TIC*talk*

FGC Forest Genetics Council of British Columbia

Information for and from the tree improvement community of British Columbia

Vol. 7, No. 1 December 2006

Seventh Edition

The genetic resource is fundamental to biological processes, and allows all other forest values to exist. Knowledge-based management of this important resource is a necessary component of modern forest management. In British Columbia, forest gene resource management (GRM), including tree improvement, has grown in complexity and in relevance to operations since the 1950s when research began at the Cowichan Lake Research Station on coastal Douglas-fir genetics. Now, some 50 years later, BC is a world leader in the broad field of GRM, with seed orchards and breeding programs for 10 species, a centre for gene conservation research at UBC, comprehensive genecology programs, cooperative business planning, and a strong policy and information management framework. At the present time, nearly half of the seed sown in this diverse province is derived from select sources, and this number is rising every year.

Several key factors combine to make BC a GRM leader. These include strong and long-term support from the Ministry of Forests and Range as the steward of public lands, involvement and support from industry, and cooperative stakeholder input through the Forest Genetics Council (FGC). In addition, a talented and dedicated group of people has developed operations, programs, policy, and administration systems that combine to form a provincial program that is an increasingly important component of sustainable forest management operations.

At a personal level, I'm very proud to be part of this provincial program, and to be an associate of the many fine people involved. We still face many challenges with issues such as mountain pine beetle and climate change. Also, the aggressive goals set by the FGC will stretch our talent and resources if they are to be met. I'm confident, however, that the combination of dedicated people, broad cooperation, and ongoing support will maintain BC as a world leader in the field of gene resource management.

Jack Woods
Forest Genetics Council of BC
and SelectSeed Co. Ltd.

INSIDE

MPB Impacts on Lodgepole Pine Seed Supplies and Genetics

submitted by Jack Woods

Beetle 10, pine 0. No greater force of change has hit BC's interior forests in recorded history.

Beetle 10, pine 0. No greater force of change has hit BC's interior forests in recorded history. Mountain pine beetle (MPB) impacts are well documented and well known to those working in the forest industry. But what is the impact on lodgepole pine (Pli) genetics? What are we losing, and are there opportunities?

Genetic Diversity and Conservation

Mountain Pine Beetle is devastating mature Pli, and the timber supply impacts are severe. However, when walking through almost any beetle-killed stand, it doesn't take long to notice the large number of young trees that remain. These trees carry the genetic code of the local population in numbers that easily maintain the genetic diversity at pre-beetle levels. Consider threatened wildlife populations; biologists judge census numbers in the low 100s as sufficient to maintain genetic diversity. This number of individual trees is easily achieved by post-MPB Pli populations within even small stands. The combination of high remaining numbers of live trees, high rates of pollen exchange (gene flow) among stands, and the natural tendency for Pli populations to be genetically similar over relatively large geographic areas, leaves geneticists confident that the loss of genetic diversity and adaptation potential is not a serious concern. Dr. Sally Aitken, professor of forest genetics and Director of the UBC Centre for Forest Gene Conservation, points out that, although temporarily set back, the remaining pine populations carry the genetic diversity of trees killed by the beetle, and the rich genetic resource of the species is not threatened.

The combination of high remaining numbers of live trees, high rates of pollen exchange (gene flow) among stands, and the natural tendency for Pli populations to be genetically similar over relatively large geographic areas, leaves geneticists confident that the loss of genetic diversity and adaptation potential is not a serious concern.

Seed Supply

Increased allowable annual cut (AAC) to salvage beetle-killed timber is putting pressure on seed supplies in some zones. In the 2006 sowing year, overall provincial sowing increased to 275 million seedlings, from about 222 million in 2001 and 2002. Figure 1 shows sowing requests by year from 2001 to 2006.[1] The bulk of the provincial sowing increase is lodgepole pine (up roughly 40 million seedlings [38%] from 2001 and 2002 to 2006). Other primary interior species also increased, with interior spruce (Sx) up about 10 million (14%), Douglas-fir up about 7 million (70%), and western larch up about 1.5 million (25%).

These dramatic increases in sowing have the potential to stress future seed supplies for some species and zones. Select seed from orchards (class A) is available in sufficient quantities for interior spruce and western larch; however, lodgepole pine and Douglas-fir orchards are generally younger and not yet in full seed production. These orchards are increasing in output, but are not keeping pace with seed demands – a problem that is becoming worse with rising harvest and planting levels. To fill this seed supply gap between orchard production and sowing needs for Pli and Fdi, licensees must collect and use wild seed.

Licensee Support for Seed Supply

Several licensees and BCTS are currently collecting cones in superior provenance areas (class B+) identified through a large Pli genecology research trial established in the 1970s. This long-term trial has produced a wealth of data on the genetics of lodgepole pine, and created the opportunity to collect B+ seed with a modest level of genetic gain in growth over non-selected (class B) seed sources. A number of licensees and BCTS are collecting cones in advance of MPB killing older trees within the superior provenance areas.

To aid this effort, the Ministry of Forests and Range Tree Improvement Branch, with support from the Forest Genetics Council and the Forest Investment Account, has prepared detailed information on lodgepole pine seed supplies, superior provenance sources, seed inventories, and cone crops. This information is available on the Tree Improvement Branch website at http://www.for.gov.bc.ca/hti/pinebeetle/index.htm.

1 Data from the Seed Planning and Registration System (SPAR). Sowing years end July 1st; for example, the 2006 sowing year ends July 1, 2006.

Pli Breeding Programs and Selecting for MPB Resistance

An often-asked question is whether Pli can be selected for resistance to MPB. Research on genetic resistance and the mechanisms for resistance is currently being undertaken by Drs. Michael Carlson and Alvin Yanchuk (MoFR Research Branch), and Dr. Kimberly Wallin (Oregon State University). Results suggest that trees vary in their level of resistance to beetle attack. However, the logistics and trade-offs of using trees showing some resistance to MPB require considerable analysis. First, when selecting trees for resistance to a pest, the genetics of the pest and its ability to adapt must be considered. Second, the genetic basis of the resistance of a tree (one or several genetic factors contributing) must be understood to develop an appropriate breeding and seed production strategy. Third, existing seed orchards contain trees selected for stem-volume production and stem form, and it may be difficult to find trees showing MPB resistance as well as superior growth and form traits. This will tend to reduce gains in growth and form relative to selections for seed orchards that do not include MPB resistance. Finally, new selections for MPB resistance placed in seed orchards will take at least 10 years before they begin to produce significant amounts of seed.

These technical issues add difficulty to the development of orchards capable of supplying seed with higher beetle resistance; however, understanding the genetic mechanisms of resistance is a first step, and may well lead to useful information and additional traits to build into future selections for improving the general resistance of Pli to MPB or other pests.

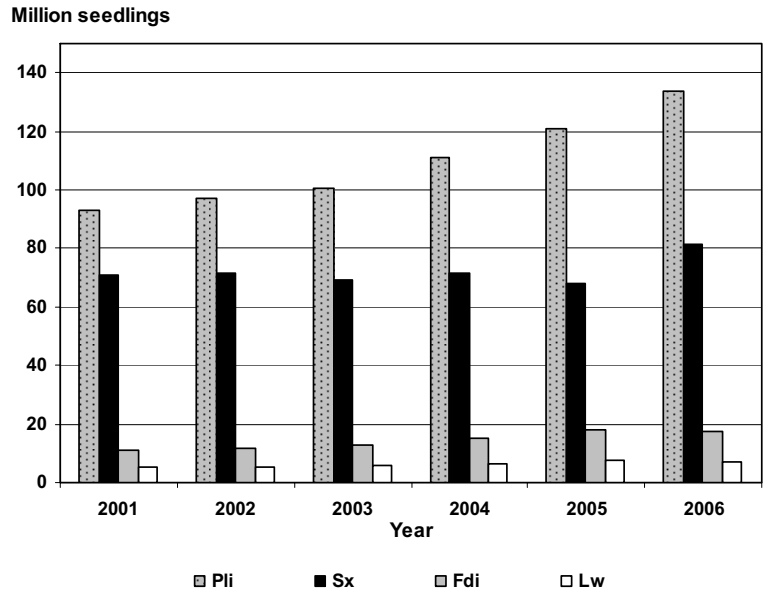

Figure 1. Sowing requests as recorded on SPAR for the primary interior plantation species from 2001 to 2006.

They're Heeeere! – Observations of the First Mountain Pine Beetle Attacks Recorded at the Kalamalka Forestry Centre

submitted by Jim Corrigan, Michael Carlson, Gary Giampa, Vicky Berger, Chris Walsh and Ward Strong

The Ministry of Forests and Range (MoFR) Kalamalka Forestry Centre (KFC) is located in the North Okanagan just south of Vernon. Approximately 6000 mature (18- to 25-year-old) lodgepole pine trees are planted in six orchards at this facility (Fig. 1). As of late July in 2006, no bark beetle attacks had been detected in any of these plantations.

As of late July in 2006, no bark beetle attacks had been detected in any of these plantations.

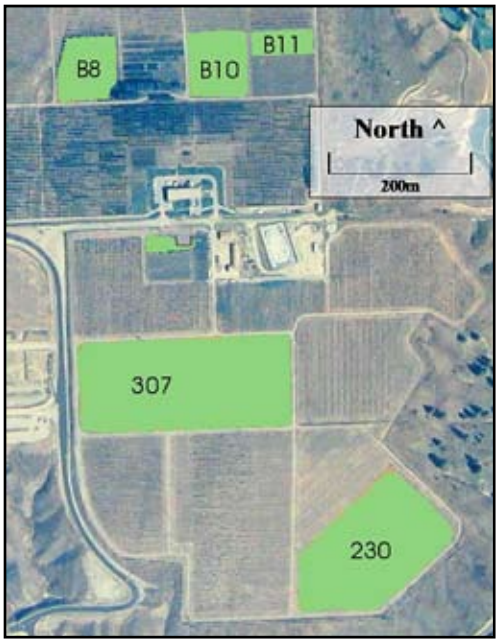

Figure 1. Aerial view of the Kalamalka Forestry Centre with the lodgepole pine orchards highlighted in green. Three Clone Bank Blocks (8, 10, 11) are located in the Research Station fields. Two Seed Orchards (#307, #230) are situated to the south. A small, retired research plot (EP907 – highlighted but not labeled) is located just southwest of the KFC buildings.

The Invasion

On Wednesday morning, August 2, 2006, Gary Giampa, Kalamalka Seed Orchard Supervisor (MoFR), was scouting orchard #307 (Nelson SPU) in order to assign collection duties to the cone harvest crew. He identified pitch tubes, characteristic of bark beetle attacks, on a number of trees in #307. Subsequent monitoring of the KFC pine orchards by Gary, Jim Corrigan (Interior Seed & Cone Pest Biologist, MoFR) and Vicky Berger (Research Technician, MoFR) revealed that beetle attacks were not restricted to a few trees in the #307 orchard. Rather, attacked trees were found in every lodgepole pine orchard at the facility. All indications were that these attacks had occurred in the preceding 24 to 48 hours. We speculated that large numbers of beetles were blown into the site on winds from the north. Adult specimens were collected from attacked trees, keyed out, and identified as mountain pine beetle, *Dendroctonus ponderosae* (MPB). In total, over 800 trees were attacked during the first flight of MPB adults into the KFC grounds (Table 1).

On Wednesday morning, August 2, 2006, attacked trees were found in every lodgepole pine orchard at the facility.

The Response

1. On August 2, an advisory of the MPB invasion at KFC was sent to all Okanagan Seed Orchards. Subsequent reports indicated that about a dozen trees had been attacked at the Vernon Seed Orchard Company. A similar number of attacks were recorded at Pacific Regeneration Technologies, while no attacks were detected at MoFR Bailey Road or at the Tolko Eagle Rock Seed Orchards. The uneven, patchy attack pattern in the area is an aspect of this invasion that we cannot explain. Over 95% of all attacks in the region were recorded at KFC, and nearly 75% of them were recorded in a single plantation – Seed Orchard #307.
2. Within 48 hours of the first detection of beetle attacks at the KFC, protective pesticide sprays (2% Sevin solution applied to the boles) had been put on trees in several of the most heavily attacked orchards. The following trees were treated: a) all trees in #307; b) the high breeding value trees in #230 (about 25% of the orchard); c) a few selected trees in EP907; and d) one tree being used in ongoing trials in the Research Blocks. In late August, a Sevin bole spray was applied to the previously unsprayed trees in EP907. The consequences of these sprays are discussed below.
3. In Seed Orchards #307 and #230 and in Research Blocks 8, 10 and 11, monitoring tours were conducted after the initial MPB invasion in early August to determine the location and the relative severity of the

Table 1. Initial MPB attacks at the Kalamalka Forestry Centre (Aug. 1–3, 2006) classed by the relative severity of attack

	Number of Trees Attacked				
Orchard	Light	Medium	Severe	Total attacks	% orchard attacked*
#307	301	155	152	608	30
#230	53	14	0	67	4
EP907	0	5*	5*	10*	15
Block 8	25	32	60	117	16
Block 10	14	6	9	29	3.5
Block 11	0	0	1	1	<1
Total – 830–840 trees attacked*					

* Estimated values

attacks on these trees. Trees were rated visually as being: a) Not attacked (no pitch tubes seen on bole); b) 'Light' (1–10 attacks); c) 'Medium' (11–20 attacks); or d) 'Severe' (more than 20 attacks seen on bole). Table 1 shows the number of attacked trees in each orchard classified by severity of attack. It is seen that #307 sustained the majority of the more intense attacks that occurred at the KFC. It is also noted that a majority of the attacks in Block 8 (79%) and EP907 (100%) were characterized as moderate or severe.

4. Four pheromone-baited Lindgren traps (from Phero-Tech Ltd.) were placed in the area on August 11 and have been checked twice weekly since that time. A sub-sample of every collection has been identified, and all individuals have keyed out to MPB. Based on trap catches, it is clear that adult beetles have been active in the KFC area from early August through to mid September (Table 2). Dezene Huber (University of Northern British Columbia – pers. comm.) has indicated that our larger trap catches were reflective of substantial beetle activity in the area.

Table 2. Weekly catches from four MPB pheromone traps set around the Kalamalka Forestry Centre

Trap catches from…	Number of beetles caught
Aug. 14, 17	531
Aug. 21, 24	563
Aug. 28, 31	63
Sept. 4, 7	391
Sept. 11, 14	41
Sept. 18, 22	1

5. Weekly follow-up monitoring tours to detect newly attacked trees have been done in all orchards except EP907 since the first week of August. Table 3 shows the cumulative results of these monitoring tours. All of these subsequent attacks have been in the 'Light' severity category.

   One might attribute the relatively low numbers of newly attacked trees and the 'Light' nature of all later attacks to the Sevin pesticide sprays applied in early August. We believe that this spray has been instrumental in protecting the trees in #307 from further mass attacks. However, it must be noted that the three Research Blocks, which were unsprayed except for one tree, and orchard #203 (25% sprayed), had similar low levels of new attacks to #307 through the latter weeks of August and into September (Table 3).

6. Because of the large number of attacks in Seed Orchard #307, the distributional aspects of the MPB invasion could be examined in this location. Attacked trees appeared to be relatively clumped, with several 'hotspots' of high beetle activity and other areas with relatively few attacked trees (Fig. 2). Because of the tendency of bark beetles to aggregate their attacks on individual trees and on trees located near previously attacked trees, this distribution was consistent with other reports of the attack biology of MPB.

7. On the suggestion of Alvin Yanchuk (Manager, Forest Genetics Section, Research Branch, MoFR), the distribution of MPB attacks in #307 was examined across clones, full and half-sib families and provenances. Chris Walsh, Kalamalka Seed Orchard Manager (MoFR), produced graphs showing the percentage of the

Based on trap catches, it is clear that adult beetles have been active in the KFC area from early August through to mid September.

Because of the tendency of bark beetles to aggregate their attacks on individual trees and on trees located near previously attacked trees, this distribution was consistent with other reports of the attack biology of MPB.

Table 3. MPB attacks at the Kalamalka Forestry Centre recorded after the initial attacks of Aug. 1–3, 2006

Orchard	Later attacks (% of total attacked in 2006)	Total attacks in 2006	Orchard sprayed after first attack?
#307	98 (14%)	706	All trees
#230	28 (29%)	95	25% of the trees
EP907	10*(50%)	20*	Most of the trees**
Block 8	18 (13%)	135	No
Block 10	2 (6.5%)	31	No
Block 11	0 (0%)	1	This tree sprayed
Totals to date – 980–1000 trees attacked by MPB in 2006**			

* Estimated values.

** Most trees in EP 907 were not sprayed until late August.

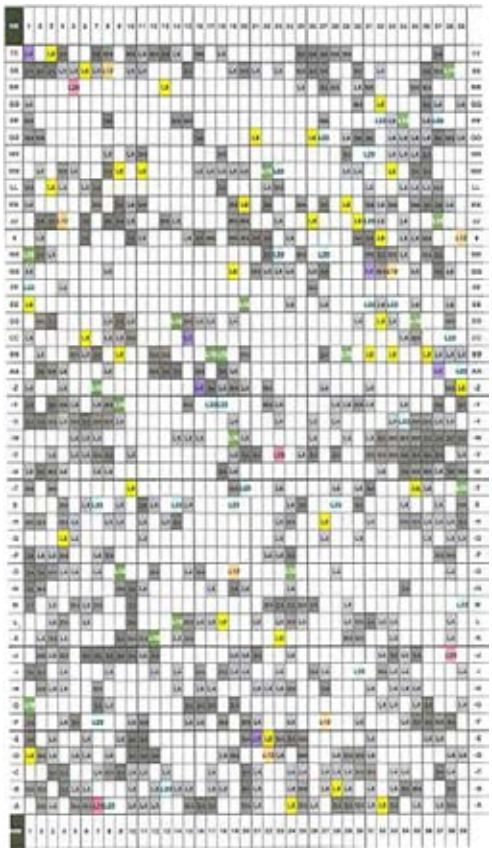

Figure 2. Orchard grid map of the (approximately) 1800 trees in Seed Orchard #307. Non-white squares correspond to the locations of the 706 attacked trees in the orchard. All gray squares indicate ramets attacked in the first invasion. The different gray tones correspond to the severity of attack on each tree. Coloured squares represent attacks taking place in the weeks after the initial MPB invasion. All of the later attacks were 'Light' in severity.

ramets attacked for each clone, family and provenance during the first MPB invasion of August 1–3 (Fig. 3). Dr. Ward Strong (Entomology Research Scientist, Research Branch, MoFR), used a Chi square procedure to determine if these attack patterns would have been observed if the beetles had attacked clones, families and provenances at random. Attack frequency distributions were determined to be non-random for clones, families and provenances in orchard #307 ($P<0.001$ for all – Fig. 3).

Genetic variation for MPB attack frequencies was first observed in the Prince George lodgepole pine progeny test series (EP770.20) by Robb Bennett (Pest Management Officer, MoFR), Staffan Lindgren and Dezene Huber (University of Northern British Columbia) and further investigated by Alvin Yanchuk, Kimberly Wallin (Oregon State University) and John Murphy (Research Technician, MoFR). Observations of genetic variation in MPB host preferences at multiple levels of genetic hierarchy (clone, family, provenance) in KFC Seed Orchard #307 will allow for additional study of resistance/tolerance mechanisms operating in the lodgepole pine host.

Attack frequency distributions were determined to be non-random for clones, families and provenances in orchard #307.

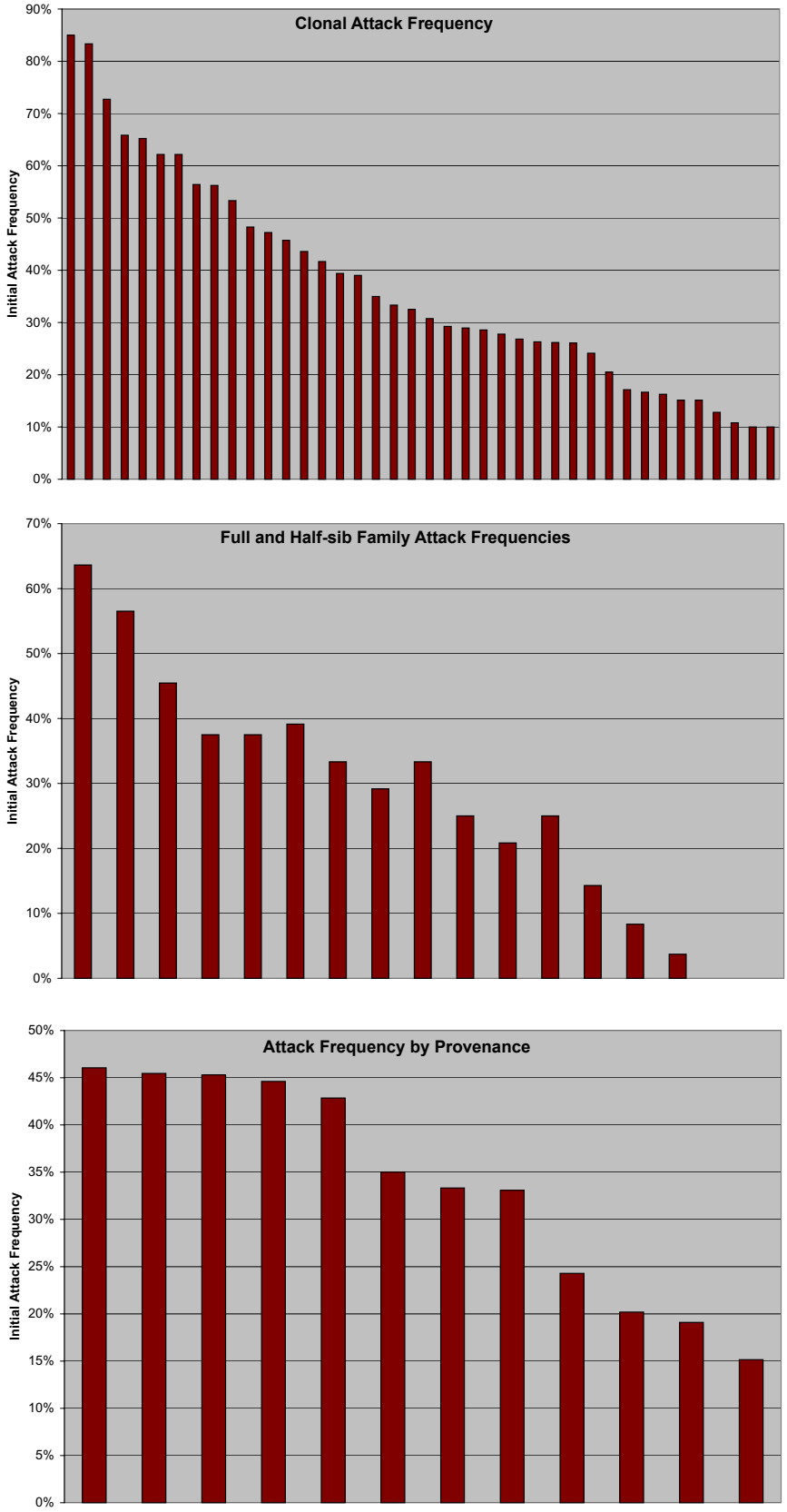

Figure 3. Relative percentage of ramets attacked in Seed Orchard #307 (y axis) during the initial MPB invasion of Aug. 1–3, 2006. Relative attack frequencies are shown for clones (top), families (middle) and provenances (bottom).

The Bottom Line … How many pine trees will die in 2006 at the Kalamalka Forestry Centre?

The MPB invasion of the pine orchards at the KFC shocked everyone at the facility. Early post-attack planning included serious considerations of a sanitary removal of 200–600 of our trees in the upcoming winter season. However, during weekly monitoring walks, it was observed that very few of the attacked trees were accumulating sawdust at the bases of their boles. We believe that most of our attacked trees, including many 'Medium-' and 'Severely-attacked' individuals, have successfully repelled the attacks by MPB in 2006. We saw the production of extremely large pitch tubes on our trees and have observed many beetles that have been 'pitched out' and killed (Fig.4). Recent samples indicate that few beetles are present in the entrance tunnels and that most attacks have not proceeded to brood production.

Recent samples indicate that few beetles are present in the entrance tunnels and that most attacks have not proceeded to brood production.

Current (optimistic?) projections are for the death of less than 50 trees across all of our pine orchards. Included in this mortality are about half of the attacked trees in the retired EP907 block. These are among the oldest, and largest, trees at the KFC (23–25 years old). They have not been topped, they are not fertilized and are not on the irrigation system. In the balance of the pine orchards, we believe that the good health of the ramets has contributed to their resistance to lethal attacks in 2006. Most of these trees are well fertilized and continuously drip irrigated. The seed orchard trees are protected from most potential pest problems through a modern IPM program. It is not yet known if the blue-stain fungus will become a major mortality factor for attacked trees at the KFC. It is hoped that trees repelling the beetle attacks also are vigorous enough to overcome infections caused by this pathogen.

The maintenance of strong healthy trees, along with prophylactic use of chemical pest controls, likely will be the cornerstones of future recommendations for controlling MPB in high-value research, clone bank and seed orchard pine plantations. In the long term, study of host resistance mechanisms and host/parasite interactions using resistant and susceptible clones, families and provenances will contribute to a better understanding of MPB biology.

Figure 4. Large pitch tubes and a pitched-out beetle (right) on an attacked pine tree at the KFC. The good general health of the trees in the KFC orchards may allow many of them to survive their first encounter with MPB in 2006.

2007 Sowing Guidelines

submitted by Dave Kolotelo, Susan Zedel, and Al McDonald

The sowing guidelines are:

- a set of calculations that convert seedlings requested by forest professionals to the amount of seed that needs to be removed from long-term freezer storage
- the default conversion factor on SPAR
- used to calculate the number of potential seedlings for an entire seedlot as well as seedlings producible per gram of seed
- used by many forest companies and nurseries. However, some adjust the grams of seed required (usually downwards) based on past experience or limitations placed on high-value seed by the owner.

The sowing guidelines have undergone revisions in 1996, 1999 and most recently in 2001. Additional details on the 1999 (select Vol 3 #4) or 2001 (select Vol 5 #2) can be downloaded from http://www.for.gov.bc.ca/hti/publications/notes/notes.htm.

Some nurseries have asked that their nursery-specific guidelines are entered as a default in SPAR. This intuitively seems reasonable, but it produces problems when one is comparing production figures across nurseries. The same amount of seed could be used to produce different quantities of seedlings at different nurseries. The problems become multiplied when one considers the impacts of changing nurseries on seedling production.

Nursery Grams Adjustment Screen

To assist with nurseries wishing to be efficient with seed, a new Nursery Grams Adjustment Screen has been added to SPAR. Nurseries may now select sowing requests based on:

- species
- stock type
- planting year
- stock age
- container type or season.

They are able to display them on one common screen where grams can be adjusted. Sowing requests with a common set of parameters may be updated on one screen. Previously each sowing request would need to be accessed individually and changes entered, making it a relatively slow process.

Minor adjustments to the sowing guidelines are being introduced for 2007 sowing. The change is strictly for **lodgepole pine (Pli)** seedlots and the reduction amounts to a 6.3–8% decrease in allocated seed depending on the germination capacity (GC) (%) of the seedlots. For seed owners, these guidelines suggest that they should be able to obtain more trees. For nurseries it means that less seed will be provided to produce Pli seed if they have followed these guidelines in the past. This change is in response to the need for improved seed efficiencies with Pli due to various challenges such as mountain pine beetle, wildfires, and the low inventory of seed orchard seed.

The new Pli guidelines and current guidelines for other species are illustrated in Figure 1 for GC values between 70 and 100% (covering most Pli seedlots).

1. The changes have been realized by reducing the correction or oversow factor by 0.1.
2. This factor is entered to two decimal places and allows for a streamlined reduction in seeds per seedling across the germination range.
3. The new 2007 Pli guidelines do not provide specific sowing factor or correction factor terms as these small reductions in seed are best implemented by each nursery with consideration to their sowing equipment and attitude to risk.

To compare seeds supplied per seedling at 99 and 100% GC, the term is reduced from 1.75 to 1.61, while at 69 and 70% GC, the number of seeds per seedling goes from 4.81 to 4.43. A comparison of the changes in seeds per seedling for GC values between 100 and 21% (the lowest GC value in the guidelines) are illustrated in Table 1. The seeds per seedling number is important, as it is the value used in the calculations converting seeds to seedling and vice versa. The equations are the same as those presented in 2001, but are repeated here for ease of reference.

The sowing guidelines are...used to calculate the number of potential seedlings for an entire seedlot as well as seedlings producible per gram of seed.

To assist with nurseries wishing to be efficient with seed, a new Nursery Grams Adjustment Screen has been added to SPAR.

Minor adjustments to the sowing guidelines are being introduced for 2007 sowing. The change is strictly for lodgepole pine.

$$\text{Grams of seed} = \frac{\text{No. of seedlings requested} \times \text{Seeds supplied per seedling}}{\text{Seeds per gram}}$$

$$\text{Potential seedlings} = \frac{\text{Grams of seed} \times \text{Seeds per gram}}{\text{Seeds supplied per seedling}}$$

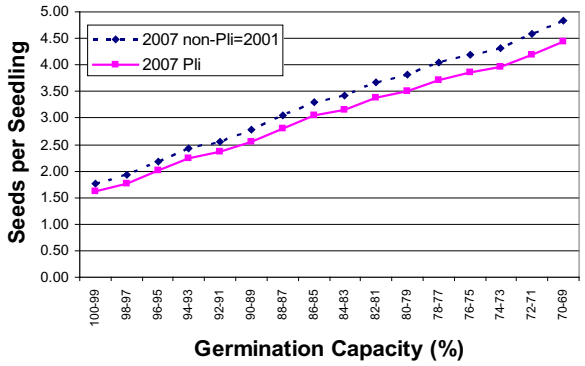

Figure 1. A comparison of seeds per seedling supplied through the 2007 Pli guidelines and 2007 non-Pli guidelines (= 2001 guidelines) from 69 to 100% germination capacity.

Table 1. A comparison of the seeds supplied per seedling and % reduction of the 2007 Pli guidelines and 2007 guidelines for other species

Germination Capacity (%)	2007 non-Pli Seeds/ Seedling	2007 Pli Seeds/Seedling	% Reduction Seeds/ Seedling
100–99	1.75	1.61	8.0
98–97	1.91	1.76	7.9
96–95	2.18	2.01	7.8
94–93	2.43	2.24	7.8
92–91	2.56	2.36	7.8
90–89	2.78	2.56	7.9
88–87	3.05	2.81	7.9
86–85	3.30	3.04	7.9
84–83	3.43	3.16	7.9
82–81	3.68	3.39	7.9
80–79	3.81	3.51	7.9
78–77	4.04	3.72	7.9
76–75	4.18	3.85	7.9
74–73	4.31	3.97	7.9
72–71	4.56	4.20	7.9
70–69	4.81	4.43	7.9
68–67	4.95	4.56	7.9
66–65	5.20	4.79	7.9
64–63	5.34	4.92	7.9
62–61	5.60	5.16	7.9
60–59	5.76	5.31	7.8
58–57	5.88	5.42	7.8
56–55	6.14	5.66	7.8
54–53	6.29	5.80	7.8
52–51	6.55	6.04	7.8
50–49	6.71	6.19	7.8
48–47	6.87	6.34	7.7
46–45	7.15	6.60	7.7
44–43	7.32	6.76	7.7
42–41	7.50	6.93	7.6
40–39	7.69	7.11	7.5
38–37	7.89	7.30	7.5
36–35	8.11	7.51	7.4
34–33	8.34	7.73	7.3
32–31	8.60	7.98	7.2
30–29	8.78	8.16	7.1
28–27	9.00	8.38	6.9
26–25	9.27	8.65	6.7
24–23	9.60	8.98	6.5
22–21	9.86	9.24	6.3

Seed Planning and Registry System (SPAR)

submitted by Susan Zedel

Significant enhancements and maintenance to the system have been implemented over the past four years since the initial release of web-based application of SPAR in August 2002.

It has been five years since the Tree Improvement Branch began the redevelopment of the Seed Planning and Registry system (SPAR) to a web-based application (see TICtalk Vol. 4, No. 1, Spring 2001). The first version of the 'new and improved' SPAR was released in August 2002. During this first period of development, funding for the project was provided jointly by the Forest Genetics Council and the Ministry of Forests.

Significant enhancements and maintenance to the system have been implemented over the past four years since the initial release of SPAR in August 2002. Funding for this work has been provided by Ministry of Forests and Range Information Management/Information Technology Capital funding and Tree Improvement Branch.

The enhancements of interest to the Forest Genetics community include:

- implementation of the information requirements contained in the FRPA *Chief Forester's Standards for Seed Use* (as of August 2005)
- the addition of parent tree data to SPAR (July 2005)
- the online application for "seedlot registration," which includes a parent tree contribution screen for orchard seedlots (September 2005)
- the online "application for vegetative lot registration," which includes a parent tree contribution screen (August 2006)
- new reports on genetic gain, seed use by genetic class, seed planning units, etc. (2004–2006).

SPAR is the repository for parent tree data including origin information, tested area of use and test results determined by the MoFR Research Branch Forest Genetics group.

Since some readers of TICtalk may not be familiar with the Seed Planning and Registry system, following is an overview of the original features and recent enhancements.

Seedlot data available in SPAR include:

- the genetic class, which indicates if a seedlot source is a seed orchard, natural stand or superior provenance stand.
- collection and extraction information, such as the dates and agencies involved in the collection and extraction.
- for seedlots collected from parent trees or superior provenance areas, the genetic worth of the seedlot. The breeding values of the tested parent trees determine the genetic worth. A seedlot can have for one or more genetic trait, G (growth and volume), D (relative wood density), R (pest resistance) and M (major gene resistance – western white pine only).
- the geographic location, including latitude, longitude, elevation range, seed planning zone and biogeoclimatic zone of the collection site for natural stand collections.
- the area of use where a seedlot can be transferred, which includes seed planning zones and elevation range for seed orchard collections and additionally BEC zone, latitude range and longitude range for natural stand collections.
- results of tests performed at the Tree Seed Centre on a seedlot over time, including moisture, purity, germination capacity, peak value, seeds per gram, fungal assays, etc.
- original balance and ownership details, as a seedlot can have multiple owners.
- details of seed withdrawals for seedling requests and other transactions. The balance of a seedlot changes as requests are made against the seedlot.

Vegetative lot data available in SPAR:

- Most vegetative lots are collected at production facilities (orchards in SPAR). Tested parent trees (clones) are kept in containers, hedges (yellow cypress) or stoolbeds (hybrid poplar).
- Occasionally natural stand vegetative lot collections are made, in which case the SPAR data includes latitude, longitude, elevation range, seed planning zone and biogeoclimatic zone of the collection site.
- Vegetative lot quantities are estimated for a "production year." The "rooting success" is an estimated percentage of the cuttings that would produce "seedlings."

Parent tree data in SPAR:

- SPAR is the repository for parent tree data including origin information, tested area of use and test results determined by the MoFR Research Branch Forest Genetics group. The breeding values (BV) of the parent trees are used to calculate the genetic worth (GW) of seedlots and vegetative lots when they are registered on SPAR.

- Parent tree test results can be for one or more genetic traits, including G (growth and volume), D (relative wood density), R (pest resistance) and M (major gene resistance – western white pine only).

Seedlot registration on SPAR includes:

- a new "application for seedlot registration" function, which became available in September 2005. Seed orchards and natural stand cone collectors now enter all the information required by the *FRPA* Chief Forester's Standards for Seed Use using this function. The screen layout differs for Class A (seed orchard collections) and Class B (natural stand collections) seedlots. Orchard managers are required to enter cone and pollen count data for all the parent trees in the orchard. SPAR then calculates effective population size (Ne) and genetic worth (GW) for a seedlot from the parental contribution.
- a SMP (supplemental mass pollination) contribution screen, which was added in September 2006.

Vegetative lot registration on SPAR includes:

- a new "application for vegetative lot registration" function, which became available in August 2006. This function is similar to the seedlot registration process, except that vegetative production facility managers enter clone quantities on the parent tree contribution screen.

Request functions include:

- seedling requests, where a client enters information that will initiate withdrawal of seed from storage, seed preparation and shipment to a nursery, sowing at the nursery and production of seedlings for reforestation. The information required in a seedling request includes: planting site geographic parameters, forest licence and tenure information, seedling quantity required, nursery, seedling stocktype, and stock age information. These parameters are run through complex queries to determine suitability of seedlots based on the *FRPA* Chief Forester's Standards for Seed Use, availability of seedlots based on ownership, and seedlot quantity required to fill the order based on sowing guidelines.
- cone and seed processing requests.
- direct withdrawal of seed for purposes other than producing seedlings for establishing a free-growing stand.
- seed sale requests, where ownership of all or a portion of a seedlot is transferred between agencies.

Nursery-specific functions include:

- latest sowing date table, where nurseries enter their sowing dates for specific species, container type, planting year/season combinations. These sowing dates then trigger 'recommended action dates' for the Tree Seed Centre to withdraw the seed from storage, stratify, and prepare for shipment to the nursery.
- nursery gram adjustment function, where nurseries can list several seedling requests on one screen and reduce the grams of seed required to sow each request.

SPAR Reports

Reports in SPAR are created by entry of parameters on a report submission form. Most reports are created as Adobe Acrobat pdf files. Other reports create data extracts in MS Excel format. SPAR reports include:

- seedlot listing or search reports with one line of information per seedlot, seedlot detail report with options for extensive information for each seedlot, seedlot ownership by agency report, seedlot usage report, and seed orchard reports.
- parent tree reports, listing parent tree origin, tested areas of use and test results.
- seedling request listing or search reports with one line of information per seedling request, seedling request confirmation report, and seedling request status report.
- nursery reports with seedling request information pertinent mainly to a nursery, such as sowing guidelines and sowing dates.
- inventory reports, which summarize quantity of seed available for specific areas.
- seed use and genetic gain reports, which summarize quantities of improved or natural stand seed used in seedling requests. These reports are important for incorporating genetic gain in timber supply analyses.
- data extracts, which provide seedlot, vegetative lot, parent tree or seedling request data in a spreadsheet format that can be sorted or manipulated by the user.

Seedlot registration on SPAR includes... a new "application for seedlot registration" function, which became available in September 2005.

Vegetative lot registration on SPAR includes...a new "application for vegetative lot registration" function, which became available in August 2006.

Administrative Tasks

The Tree Seed Centre and Tree Improvement Branch headquarters staff have several administrative and approval tasks in SPAR, some of which include:

- table maintenance including test grams, test frequency, seed price, sowing rule factors, and transfer limits.
- approval and completion of seedlot registration when all the requirements of the Chief Forester's Standards for Seed Use have been met and testing completed.
- approval of newly registered parent trees and test results.
- monitoring and approval of seedling requests where privately owned surplus seed has been selected. This requires authorization by email from the seedlot owner.

By January 2007, there will be links on the seedlot, vegetative lot and seedling request screens to open SeedMap with the spatial data displayed.

SPAR Business Cycle

There are normally specific times of the year when there is heightened activity for the SPAR functions listed above. Seedlot registration depends on species-specific timing of cone collections. For example, most seed orchard collections occur between August and October. Most seedling requests are entered in the period from September to December. Seed withdrawal, preparation and shipments to nurseries for sowing occur between December and June, depending on the seedling request stock age and stock type.

During the slower period of the cycle (from May through August each year), SPAR enhancements are developed and released. Maintenance of the application and database is ongoing all year as required. In 2006, there are some major infrastructure and security changes occurring during the slower period.

SPAR enhancements are currently underway to use data from other systems in online screens and reports. By January 2007, there will be links on the seedlot, vegetative lot and seedling request screens to open SeedMap with the spatial data displayed. SPAR users will be able to view the collection origin for natural stand lots and the "area of use" of any seedlot. For suitable lot searches and seedling requests, the geographic location and Seed Planning Zones entered in SPAR will be verified with the spatial data. A link will bring up SeedMap with a display of the potential planting site, the applicable seed planning zones, etc. New seed use reports will summarize actual planting data from RESULTS (Reporting Silviculture Updates and Land-status Tracking system) to derive genetic gain.

For more information on SPAR,visit the website at http://www.for.gov.bc.ca/hti/spar. Contact Susan Zedel at the Tree Improvement Branch if you have questions or suggestions.

SelectSeed Company Ltd.

submitted by Jack Woods

SelectSeed is a limited company that is wholly owned by the Forest Genetics Council of BC through the BC Forest Genetics Society (all Society members are also members of Council). In 1999, the newly organized Forest Genetics Council of BC had set forward-looking provincial objectives and was structuring programs to deliver on these objectives. Council had identified the need for substantial interior seed orchard expansions, but there were no existing orchard operators with the capital necessary to establish the approximately 35 000 ramets (95 ha) of orchards needed. Negotiations with Forest Renewal BC (FRBC), an active investor in forest management at the time, for funding to develop the orchards had come to an impasse. While FRBC was keen to support the orchard investments, they were not willing to release funds for capital development without a long-term mechanism to obtain a return on their investment. Council's solution was SelectSeed Company Ltd.

SelectSeed is operated by a separate Board of Directors, which is elected by Council. Current directors are Glen Dunsworth (chair), Reid Carter, Shane Browne-Clayton, Russ Clinton, and Jim Burbee. SelectSeed's mandate is twofold:

1. the development of seed orchards identified by Council and not being undertaken by other operators, and
2. program management on behalf of Council.

Beginning in the spring of 2000, SelectSeed received a mandate from Council to establish 14 seed orchards (9 Pli, 3 Fdi, and 2 Sx), totaling just over 35 000 ramets. Freshly minted, with a new Board of Directors and one staff member (the author), SelectSeed developed a Business Plan, completed negotiations with FRBC for a multi-year agreement, and embarked on orchard developments through a call for proposals. Response to the call was good, and SelectSeed was able to successfully enter long-term contracts with five private-sector companies for the development of the 14 seed orchards.

At the present time, the 14 SelectSeed orchards are well over 90 percent established, and several early cone crops have been harvested (Table 1). Contractual arrangements with operators have been

Table 1. Summary of SelectSeed Co. Ltd. seed orchard developments

Orchard #	Species	Seed zone	# ramets planned	% of ramets established	Orchard company*	Location
321	Fdi	NE low	2 187	97	PRT	Armstrong
232	Fdi	QL	975	79	VSOC	Vernon
233	Fdi	PG	786	100	VSOC	Vernon
343	Sx	TO high	1 052	100	Tolko	Armstrong
342	Sx	TO low	454	100	Tolko	Armstrong
337	Pli	NE low	1 000	100	PRT	Armstrong
338	Pli	TO low	4 780	97	PRT	Armstrong
237	Pli	PG low	4 871	85	KRSO	Kettle Valley
236	Pli	PG low	4 500	100	VSOC	Vernon
339	Pli	TO high	3 473	99	Tolko	Armstrong
234	Pli	BV low	3 000	99	VSOC	Vernon
240	Pli	BV low	3 100	97	Sorrento	Sorrento
241	Pli	CP low	2 000	90	Sorrento	Sorrento
238	Pli	CP low	3 100	87	KRSO	Kettle Valley
TOTALS			**35 294**	**94**		

* VSOC – Vernon Seed Orchard Co.; KRSO – Kettle River Seed Orchard Co.; Sorrento Nurseries Ltd.

robust and trouble-free. Thanks to the dedication of the contract operators working with SelectSeed (Kettle River Seed Orchard Co., PRT Ltd., Sorrento Nurseries Ltd., Tolko Ltd., and Vernon Seed Orchard Co.), all orchards are well managed, growing quickly, and beginning to produce cones. Tree breeding staff from MoFR (Mike Carlson, Barry Jaquish, John Murphy, Vicky Berger, Val Ashley) provided key support with scion collections from selected parent trees, and with technical issues.

Currently, SelectSeed is primarily supported through Forest Investment Account funds. As orchards mature and produce seed, it will become increasingly self-supporting through seed sales. By about 2012, it is anticipated that SelectSeed will have sufficient seed-sale revenue to meet operating costs. SelectSeed's business plan projects a profit from seed sales following 2012. This profit will be used at Council's discretion to meet other program needs.

As a cooperatively owned company, SelectSeed is uniquely positioned to respond to needs identified by the FGC. Seed will be made widely available for sale to a range of licensees (woodlots, first nations, major tenure holders, etc.), and an effort will be made to pattern sales to maximize immediate seed use.

Program management responsibilities on behalf of the Forest Genetics Council were initially given to SelectSeed to ensure representation on behalf of all stakeholders. FGC members in 1999 were adamant that long-term program success was dependent upon this independent function. After nearly six years, SelectSeed has proven its worth through successful orchard developments, adherence to business principles, and effective program management on behalf of the FGC.

ClimateBC: A Computer Program to Generate High-resolution Climate Data for British Columbia

submitted by Tongli Wang

Introduction

With increasing concern about climate change, climate data have become essential for ecological research and forest genetic resource management. Due to the limited number of weather stations available, climate data for a site of interest must be estimated based on data from weather stations nearby, a process called interpolation. Widely used interpolated climate data for British Columbia are PRISM 1961–1990 climate normals (Daly et al. 2002). Climate normals represent a long-term (30-year) average of climate data. This PRISM climate normal dataset has been generated for mean monthly maximum and minimum temperatures and monthly precipitation at a resolution of about 4 × 4 km (Daly et al. 2002).

As shown in Figure 1A, this resolution is not high enough for practical applications in mountainous regions. For temperature variables in particular, predicted values can be several degrees different from observed ones due to elevational differences (up to 1200 m in BC) within a 4 × 4 km PRISM tile. In addition, there is a need for additional variables such as dryness, growing degree days, frost-free period, etc. The ClimateBC software has been developed as a one-stop solution to: 1) downscale the PRISM data; 2) estimate additional climate variables; and 3) integrate historical climate data as well as future predictions by global circulation model. Interpolated climate variables using ClimateBC were substantially improved over the original PRISM data in terms of both spatial resolution (Figure 1) and prediction precision (15–30% for temperatures and 14% for precipitation) (Wang et al. 2006; Hamann and Wang 2005).

With increasing concern about climate change, climate data have become essential for ecological research and forest genetic resource management.

The ClimateBC Software

ClimateBC is based on the PRISM 1961–1990 normal data covering British Columbia, the Yukon, the Alaska Panhandle, and western Alberta and parts of the Northwest Territories, Washington, Idaho, and Montana (Figure 2). Methodologies that downscale PRISM data and calculate many derived variables are described by Wang et al. 2006 and Hamann and Wang 2005.

The current (June 2006) and tested version of ClimateBC is version 2, which generates scale-free seamless climate data for annual, seasonal, and monthly temperature and precipitation variables. It also estimates 11 more complex, but biologically relevant climate variables, such as frost-free period, and various growing degree days. Some major global circulation models (GCM) have also been integrated for predicting climates in the 2020s, 2050s and 2080s. A more complete version (version 3), which includes predictions by many more general circulation

ClimateBC is based on the PRISM 1961–1990 normal data covering British Columbia, the Yukon, the Alaska Panhandle, and western Alberta and parts of the Northwest Territories, Washington, Idaho, and Montana.

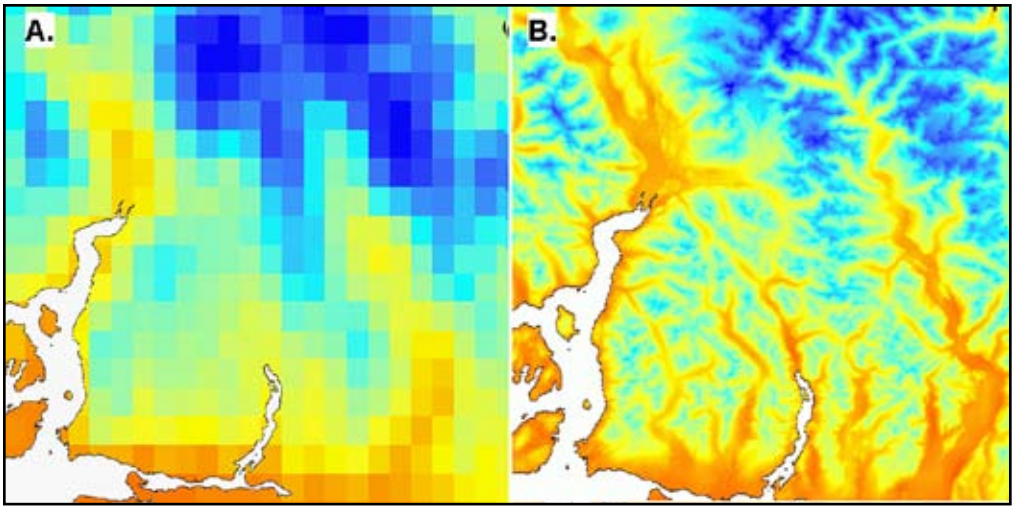

Figure 1. Maps of mean annual temperature predicted by A) PRISM, and B) ClimateBC v2.3 for the area north of Vancouver area at a resolution of 100 × 100 m. Source: Wang et al. 2006.

With the climate data generated by ClimateBC, high-resolution climate maps can be produced for current and future periods.

Figure 2. The areas covered by ClimateBC.

models and emission scenarios as well as historical climate data, is currently in the beta testing stage. A web version of ClimateBC has also been developed. The functionality of the web version is equivalent to ClimateBC v2, except for the ability to process multiple locations at a time. All versions can be accessed at the Centre for Forest Gene Conservation web site at http://genetics.forestry.ubc.ca/cfgc/climate-models.html.

As shown in Figure 3, the user can input latitude, longitude, and elevation (optional) to generate up to 75 monthly, seasonal, and annual climate variables. The multi-location processing function can be used to process spreadsheets of coordinates.

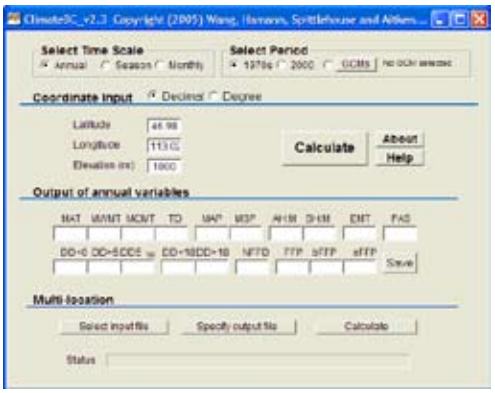

Figure 3. The interface of ClimateBC v2.

Applications

With the climate data generated by ClimateBC, high-resolution climate maps can be produced for current and future periods. The maps of mean annual temperature (MAT) for BC are shown in Figure 4 for the reference period (1970s) and future periods (2020s and 2050s). ClimateBC makes much ecological research possible. For example, the modeling of Biogeoclimatic Ecological Classification (BEC) with climate variables (Hamann and Wang 2006) requires high-resolution climate data for accurate modeling (Figure 5). Similarly, the use of ClimateBC is also critical for modeling seed planning units (SPUs) in order to decide where to deploy species and genotypes so that they can thrive under current and potential future scenarios. Further examples for applications are provenance testing, where genetic variation can now be analyzed as a function of multiple climate variables (Wang et al. 2006). The software and data has also been used for better understanding of ecological interactions between hosts and diseases (Woods et al. 2005).

Acknowledgements

This project was developed together with Andreas Hamann (currently at Department of Renewable Resources, University of Alberta), Dave Spittlehouse (Research Branch, MoFR), and Sally Aitken (Department of Forest Sciences, UBC). Funding for this study was provided by the Forest Investment Account through both the BC Forest Science Program and the Forest Genetics Council of BC and a joint Strategic Grant from NSERC and the BIOCAP Canada Foundation.

References:

Daly, C., W.P. Gibson, G.H. Taylor, G.L. Johnson, and P. Pasteris. 2002. A knowledge-based approach to the statistical mapping of climate. Climate Research 22: 99–113.

Hamann, A., and T.L. Wang. 2005. Models of climatic normals for genecology and climate change studies in British Columbia. Agric. and For. Meteor. 128: 211–221.

Wang, T., A. Hamann, D.L. Spittlehouse, and S.N. Aitken. 2006. Development of scale-free climate data for western Canada for use in resource management. Intl. J. Climatology 26(3): 383–397.

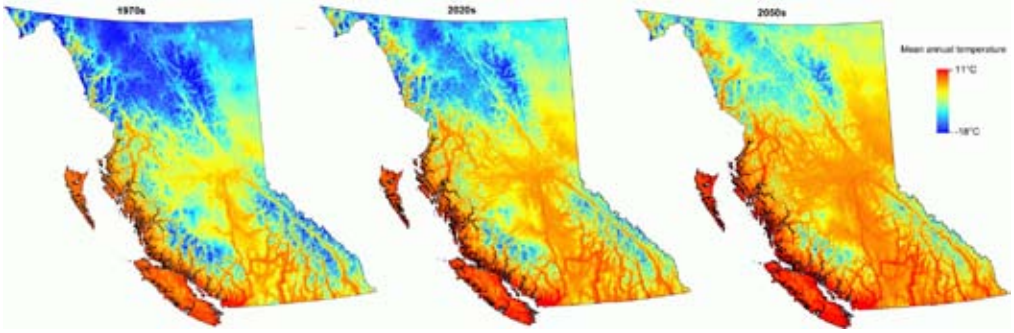

Figure 4. High-resolution maps of mean annual temperature (MAT) for BC for the periods of the 1970s (1961–1990, the reference period), 2020s (2011–2040), and the 2050s (2041–70).

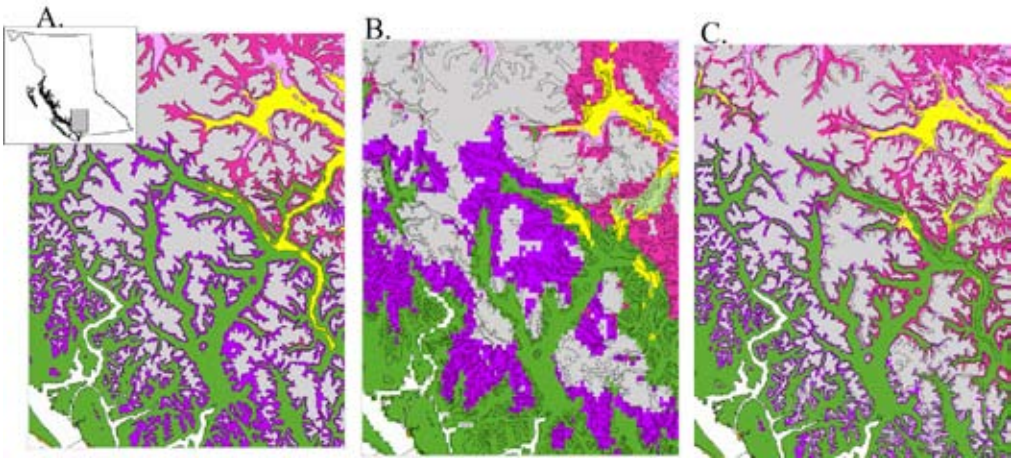

Figure 5. Modeling of BEC zones using ClimateBC vs. Prism data A) observed, B) modeled using PRISM data, and C) modeled using ClimateBC. Source: Hamann and Wang (2005).

Will Deer-resistant Western Redcedar Become a Reality?

submitted by John Russell

Deer browsing on western redcedar in the Pacific Northwest can result in delayed regeneration and potential plantation failure. Currently, it can cost up to $6 CND per tree to protect seedlings from browse and bring a plantation to free-to-grow. Staff at Cowichan Lake Research Station, Research Branch, in conjunction with others including Dr. Bruce Kimball, chemical ecologist with the United States Department of Agriculture, are in the process of developing populations of deer-preferred and not preferred trees to help alleviate this problem.

From the perspective of an herbivore, plants contain both beneficial and deleterious phytochemicals that impact palatability and diet selection. By integrating the flavour of foods with the postingestive consequences of consuming them, herbivores learn to prefer beneficial plants and to limit intake of plant secondary metabolites (PSMs). Monoterpenes are one class of PSMs that are regularly encountered by deer and have been demonstrated to impact deer preference.

Monoterpenes are one class of PSMs that are regularly encountered by deer and have been demonstrated to impact deer preference.

Conifer needle monoterpenes vary considerably among individuals and exhibit high heritability. In a western redcedar genetic trial on southern Vancouver Island, total monoterpenes were significantly correlated with browse such that trees that were heavily browsed tended to have low monoterpene content. In addition, there was no significant correlations with monoterpenes and growth (Figure 1).

Individuals within this trial were selected for three populations: 1) deer not preferred, chosen for both absence of deer browse and high needle monoterpenes; 2) deer preferred, selected based on both heavy browse and minimal or no needle monoterpenes; and 3) trees selected with intermediate monoterpene levels to emulate an average wildstand seedlot. Copies of these selections were planted in feeding choice experiments with black-tailed deer at three different locations, including penned deer at the USDA Olympia Field Station (Figure 2), to observe the relationship between browse

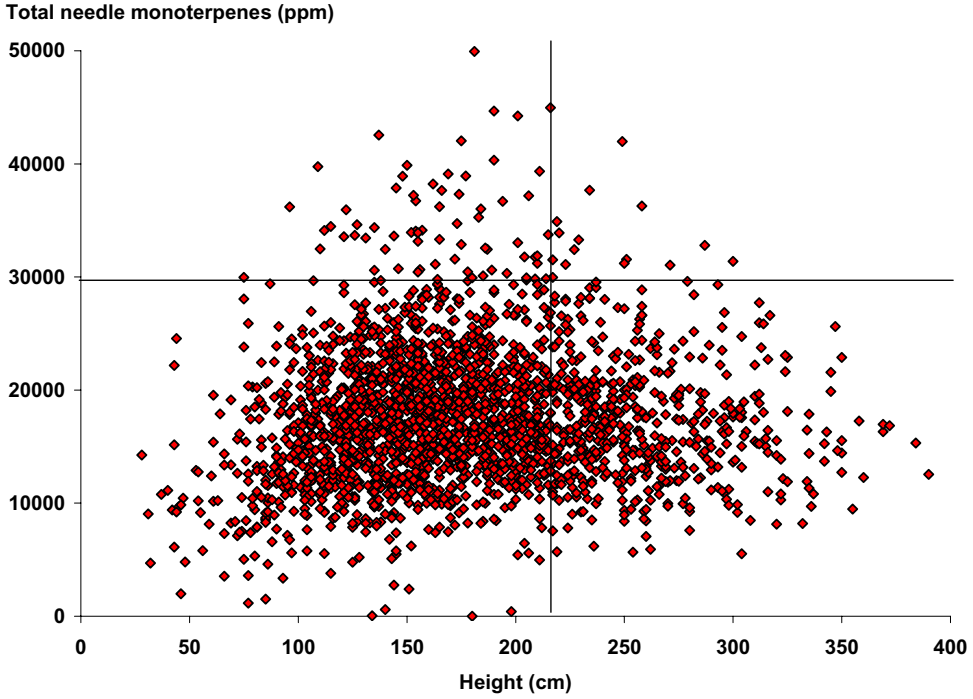

Figure 1. Relationship between six-year tree height and total needle monoterpenes in western redcedar grown at Holt Creek, southern Vancouver Island.

resistance and phytochemical concentrations. Preliminary results from all three trials were similar and encouraging, demonstrating that browse preference is a function of total needle monoterpene content (Figure 3).

Planting seedlings that are high in needle monoterpenes doesn't necessarily guarantee browse resistance. Plants contain both beneficial and deleterious phytochemicals and if bitter, high monoterpene trees are the

Figure 2. Western redcedar feeding choice trial with black-tailed deer at the USDA National Wildlife Center's Olympia Field Station.

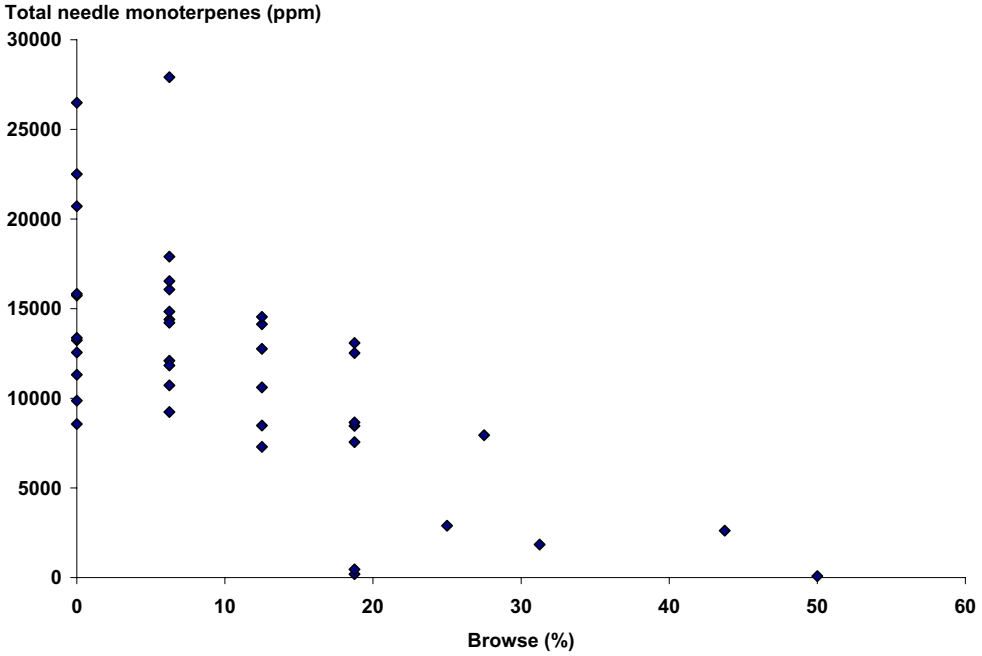

Figure 3. Relationship between total needle monoterpenes and percent browsing by clone in western redcedar grown at Fairservice Main, south Vancouver Island.

Preliminary results from all three trials were similar and encouraging, demonstrating that browse preference is a function of total needle monoterpene content.

The next step in our research is to outplant mixtures of trees with varying levels of needle monoterpenes in operational trials.

only available food source, deer will make a choice on the balance between energy input and cost of detoxification. The next step in our research is to outplant mixtures of trees with varying levels of needle monoterpenes in operational trials. If deer pressure is high, mixtures of not preferred trees with "average" wildstand seedlots would give the deer something to eat and hopefully the not preferred trees will be left alone long enough to become free to grow. If deer pressure is moderate, but still present, and volume production is a goal, then mixtures of deer-preferred seedlots with elite growth seedlots may give the deer enough foliage to browse on and the elite trees may be left alone or browsed minimally.

These current selections are just the beginning. We are breeding for needle monoterpene concentrations at Cowichan Lake Research Station using the preferred and not preferred selections from the above field trial. In addition, monoterpene profiles have been developed from the approximately 1000 parent trees whose progeny are also currently being field tested. Expression of terpenes occurs in a seedling's first year and breeding can be done in as little time as two years (Figure 4). Therefore, additional selections for deer resistance will come on quickly. The goal is to develop custom-made seedlots with varying degrees of resistance tailored for specific usages.

The goal is to develop custom-made seedlots with varying degrees of resistance tailored for specific usages.

Figure 4. Breeding young western redcedar trees at Cowichan Lake Research Station.

The Ultimate Deer Repellant

submitted by Don Pigott

In 1980 I was responsible for the establishment and management of seed orchards for MacMillan Bloedel. We had two seed orchard complexes located in Cedar near Nanaimo. One site was adjacent to the Crow and Gate pub (very convenient), and the other near the Harmac Pulp Mill. Both sites were fenced with 8' high deer fencing. The Crow and Gate site had been previously farmed, and was surrounded by other farmland, so the odd stray deer that threatened to eat our trees tended to be controlled by the neighbours, and browsing was never an issue. The Harmac location was a different matter. This was our original clonebank and seed orchard facility which we had to first log, clear, and cultivate prior to planting. After having logged and effectively destroyed 50 acres of prime deer habitat, we had displaced the substantial population into the surrounding timber.

It should have been no surprise to us that, after having planted most of the site with succulent, well-watered, fertilized, and expensive, grafted trees, deer browsing was going to become an issue. Apparently deer will, when motivated, leap 8' high fences in a single bound, crawl on their belly under, or in one case, climb over said fences. I'm sure a few would also wait until the gate was open in the morning, and trot in for breakfast or lunch.

It was extremely disheartening to discover row after row of carefully tended grafts munched into oblivion.

At the time, we tried numerous commercial and anecdotal repellants to discourage our intruders. These included BGR (Big Game Repellant), Scoot, garlic, pepper, rotten egg and baking soda mixtures, human hair from a local barber hanging in nylon stockings, and a number of other suggestions...

Some of the repellants that were sprayed actually worked fine, but required frequent reapplication as not only were they diluted by the rain, but we often irrigated overhead, which also decreased their longevity.

One of my well-read colleagues in our "downtown office," who was sympathetic to our plight, had discovered an article on a substance called "Cougar Pith" used for repelling deer in Germany. This material was allegedly an extract of cat urine, and came with glowing recommendations. I immediately attempted to acquire the product, but importing a toxic substance with a name like that proved to be legally problematic. After some investigation, I had all but given up and was looking for alternatives.

The Circus Comes to Town

My two children were six and four years old in the spring of 1980, when the Shrine Circus came to town, and like all parents I dutifully took them to see the clowns, acrobats, scantily clad ladies on horseback, and the animal acts. Now this particular circus was owned by a muscular fellow with the auspicious name of Tarzan Zerbini, who was also the show's lion tamer. The kids watched in awe as Tarzan cracked his whip (can't do that today), and had the lions and tigers perform various stunts and tricks. In the middle of his performance, however, one of the lions stopped, squatted, and unceremoniously left a rather large deposit in the centre of the ring. Bozo the clown immediately entered the ring, scooped up the material and retreated.

The light came on…

After the show was finished, we wandered outside and located the convoy of trailers which the performers called home. I inquired after, and quickly located, Tarzan who was in the process of putting new line on his salmon fishing reel as he was intending to try his hand in the local waters between shows. After introducing myself and giving him a few pointers on good places and lures to try, I told him about our deer problem, and explained that I thought that probably both "Cougar Pith" and his "animal products" contained the same desirable properties. He enthusiastically showed us his inventory, and offered to provide us with the entire proceeds of the week for free, adding that if we were willing to take his elephant by-products, he might even be willing to pay us. I declined the elephant goodies, but assured him "we" would return on Monday morning to load up.

On Monday morning, after the start of the week coffee ritual, I explained to my assistant "Mikey" my repellant hypothesis and arrangements with Tarzan. We discussed how, and where best to spread it (by shovel)

It should have been no surprise to us that, after having planted most of the site with succulent, well-watered, fertilized, and expensive, grafted trees, deer browsing was going to become an issue.

He was extremely keen to try anything that had the chance of relieving the frustration of having to re-graft, and replace material destroyed by browsing.

"Please don't ever ask me to do that again."

around the orchard. He was extremely keen to try anything that had the chance of relieving the frustration of having to re-graft, and replace material destroyed by browsing. As always, he immediately bolted out the door with a couple of summer students in tow, and headed to the circus to pick up our new-found repellant. About half an hour later I heard him drive past the office, heading for the orchards. At that exact moment I caught a whiff of something through the open window that, at the time, I assumed was the smell of chlorine from the pulp mill as the wind changed direction.

There was virtually no deer browsing damage that season. It proved so successful that re-application was unnecessary.

An hour later Mikey pulled up to the office in his truck. The door opened, Mikey and the students came in. The air was filled instantly with an odor that violates the senses to their very core. There was some coughing, cursing, and a line-up to the washroom to wash-up. Mikey sat down at the desk opposite me. His eyes were red and watering as he coughed a few more times. It was all I could do to not evacuate the building because of the burning amoniatic smell.

He spoke quietly, "Please don't ever ask me to do that again."

For several days the aroma lingered around the office, and for a much longer period in his truck. Certainly it was detectable in the field for the duration of the summer. However, some might argue that the pain was worth the gain. There was virtually no deer browsing damage that season. It proved so successful that re-application was unnecessary. It had been applied at a time when the grafts were stretching, and the following year the trees were large enough to escape serious browse damage.

Deer browsing continues to be a problem today, particularly with operational tree planting programs. There are new repellants on the market, but most still require expensive re-application on the "wet coast." Unfortunately because of our humane society today, the lions and tigers have all gone from the circus, but I know that there is a market out there for the "Ultimate Deer Repellant."

Photo credit: Michael Carlson

The Cowichan Lake Research Station Turns 77

submitted by John Parminter and Don Carson

The Cowichan Lake Research Station (CLRS), the BC Forest Service's flagship coastal research facility, has seen much activity over the decades since it was established in 1929.

The site was selected because the lookout on Bald Mountain provided for wildfire detection and the large forest of primarily 20-year-old Douglas-fir was a prime subject for research.

The station staff in 1929 consisted of the superintendent and just four researchers. Because a road to Mesachie Lake did not yet exist, they relied upon boat access to and from Lake Cowichan. In the first year of operation, a site was cleared to accommodate four buildings, and a firebreak was built on the eastern side of the property. Framed tents with wooden floors were used as living quarters.

The Depression quickly reduced research funding, and resulted in a serious loss of staff, but other initiatives kept the station alive through the 1930s. A provincial job relief program began in 1931 and crews billeted at the CLRS constructed roads and trails. The Young Men's Forestry Training Plan started up in June of 1935, due to the determination of Hugh Savage, the MLA from Duncan. About 60 men came to the station, where they added a cookhouse, bunkhouses, a residence, a telephone system and a water system to the camp.

The pay was $1 per day, with a $10 clothing allowance after two months of work. The food was good and there was organized recreation, as well as field trips to sawmills and logging camps, lectures on forestry and courses in log scaling and first aid. Other job relief and training programs, such as the provincial Forest Development Project, and the federal National Forestry Program and Youth Forestry Training Program, resulted in more men being stationed and trained at the CLRS until 1940.

Reforestation then took over as the mainstay of operations and the first crew arrived in 1941 to plant seedlings between Mesachie Lake and the village of Lake Cowichan. They were joined by Alternative Service Workers, or conscientious objectors, in 1942. Those crews were trained in fire suppression but planted seedlings when not on fire duty. They also felled snags, converted railway grades to roads and dismantled abandoned logging camps in the area.

The ASW crew answering to the dinner bell in 1942.

The station was a very busy place during the war, housing as many as 115 men, including the cookhouse staff, but a serious labour shortage resulted after cancellation of the Alternative Service Worker (ASW) program in 1944. Very little tree planting took place in 1945, and a backlog of seedlings accumulated.

The research program was reborn in 1947 when the pioneering forest thinning experiments, begun in 1929, resumed. Other research based at Cowichan Lake investigated tree seed production, direct seeding for reforestation and the effects of slashburning. The research station also enabled the reforestation of public and private lands and federal research in forest entomology, pathology and silviculture in the area.

The most important work begun during the 1950s was the Douglas-fir tree improvement program, which evaluated the characteristics of trees grown from seeds collected at different locations in the province and produced by crossing different natural populations. The program continues to this day, with Douglas-fir being in its third generation of breeding, and several other breeding programs for important coastal species also centered at CLRS. The clonal archives for all coastal species are managed at CLRS, and form an important component to gene conservation, as well as testing facilities that have contributed much to our knowledge of the natural variability in populations of trees and their adaptations to local environments.

In 1963, a nursery site was prepared and it was expanded later in 1980. Much of the work in the 1960s and 1970s involved developing

The station staff in 1929 consisted of the superintendent and just four researchers.

The pay was $1 per day, with a $10 clothing allowance after two months of work.

The research program was reborn in 1947 when the pioneering forest thinning experiments, begun in 1929, resumed.

the nursery, establishing plantations and providing trees for seed orchards. Other work in the 1970s concentrated on evaluating the effects of different thinning and fertilization regimes on tree growth and yield.

The station's 50th anniversary in 1979 was commemorated by a gathering of foresters and many others who were closely associated with the development of the CLRS. The program ended with a dedication ceremony and the Honourable Tom Waterland, then Minister of Forests, unveiled a stone cairn containing a time capsule.

Cuts in funding in recent years brought about a reduction in staff and resources. However, the station staff and visiting scientists continue to provide support and solutions in order to ensure that the station is still providing critical services to the Forest Service's mandate. World-wide recognition of this research and the facilities is evident by the number of international scientists, foresters and media personnel who have visited the station since its inception and continue to do so.

World-wide recognition of this research and the facilities is evident by the number of international scientists, foresters and media personnel who have visited the station since its inception and continue to do so.

The conference facilities, the bunkhouses, the famous cookhouse (designated a Forest Service heritage building in 1983) are once again available for use. The superb location makes the research station a prime choice for field trips and meetings. People belonging to many different public and private organizations have toured the grounds, research installations and projects, and often stayed at the station to enjoy its varied forests and to visit elsewhere in the region.

The Cowichan Lake Research Station has come a long way from its origins as a tent camp in 1929. It provides many specialized services to support long-term forest research and enjoys a co-operative relationship with the neighbouring communities. Results from the station's experiments have been applied extensively in nursery, reforestation, silviculture and tree improvement operations in coastal BC – thanks to the foresight of a handful of people in the BC Forest Service in the 1920s and the dedication of many others since then.

For more information, visit http://www.for.gov.bc.ca/hre/stations.htm.

Current staff and forest genetic technicians stationed at CLRS.

Aerial veiw of CLRS in the 1990s.

The authors wish to thank Ralph Schmidt for background material found in "The History of Cowichan Lake Research Station" by Ralph Schmidt.

Forest Genetics/Tree Improvement Websites of Interest in Canada

submitted by Diane Douglas

The following article pulls together websites of interest to forest genetics and tree improvement in Canada. A future article will focus on websites from other jurisdictions.

British Columbia

British Columbia Ministry of Forests and Range, Research Branch, Forest Genetics
http://www.for.gov.bc.ca/hre/forgen/

This site was revamped in 2005 by Alvin Yanchuk and includes information on:

- tree breeding and genetic improvement (history and species)
- gene conservation
- seed transfer and climate change (provenance trials)
- supporting research projects in forest genetics
- image bank.

Tree Improvement Branch
http://www.for.gov.bc.ca/hti/index.htm

This site contains links to the Tree Seed Centre (http://www.for.gov.bc.ca/hti/treeseedcentre/index.htm), Policy and Planning, Seed Production, Seed Orchard Pest Management, SPAR (http://www.for.gov.bc.ca/hti/spar/index.htm), SeedMap and the Operational Tree Improvement Subprogram.

Forest Genetics Council of BC
http://www.fgcouncil.bc.ca

This site includes information about FGC, its business, strategic, annual and project plans. Extension notes and tree improvement information is also found here.

SelectSeed
http://www.fgcouncil.bc.ca/sel.html

The Select Seed Company Ltd. (SelectSeed Co., SelectSeed) supports Forest Genetics Council of BC (FGC) objectives for the development of seed orchard facilities to meet the provincial demand for high quality, ecologically adapted tree seed through investments, cooperative work with FGC members, and effective program management.

University of BC Forest Genetics
http://genetics.forestry.ubc.ca/

This site provides a central point for facilities, faculty, links, and resources, including faculty links for Sally Aitken, Jorg Bohlmann, Yousry El-Kassaby, and Kermit Ritland.

Under **Facilities**, two sites are featured:

1. Centre for Gene Conservation
   http://genetics.forestry.ubc.ca/cfgc/
   This is a new site, developed by Christine Chourmouzis, Research Scientist. It has an abundance of information, great images, and is easy to navigate.
2. Genetic Data Centre, Univ. British Columbia
   http://www.forestry.ubc.ca/gdc/

Gene Namkoong is recognized with a tribute page and resources: http://genetics.forestry.ubc.ca/Gene_Namkoong.html

British Columbia Seed Orchards

1. TimberWest
   http://www.timberwest.com/operations_seed.cfm
2. Vernon Seed Orchard Company (VSOC)
   http://www.vsoc.ca/index.htm

Alberta

Alberta Forest Genetics Research Council
http://www.abtreegene.com/

University of Alberta Forest Genetics and Tree Improvement
http://www.rr.ualberta.ca/Research/For_Genetics_Tree_Improv/Index.asp

Faculty and Staff, including links for Bruce Dancik, Barbara Thomas, and Francis Yeh
http://www.rr.ualberta.ca/Research/For_Genetics_Tree_Improv/Index.asp?page=People

Andreas Hamann web page
http://www.rr.ualberta.ca/people/hamann/

Ontario

Forest Genetics Council of Ontario
http://www.fgo.ca/kb/aboutus.html

Forest Genetics Ontario (FGO) is a not-for-profit association incorporated under the laws of the Province of Ontario. Their mission is forest genetic resource management through a partnership of government, the forest industry, and other stakeholders.

New Brunswick

Atlantic Tree Seed Centre brochure
http://www.gnb.ca/0079/pdf/Kingsclear_Forest_Tree_Nursery-e.pdf#pagemode=bookmarks&page=9

Prince Edward Island

Dover Seed Orchard (brief description)
http://www.gov.pe.ca/focus/segment.php3?number=646

Canada

The following website provides a gateway to the Canadian Council of Forest Minister's website, as well as provincial forestry ministries.
http://www.canadian-forests.com/prov-gov.html

Canadian Council of Forest Minister's National Forest Information System
http://nfis.org/index_e.shtml and an affiliated page

Canadian Forest Genetics Information System (CAFGRIS) – Information on Native Trees of Canada and Tree Species of Concern
https://cfsnet.nfis.org/data/index_e.shtml
(You need to register and log in to this site.)

Canadian Forest Service
www.cfs.nrcan.gc.ca

This is the main link for CFS. Centres and program areas can be found from this area.

National Tree Seed Centre
http://www.atl.cfs.nrcan.gc.ca/SeedCentre/seed-center-e.htm

The National Tree Seed Centre (NTSC) provides seed for scientific research and stores seed for ex-situ conservation. It is located at the Canadian Forest Service, Atlantic Forestry Centre (CFS-AFC) in Fredericton, New Brunswick.

Universities

The following website provides a gateway to universities in Canada that offer forestry and forest genetics education.
http://www.canadian-forests.com/univer-coll.htm

Publications

The Misunderstood Forest by Gene Namkoong
"This is not a book on population or quantitative genetics, which we all would have expected, but the relationship of humans to forests. Although there are many books examining the historical and present day conflicts over forest use, few address the underlying reasons why we have struggled with what forests are and what they mean to us."

To download, visit: http://genetics.forestry.ubc.ca/book.html

Genomics for future forests.
First Canadian forest genomics symposium. 2006. Bonfils, A.-C.; Gamache, I., editors. Natural Resources Canada, Canadian Forest Service, Headquarters, Science and Programs Branch, Ottawa. 80 p.

To purchase or download, visit:
http://bookstore.cfs.nrcan.gc.ca/detail_e.php?recid=12585678

Seed source selection and deployment to address adaptation to future climates for interior spruce in western Canada.
Yanchuk, A.D. and G.A. O'Neill. 2006. Seed source selection and deployment to address adaptation to future climates for interior spruce in western Canada. Final report to the Climate Change Impacts and Adaptation Directorate Project A644. Victoria, BC. Research Branch, BC Ministry of Forests and Range. pp. 1–8. Climate change is already significantly affecting the health and productivity of Canada's forests. Planted forests that are adapted to today's climate will be maladapted when they are harvested in 60–80 years. However, if seed lots for reforestation are selected so as to maximize their adaptation over the duration of their rotation, productivity of Canada's forests could be enhanced by capitalizing on increased future temperatures. To ensure that the most economically important tree crop planted in Canada – interior spruce (white and Engelmann spruce and their hybrids) – is adapted to future climates, forest scientists from western North America have initiated a long-term project that will act as a cornerstone to the genetic resource management of interior spruce in western North America, and as a model for other species and regions. This innovative project will capitalize on advances in climate modelling, geographic information systems and ecological modelling to provide tools that will help maintain the health and productivity of Canada's forests in a changing climate.

http://www.for.gov.bc.ca/hre/pubs/pubs/1403.htm

Is an Unprecedented Dothistroma Needle Blight Epidemic Related to Climate Change?
Alex Woods, K. David Coates, and Andreas Hamann, Bioscience, September 2005, Vol. 55 No. 9.

Dothistroma needle blight caused by the fungus *Dothistroma septosporum* is a major pest of pine plantations in the southern hemisphere, where both the host and the pathogen have been introduced. In northern temperate forests where the pest and host trees are native, damage levels have historically been low, however, Dothistroma is currently causing extensive defoliation and mortality in plantations of lodgepole pine in northwest British Columbia, Canada. The severity of the disease is such that mature lodgepole pine trees in the area are succumbing, which is an unprecedented occurrence. This raises the question whether climate change might be responsible by surpassing an environmental threshold that has previously restricted the development of a pathogen in temperate regions. Establishing a causal relationship between climate change and local biological trends is usually difficult, but we found a clear mechanistic relationship between an observed climate trend and the host:pathogen interaction. A local increase in summer precipitation, not climate warming, appears to be responsible.

Editorial Bioscience, Vol 55 No. 9
http://www.aibs.org/bioscience-editorials/editorial_2005_09.html

The article is available as a pdf download at
http://www.rr.ualberta.ca/People/Hamann/climate/PDF-Documents/Woods_et_al_2005.pdf

Tree Planter's Notes are Back!

Tree Planter's Notes had a hiatus from 2000–2005, however, Issue 51 (1) published 2005, and 50 (1) published 2003, are now available and being sent to anyone who receives the Forest Nursery Notes. You, too, may receive complimentary copies of TPN for the next year or two (and a no-cost subscription to Forest Nursery Notes) by contacting:

Forest Nursery Notes
JH Stone Nursery
2606 Old Stage Road
Central Point, OR 97502-1300
FAX: 541.858.6110
E-mail: nurseries2@aol.com

Electronic versions of both current and past TPN issues are posted on the web at
http://www.rngr.net/Publications/tpn/index_html?volno=on

Recent Meeting Information

Canadian Tree Improvement Association (CTIA) meeting was held July 24–29, 2006 in Charlottetown, PEI. Meeting information, speaker bios, agendas, and affiliated IUFRO Tree Seed Symposium, Wood Quality Working Group, Tree Seed Working Group information can be found at this site. The CTIA 2004 Proceedings are also posted at this site.

http://www.gov.ns.ca/natr/forestry/ctia

Don Carson Retires

submitted by Alvin Yanchuk

We'll miss his experience, knowledge of horticulture and the stations, his positive contributions to tree improvement in BC, but most of all his positive outlook on everything.

Don Carson retired at the end of July this year, after a long and productive 30+ years with the British Columbia Forest Service.

Don started his career in Prince George at the Tree Improvement Station (PGTIS) in 1974, and moved to the coast to the Koksilah Nursery in 1978. He then transferred to Cowichan Lake Research Station (CLRS) in 1980.

Since 1982 he has been the station superintendent at CLRS, and in 2001, Don became manager of all Research Branch Research Stations. We'll miss his experience, knowledge of horticulture and the stations, his positive contributions to tree improvement in BC, but most of all his positive outlook on everything.

Clare and Character

submitted by Roger Painter

When you think of Clare Hewson you think of the word character.

Clare was certainly a character but behind that was a person who cared deeply about our resource and the tree improvement industry and the people he worked with.

Character. When you think of Clare Hewson you think of the word character. Now many people's image of him is as he appears in this picture – the long-haired prospector always ready to spin a yarn or give you his take on the best place to find gold. Clare was certainly a character, but behind that was a person who cared deeply about our resource, the tree improvement industry and the people he worked with.

Clare graduated from UBC in 1967 and worked for both the Alberta and Canadian Forest Services before joining the BC Forest Service in 1970. He became a Registered Professional Forester in 1973, about the time he started working on seed orchards in Prince George. We can certainly credit him for being the driving force behind developing and implementing a Tree Improvement Seed Orchard program for the North Central Interior of BC. He worked diligently there until 1985 when he moved to Vernon and the Kalamalka Forestry Centre to become projects forester. Clare spent the rest of his career at Kalamalka, working on numerous Seed Orchard and tree improvement

related projects that included developing techniques to improve efficiency of managing seed orchards, establishing plantations to demonstrate the value of seed orchard seed and tree improvement, and establishing progeny tests and realized gain trials. He retired in 2000 after a very successful career and I don't think you will find anyone who will challenge the legacy he has left behind. His contributions have been invaluable.

On the surface, this was Clare at work. However, his personal side and some of his other work-related activities are far from public. He loved the outdoors and of course he was always looking for gold at the end of the rainbow – that lost bonanza that all prospectors hope to find. This in some ways defined Clare's personality. In all his pursuits, he was always optimistic and happy-go-lucky. Well almost always. Clare was not afraid to express his opinions, whenever the opportunity arose, on topics he felt strongly about, particularly related to forestry and other environmentally related areas. Usually that opportunity came to the chagrin or edification of a visiting Victoria dignitary who thought all they were going to get was a tour of Kalamalka. He always had a unique point of view and the said dignitary usually found out very clearly what that was. Clare had a special place for "Victoria" in his heart, everything from comments on faceless bureaucrats and paperwork and reports to comments on "if something needs to be done it is best to do it first and then ask Victoria for its consent." And although we faceless Victoria people may bristle, it was hard to take umbrage at someone who could say all these things with a smile on his face.

Clare also had a good sense of his place in this world and in our industry. While many of us look at progressing ever upwards through our careers, Clare was not always convinced that this was where he wanted to be. When he was asked to take on the administrative role for the former Section 88 program in the north, which came with a good promotion, he refused. Clare did not want to become a manager or bureaucrat, as it would take him away from the field work he loved. That strength of courage to recognize his niche was an endearing part of his personality/character which allowed him to be "Clare" and no one else. This culminated in his moving to Kalamalka to take on the work where he felt he could have the greatest impact and did. At the end of his career, Clare Hewson was the only person left in the Forest Service who has the title "forester" in his job description. And for those of us who knew him well, we remember him for the way he faced his final challenge. Character? Clare? Yes, Clare had plenty of character.

Clare was not afraid to express his opinions, whenever the opportunity arose, on topics he felt strongly about, particularly related to forestry and other environmentally related areas.

Clare also had a good sense of his place in this world and in our industry.

That strength of courage to recognize his niche was an endearing part of his personality/character which allowed him to be "Clare" and no one else.

A memorial was established at Kalamalka Seed Orchards in Vernon to honour Clare Hewson. Clare's memorial includes an Engelmann spruce tree, which is dedicated to him "In recognition of his many contributions to tree improvement in British Columbia," and a gold pan.

Chris Walsh, manager of Kalamalka Seed Orchards and Sherry La Valley, Clare's partner, at the dedication ceremony, November 3, 2006.

FGC Achievement Award Presented to Shane Browne-Clayton

submitted by Jack Woods

On April 16, 2006, more than 50 of Shane's colleagues and friends met to honour his considerable contributions and the presentation of the FGC Achievement Award.

The Forest Genetics Council of BC honoured Shane Browne-Clayton for his years of contribution to forest genetics and tree improvement in British Columbia. During his tenure with Riverside Forest Products, Shane played a key leadership role, representing industry in policy and planning activities over a period of some 15 years. Initially involved with the Interior Technical Planning Committee, Shane was involved with seed orchard planning and developments in the Southern Interior, including responsibility for all Riverside Forest Products orchard developments and tree improvement involvement. In 1997, Shane took on the role of Industry Co-Chair of the FGC, a role he held until his retirement in 2005.

On April 16, 2006, more than 50 of Shane's colleagues and friends met to honour his considerable contributions and the presentation of the FGC Achievement Award. We wish Shane all the best for a long and fulfilling retirement.

Provincial Chief Forester Jim Snetsinger presents the FGC Achievement Award to Shane in Kelowna.

In Memory of Jordan (Jordy) Tanz – 1953 to 2006

submitted by Jack Woods

On March 20th, 2006, Jordan Tanz, known to all of us as Jordy, passed away suddenly. Jordy is survived by his wife Petra, and children, Jeff and Katie.

Jordy was the consummate professional – always skilled, always ready, and always producing quality work. From 1996 to 2004 Jordy held the role of Executive Secretariat to the Forest Genetics Council of BC. He made important contributions to the reorganization of Council during the 1996 to 1998 period, when the current era of strategic and business planning started. Jordy's skills at facilitating meetings and moving groups to solutions were instrumental in Council's successfully developing the planning framework that largely exists today.

Jordy will be missed as a colleague and a friend. A wonderful tribute to Jordy is found on the Cortex website at http://www.cortex.ca/teatan.html.

Upcoming Events

A Whitebark Pine Workshop is planned for spring/summer 2007 to connect folks working on Whitebark Pine in BC and surrounding areas. If you would like to participate in the workshop, or have a presentation that you would like to give, please contact:

Dave.Kolotelo@gov.bc.ca 604.541.1683 ext 228 for presentations
Diane.L.Douglas@gov.bc.ca 250.356.6721 for participation

Contributors

Brian Barber, RPF
Deputy Director, and Manager, Policy, Planning & Climate Change
Tree Improvement Branch
722 Johnson St., PO Box 9518 Stn Prov Govt
Victoria, BC V8W 9C2
Phone: 250.356.0888
Fax: 250.356.8124
Brian.Barber@gov.bc.ca

Vicky Berger
Kalamalka Forestry Centre
BCMoFR Research Branch
3401 Reservoir Road
Vernon, B.C. V1B 2C7
Ph: 250 260-4758
Fax: 250 542-2230
Vicky.Berger@.gov.bc.ca

Mike Carlson, RPF
Forest Genetics and Tree Breeding
BCMoFR Research Branch
Kalamalka Forestry Centre
3401 Reservoir Rd.
Vernon, BC V1B 2C7
Phone: 250.260.4767
Fax: 250.542.2230
Michael.Carlson@gov.bc.ca

Don Carson
don_carson@shaw.ca

Jim Corrigan
Interior Seed & Cone Pest Management Biologist
Kalamalka Seed Orchards
BCMoFR Tree Improvement Branch
Vernon, BC
Phone: 250.549.5696
Fax: 250.542.2230
Jim.Corrigan@gov.bc.ca

Diane Douglas, P. Ag.
Extension and Communications
BCMoFR Tree Improvement Branch
2nd Floor, 722 Johnson St.
Victoria, BC V8W 9C2
Phone: 250.356.6721
Diane.L.Douglas@gov.bc.ca

Gary Giampa
Kalamalka Forestry Centre
3401 Reservoir Rd.
Vernon, BC V1B 2E2
Phone: 250.549.5576
Gary.Giampa@gov.bc.ca

Dave Kolotelo, RPF
Cone and Seed Improvement Officer
BCMoFR Tree Seed Centre
Tree Improvement Branch
Surrey, BC V4P 1M5
Phone: 604.541.1683 Ext. 228
Dave.Kolotelo@.gov.bc.ca

Al McDonald, P. Ag.
BC Timber Sales Headquarters
4th Floor, 727 Fisgard St.
Victoria, BC V8W 9C2
Phone: 250.387.8945
Fax: 250.356.6209
Allan.Mcdonald@gov.bc.ca

Roger Painter
Tree Improvement Co-ordinator
BCMoFR Tree Improvement Branch
2nd Floor, 722 Johnson St.
Victoria BC V8W 9C2
Phone: 250.356.9276
Roger.Painter@gov.bc.ca

John Parminter, RPF
Research Ecologist
BCMoFR Research Branch
PO Box 9519 Stn Prov Govt
Victoria, BC V8W 9C2
Phone: 250.356.6810
Fax: 250.387.0046
John.Parminter@gov.bc.ca

Don Pigott
Yellow Point Propagation Ltd
Box 669
Ladysmith, BC V9G 1A5
Phone: 250.245.4635
Fax: 250.245.5935
ypprop@shaw.ca

John Russell, RPF
Cowichan Lake Research Station
BCMoFR Research Branch
7060 Forestry Rd
Mesachie Lake, BC V0R 2N0
Phone: 250.749.6811 ext 26
John.Russell@gov.bc.ca

Ward Strong, PhD
Research Scientist, Cone and Seed Pests
BCMoFR Research Branch
Kalamalka Forestry Centre
3401 Reservoir Rd
Vernon, BC V1B 2C7
Phone: 250.260.4763
Fax: 250.542.2230
Ward.Strong@gov.bc.ca

Chris Walsh
Seed Orchard Manager
BCMoFR Research Branch
Kalamalka Seed Orchards
3401 Reservoir Road
Vernon, BC V1B 2C7
Phone: 250.260.4777

Tongli Wang
Department of Forest Sciences
University of British Columbia
3041 – 2424 Main Mall
Vancouver, BC V6T 1Z4
Phone: 604.822.1845
Tongli.Wang@ubc.ca
Homepage: http://genetics.forestry.ubc.ca/twang/

Jack Woods, RPF
Program Manager
Forest Genetics Council of BC
3370 Drinkwater Road
Duncan, BC V9L 5Z2
Phone: 250.748.9579
Cell: 250.715.6285
Fax: 250.748.0949
jwoods.fgc@shaw.ca
http://www.fgcouncil.bc.ca

Susan Zedel, P. Ag.
SPAR Project Leader/
Seed Information Systems Officer
BCMoFR Tree Improvement Branch
Victoria, BC
Phone: 250.356.1598
Fax: 250.356.8124
SPAR Info: http://www.for.gov.bc.ca/hti/spar
Susan.Zedel@gov.bc.ca

TIC*talk* Availability

TIC*talk* is available in electronic format at http://www.fgcouncil.bc.ca/new-tict.html.

For more information, contact:

Diane Douglas, BCMoFR Tree Improvement Branch
Tel: 250.356.6721 Fax: 250.356.8124
Email: Diane.L.Douglas@gov.bc.ca