with the full cohort of plug moisture

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and carbohydrates being available to the planted seedling as it starts to grow.

The challenge to the nursery community in providing seedlings that can be planted while still frozen is to package the seedling in such a way to allow the root plugs to be separated while still frozen. To date frozen plugs have been wrapped individually in the fall at the nursery, however, the wrapping technology has not yet been perfected. An automated wrapping technology was developed because manual wrapping for this purpose is very labour intensive, in a time when labour is in short supply. PRT developed a prototype machine at PRT Pelton in Maple Ridge that processed 750,000 trees during last winter's harvest. If that machine were to run two shifts per day, the nursery could process 1.5 million frozen plugs in a season. Other nurseries have wrapped similar amounts and have modified the lifting lines with more mechanical extractors, which improves efficiencies and reduces labour requirements.

Individual wrapping in the PRT experience generates more waste since it requires more than 2-3 times the amount of wrap and 10-20% more bags and boxes for packaging the trees. This results in increased cold storage, trucking, and handling costs. Based on PRT's current productivity information using the prototype machine, it is estimated that an upcharge on individually wrapped frozen plugs would be in the range of 5 cents per seedling, and production volume is limited. Since most customers are looking for ways to reduce waste and cost, this doesn't present a good option. Others in the nursery community found that although they used more wrapping material, there was no need for more bags and boxes, so costs for this innovation may differ from PRT's experience. However, all are agreed that if planting frozen seedlings became the norm, nurseries would need to invest significant capital for equipment, so a long-term commitment from customers would be essential.

Seedling Impacts

The combination of benefits from a simplification of spring reforestation logistics may offer one of the biggest eliminations of logistical inefficiencies but does planting seedlings while frozen have an impact on seedling performance? Research into this question was conducted and reported in 2002 and 2005 by Clare Kooistra and Jonathan Bakker. The findings of both trials were that, whether planted in warm or cold soils and warm or cool air temperatures, lodgepole pine, interior spruce and western larch seedlings performed equally as well when planted frozen as when planted thawed.

Although no physiological negative impacts of this practice were reported, the trails did show that western larch benefited when planted frozen. Larch is a deciduous species and flushes very rapidly once thawed, often while still in the boxes. Planting larch while still frozen allowed all the flush to develop after planting, thereby significantly reducing foliage loss.

Using frozen plugs minimizes the problem of losing carbohydrate reserves, which has consequences to growth, if seedlings are thawed and kept in storage for long periods

of time. Research work showed that stock that was left in a thawed condition for several weeks did not perform as well as seedlings planted with frozen plugs. However, in today's world, stock handling has improved to the point where seedlings are generally planted in less than two weeks from the time thawing begins and thus carbohydrate losses are minimized. Planting frozen seedlings would help to reduce carbohydrate losses even further. Other trials such as those conducted by PRT used lodgepole pine, and showed no growth or survival difference whether the plug was frozen or not. However, eliminating the portion of the seedlings that do not get planted before being held longer than two weeks will likely have benefits for those seedlings, regardless of the species.

Other Innovations

Is individual wrapping really required? What about packaging trees without any wrap? If this were done there is some concern that unwrapped seedlings would freeze together, so a short thaw period of a day or two would be needed, based on feedback from some initial trial work. In this operational trial, by the time the seedlings get to the field they were easily separated without affecting root integrity, and plug cohesiveness was maintained

Do seedlings need to be wrapped in bundles in the box? Historically, seedlings have been wrapped in bundles so that contractors, planters, and licensees would have an accurate seedling count. If unwrapped seedlings are used, ensuring an accurate seedling count is a potential challenge and concern. For instance, contractors would still require some form of reliable count per box to manage the piece rate system of paying planters, which provides key efficiencies in the field. Nurseries would need to adapt quality control or alternative counting measures to resolve this issue.

The shift to planting frozen seedlings and/or unwrapped seedlings ties into the concept of lean manufacturing, pioneered by Toyota, whereby processes are simplified and waste is reduced. Some concern exists in the field that the current practice of wrapping plugs in bundles affects plug integrity by squishing them together, which can result in weakened plug integrity at planting and, ultimately, planting faults and this may be reduced in boxing unwrapped seedlings. From the nursery side, although it's a challenge to keep track of amounts, the benefits to a packaging system without bundling are worth noting in that repetitive motion injures from bundling would be reduced and productivity opportunities may be enhanced.

Individually frozen seedlings in the box can be separated simply by alternating layer directions. Depending on clients' wishes, PRT and others in the nursery community are packaging seedlings, whether thawed or frozen, lying lengthwise in boxes and have been using this practice for years. By laying the stock horizontally, approximately 10-20% more trees are packaged per box, thereby reducing waste, as fewer boxes and bags are needed. To be more efficient in packaging, the nursery, forest companies and planting contractors want to get as many trees as possible into each box, minimizing the number of boxes in cold storage and maximizing the number of trees on trucks. This has benefits all the way down the line since it reduces the total number of boxes to be handled. Currently the weight restriction of transport loads can be a limiting factor to maximizing seedlings per box, but this can be calibrated so that the number of trees per load has been maximized.

Planters want to carry as many seedlings as possible, so they prefer to load seedlings in their bags laterally, which nests and stabilizes them as they are planted out, right down to the bottom layer.

Keeping plugs frozen until they are picked up from storage presents a simple solution to the carbohydrate reserve problem while benefiting both nurseries and planters by creating efficiencies. In order for individually wrapped, frozen seedlings for planting to be considered, the operational and capital issues must be tackled. Unwrapped trees may provide an alternative innovation but more trials with this packaging change will be required.

All of these innovations are parts of the solution to stock handling issues that continue to be explored as the silviculture industry looks for ways to create efficiencies.

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