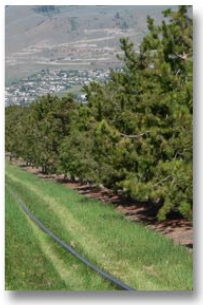
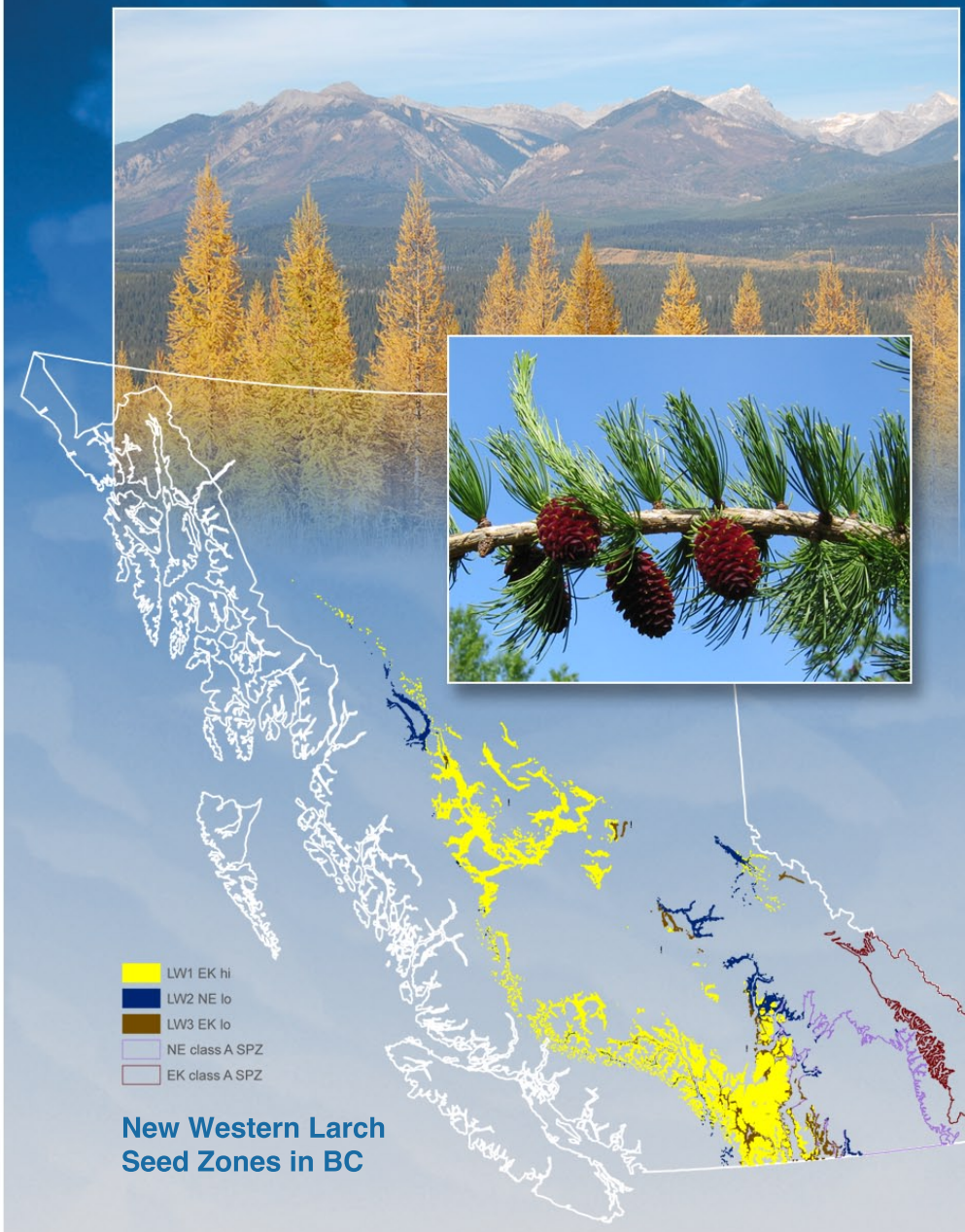


FGC Forest Genetics Council of British Columbia

ANNUAL REPORT 2011/2012



New Western Larch Seed Zones in BC

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Cover graphic:
Male and female parental contributions to a seedlot from a western larch seed orchard

The cover figure depicts new interim climate-based seed transfer standards for western larch (Larix occidentalis). Long-term field research led by the Ministry of Forests Lands and Natural Resource Operations (FLNRO) shows that seed sources from specific geographic locations grow well in some ecosystems where western larch does not occur naturally. Provenance test results and climate modeling, in combination with field-trial verification, support the development of the new seed transfer standards which allow limited planting of appropriate seed sources in some ecosystems outside the species natural distribution. This figure illustrates where sources from the East Kootenay and Nelson seed planning zones can now be planted. Photos show a western larch plantation north of its natural range near Golden, BC and a developing larch cone. This work is being led by Barry Jaquish from the FLNRO Tree Improvement Branch. Map produced by Matt Leroy (Tree Improvement Branch). Larch Photo credits Barry Jaquish and Chris Walsh (Tree Improvement Branch); graphic design Rich Rawling (Cortex Consultants Inc.).

Overview and acknowledgements

JACK WOODS,
Program Manager,
Forest Genetics
Council of BC

This 11th consecutive FGC Annual Report presents provincial-level performance indicators for the 2011/12 fiscal year and financial summaries for spending under the Land Based Investment Strategy (LBIS) Tree Improvement Program. Further details are available in the FGC Business Plan for 2011/12, and the Tree Improvement Program Projects Report for 2011/12.

The 2011/12 fiscal year saw continued increases in provincial sowing in response to the mountain pine beetle epidemic and a slow recovery of wood markets. The use of orchard seed rose to 146 million seedlings from the previous high of 140 million in 2011. Continued orchard upgrades using new parent tree selections from breeding programs are supporting increases in seedlots average genetic worth for growth, with a highest-ever provincial average of 16.7% achieved in the 2012 sowing year. 2011/12 also saw a breakthrough in the lodgepole pine seed set issue, with new information guiding orchard managers to begin cone harvest earlier to avoid late-season losses of filled seed.

The ongoing stability of the provincial program led by the FGC, under the leadership of co-chairs Brian Barber (FLNRO) and Kerry McGourlick (Western Forest Products Inc.), continues to support integrated technical and business planning for the full range of genetic resource management activities in BC. All involved are thanked for their support and work during the year; in particular Interior and Coast TAC chairs Tim Lee and Annette van Niejenhuis, Genetic Conservation TAC chair Dave Kolotelo, Pest Management TAC chair Jim Corrigan, Extension TAC chair Diane Douglas, Seed Transfer TAC chair, Lee Charleson, and Decision Support TAC chair, Guy Burdikin.

Outgoing Provincial Chief Forester Jim Snetsinger and Susanna Laaksonen-Craig, Executive Leader, Forest Sector Initiatives, are also thanked for their ongoing support and guidance.

Photos: Jack Woods

Dave Peterson,
Chief Forester,
BC Ministry of Forests
Lands and Natural
Resource Operations

Tom Ethier,
Assistant Deputy Minister,
Resource Stewardship
Division, BC Ministry of
Forests Lands and Natural
Resource Operations

Message from the Ministry of Forests Lands and Natural Resource Operations

We are pleased to participate in the 11th consecutive annual report of the Forest Genetics Council of BC. Under a new organization structure within the Ministry of Forests, Lands, and Natural Resource Operations (FLNRO), we share joint responsibility for overseeing the provincial genetic resource management program.

Being new to this program, we are impressed with its long history of collaboration among people from FLNRO, licensees, universities, and the Canadian Forest Service. We also recognize its success is attributed to clear and measureable objectives, a well-organized business planning framework, and the support and contributions of many participants.

We are pleased to see the progress made in advancing Council's objectives for enhancing the value, resilience and conservation of our forest genetic resources. The key performance measures reported in this document show an impressive level of commitment on behalf of all involved. The increasing use of select seed adds value to provincial forests in both the short- and long-term. Advancing climate-based seed transfer and genetic conservation demonstrates that the program seeks to balance economic and environmental values. This balance will ensure that BC's future forests remain genetically diverse and resilient, as well as productive. We also note that the success of this program and the message from Council to the Special Committee on Mid-Term Timber Supply was well received and has raised the profile of the provincial tree improvement program.

We thank the Forest Genetics Council for their contributions. We encourage you to continue working together to find new and more efficient ways to advance our goals and objectives. We will also do our best to support these efforts.

On behalf of the FLNRO, we would like to thank Council members, affiliated members on the technical advisory committees reporting to Council, and the many others who contribute to this important provincial program.

Lodgepole pine regeneration in the west Chilcotin near Miner Lake. *(J. Woods photo)*

Message from Forest Genetics Council Co-Chairs

BRIAN BARBER and KERRY McGOURLICK,
Co-Chairs,
Forest Genetics
Council of BC

In 2011/12, we once again saw the use and average genetic gain of select seed increase in support of FGC's long-term objectives. The FGC's programs remain the most significant contributor to government's performance measure for incremental silviculture investments.

These gains are remarkable considering that they happened during a high sowing year (253 million seedlings) and following a low orchard production year. This indicates there are now more stable supplies of select seed in storage for many species and areas. We are, however, still challenged to meet the demands for lodgepole pine and for Douglas-fir seed in some zones.

We were pleased to receive good news on the lodgepole pine seed-set issue after many years. Projects supported through the Pest Management TAC and the Operational Tree Improvement Program showed that seed losses occur at or close to the time of seed maturity. Early harvest of cones may allow avoidance of many of these losses. We hope application of this knowledge will improve seed yields in the 2012 crop. We also look forward to the results from new studies directed at understanding the specific causes of seed loss.

A strength of the FGC over the years has been the transparent and open processes that stakeholders participate in to guide genetic resource management in BC. In 2011-12, Council updated its bylaws to ensure they align with stakeholders' and FLNRO's expectations, and provide the basis for a fair and open system of cooperation and business planning. The new bylaws are available on the FGC website.

Land Based Investment Strategy funding remains critical to the delivery and success of our program. While provincial government and stakeholder support of FGC's tree improvement program remained strong in 2011/12, resourcing tree breeding and genecology research represents a challenge. These long-term endeavors require well-trained and experienced people. It can take many years of practical experience to fully develop the skills needed to advance these programs. Therefore, we are concerned that retirements and staffing constraints could have a significant impact on these programs, including the development of new climate-based seed transfer standards.

We would like to thank all those who have contributed to FGC's goals and activities over the past year; in particular those who participate on Council and its technical committees. These people are key to the continued operation and advancement of this important cooperative program.

We encourage readers of this annual report to also review the 2011/12 FGC Tree Improvement Program Project Report for further information and details about FGC projects and people.

The FGC Annual Report presents provincial-level performance indicators for genetic resource management.

1.0 Introduction

This Annual Report presents provincial-level performance indicators outlined in the FGC Strategic Plan for 2009 to 2014. It also summarizes outcomes from projects funded through the Land Based Investment Strategy (LBIS) Tree Improvement Program. These projects are outlined in the Forest Genetics Council of BC (FGC) Business Plan for 2011/12. Performance indicators reported here represent results from both LBIS investments and the investment of other cooperators.

1.1 Tree improvement and forest genetic resource management in British Columbia

Tree improvement and forest genetic resource management (GRM) includes increasing value through tree breeding and seed production, conservation of the genetic diversity of indigenous forest tree species, and enhancing forest resilience through scientifically-based seed transfer standards and the maintenance of genetic diversity. Support activities including research, extension, and records management also advance provincial GRM initiatives.

1.2 About the Forest Genetics Council of British Columbia

The Forest Genetics Council is a multi-stakeholder group representing agencies and companies who are stakeholders in managing and conserving the genetic resource of indigenous tree species.

The FGC is a multi-stakeholder group representing government agencies (Ministry of Forests Lands and Natural Resource Operations -FLNRO), the forest industry, universities, the Canadian Forest Service, and small private companies. The mandate of the FGC is to champion forest GRM, to oversee strategic and business planning for a cooperative provincial GRM program, and to advise the provincial Chief Forester on GRM policies.

The FGC leads program development and business planning for provincial investments through the LBIS, and seeks efficiencies for all investments, including those by industry and university cooperators.

1.3 FGC vision and objectives

Council set the following vision statement and objectives in its five-year Strategic Plan (2009-2014), and annually develops a Business Plan outlining activities to meet these objectives.[1]

[1] For more information on the Forest Genetics Council, see *http://www.fgcouncil.ca*.

Vision

BC's forest genetic resources are diverse, resilient, and managed to provide multiple values for the benefit of present and future generations.

Objectives

- *Increase the average volume gain of select seed used for Crown land reforestation to 20% by the year 2020*
- *Increase select seed use to 75% of the provincial total sown by 2014*
- *Adequately conserve the genetic diversity of key populations of all forest tree species native to BC by 2015, through a combination of in situ, ex situ, and inter situ conservation*
- *By 2020, high-quality genecology research information will guide operationally efficient climate-based seed transfer policy and practice for all trees planted in BC*
- *Coordinate stakeholder activities and secure the resources needed to meet Business Plan priorities*
- *Monitor and report progress in genetic resource management activities*

Retirements during 2011/12

Greg Pieper

Seed orchard manager with Tolko Ltd. at the Eagle Rock site near Armstrong from 1984 to 2011.

This interior spruce orchard produces seed for the TO zone and is operated by Tolko Ltd in partnership with SelectSeed Ltd. It was established under the supervision of Greg Pieper. *(J. Woods photo)*

2.0 Budget and Expenditures

Land Based Investment Strategy Tree Improvement Program allocations and expenditures for the 2011/12 fiscal year are shown in Table 1. The table does not include in-kind costs, staff salaries, and other substantial inputs by industry, FLNRO, and university cooperators that contribute to the success of GRM activities in BC.

Table 1
Summary of Forest Investment Account Tree Improvement program budgets and expenditures for the period April 1, 2011 through March 31, 2012 ($ x 1000).

Subprogram	Budget ($)	Expenditures ($)
Genetic Conservation	205	215
Tree Breeding	1,156	1156
Operational Tree Improvement Program (OTIP)	765	589
Extension and Communication	20	15
Genetic Resource Decision Support	60	26
Cone and Seed Pest Management	130	107
SelectSeed Ltd. orchards and FGC program management	543	543*
Genecology and Seed Transfer	620	619
Applied Tree Imp. and Biotechnology (UBC)	137	137
Administration	30	7
Risk managed (reallocations from under-spent projects)	-166	
Total	**3,500**	**3,414**

* SelectSeed allocation shown. Total SelectSeed expenditures were $877,387 with the difference supported through seed sale revenue and investment income.

Overall spending was within 3% of budget, and 50% of the programs were within 10% of their allocation. As 2011 was a low cone-production year in all provincial orchards, many OTIP projects for operational cone and seed pest management were not carried out. Funds allocated were not spent and remained with the FLNRO. An anticipated project under the Genetic Resource Decision Support subprogram did not proceed as expected. Most planned work was completed, however, with projects led by the FLNRO in tree breeding and genecology progressing smoothly due to improved circumstances for contract management relative to the previous year.

3.0 Performance Indicators

Progress towards objectives set out in the FGC Strategic Plan for the period 2009-2014 (summarized above) are measured and reported annually. Two of these objectives are to increase select seed use to 75% and increase the average genetic worth (GWg[2]) of class A select seed to 20%. Province-wide performance on these objectives has been measured and reported since 2000 and is shown below.

3.1 Increase seedlot genetic worth

Objective

Increase the average volume gain of select seed used for Crown land reforestation to 20% by the year 2020.

Performance

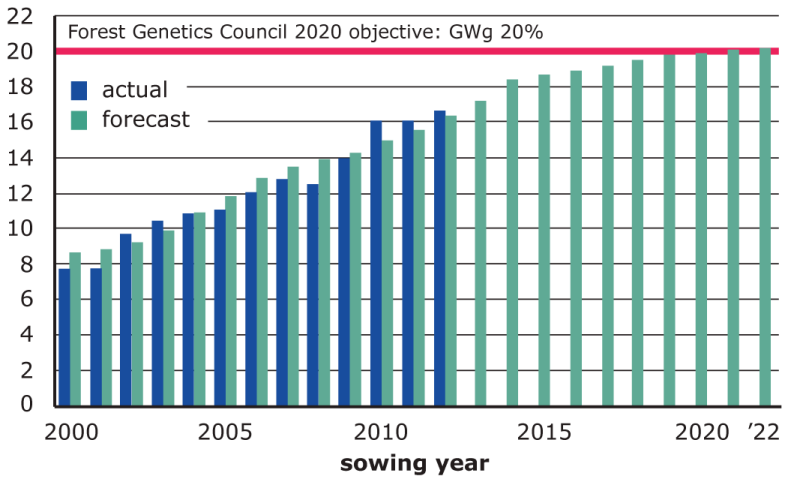


Figure 1
Annual actual and forecast average genetic worth for stem-volume growth (GWg) of select seed sown in BC.

Genetic worth for growth (GWg) increased to an average of 16.7% in the 2012 sowing year (Figure 1). The gain is largely due to increased sowing of interior spruce, a species with large supplies of high-gain seed for many seed planning units. In addition, more of the class A[3] lodgepole pine sown came from higher-gain sources, even though the overall use of lodgepole pine class A seed went down, year over year (Figure 4). Orchard upgrades, supported in part by the OTIP subprogram and using material identified in provincial breeding programs, are successfully supporting genetic gain increases.

[2] Genetic worth is a measure of rotation-age gain in a specific trait, relative to non-selected wild seed. Genetic worth for growth (GWg) is a measure of stand-based gains in wood volume expressed as a percentage.

[3] Class A seed is produced in seed orchards.

3.2 Increase select seed use

Objective

Increase select seed use to 75% of the provincial total sown by 2014.

Performance

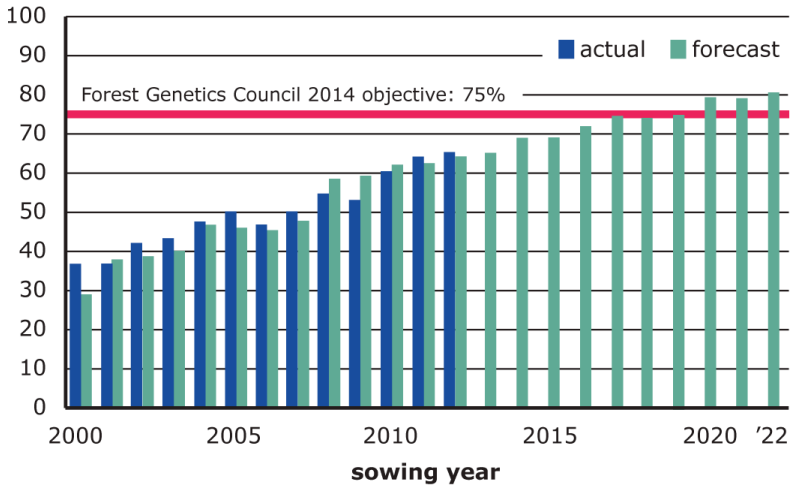


Figure 2
Actual and species-plan forecasts of select-seed use as a percentage of total provincial seed use, by year.

Select seed use as a percentage of total sowing increased slightly to 65.5%. While the lift over the previous year is relatively small, this increase was achieved despite low 2011 orchard crops (see figures 5 and 6) and increases in overall provincial sowing (Crown and private lands) to 253 million; the largest sowing year since 2007.

This increase is due primarily to increased sowing of interior spruce and coastal Douglas-fir. Class A lodgepole pine use dropped from the 2011 sowing year due to lower orchard crops of this species in 2011 relative to 2010. Figures 3 and 4 provide a breakdown of annual sowing by species and genetic class.

Provincially, the overall use of orchard seed (class A) jumped to a new high of 143 million trees, eclipsing the previous high set in 2011. The upward trend in GWg and the overall use of orchard seed are led by increasing production from higher-gain lodgepole pine seed orchards, as well as the ongoing high-gain seed use for interior spruce, western larch, and coastal Douglas-fir. High-gain seedlots of interior Douglas-fir are also beginning to have an impact, but production of this species has been held back by several poor cone-production years. A recent breakthrough in the management of lodgepole pine orchards to obtain higher seed yields from cone crops (more filled seeds per cone) may result in further increases in seed production in the 2012 production year, and beyond. Production of this species, however, remains the primary barrier to meeting provincial objectives.

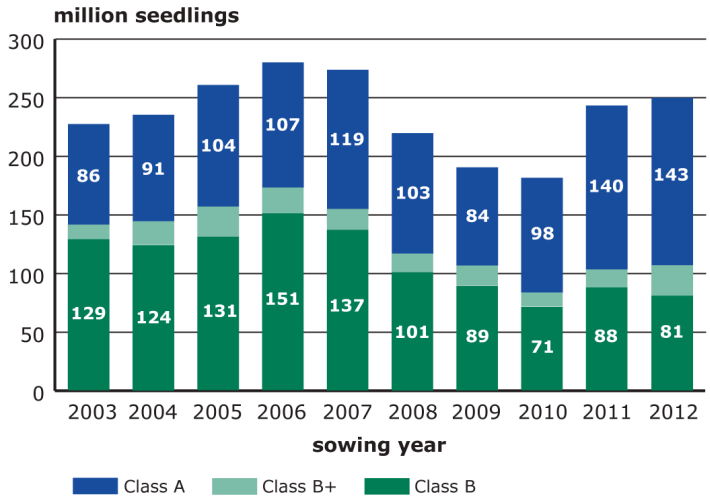


Figure 3
Provincial sowing of orchard (class A), wild-stand (class B), and superior provenance seed (class B+) from 2003 to 2012.

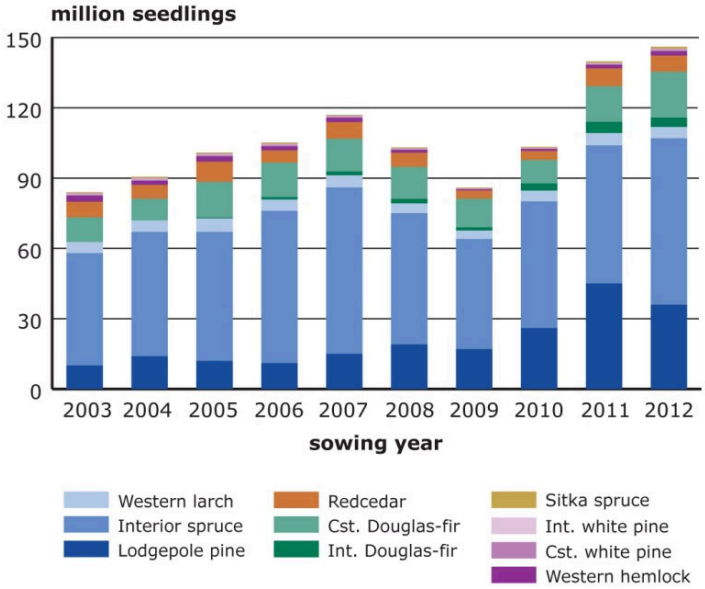


Figure 4
Provincial sowing of orchard seed (class A) by species from 2003 to 2012.

Sorrento Nurseries Ltd. produced this crop of high genetic worth Douglas-fir seedlings for planting in the Nelson seed zone.
(J. Woods photo)

Feature:

Coastal Douglas-fir breeding; BC's oldest program

Forest genetics research in BC started in about 1956 under the leadership of Dr. Alan Orr-Ewing, a scientist with the Research Branch of the BC Forest Service. Working at the Cowichan Lake Research Station on southern Vancouver Island, Dr. Orr-Ewing began his studies with coastal Douglas-fir. His early work focused on attempts to create hybrid vigour by cross-breeding trees from very different parts of the species range. He also began experiments with inbreeding. Although this early work was not continued in the long-term breeding strategy, Dr. Orr-Ewing demonstrated the benefits of selecting trees based on stem and branch form and on growth rate. This led to plus tree selections in natural stands by forest companies and the BC Forest Service and ultimately to a cooperative province-wide approach to tree improvement and forest genetics. Over 50 years later this cooperative approach continues to thrive as the Forest Genetics Council of BC.

For many years, Douglas-fir was the principle commercial species on the west coast of North America. Tree breeding programs were also started in the United States, leading to cooperative work with the BC program and substantial research collaboration. There was also interest from several European countries and New Zealand, and a rich period of investigation and exchange of material and knowledge ensued. Through the 1960's, substantial work was undertaken by cooperators to find and propagate the straightest and fastest-growing trees for breeding and seed production.

In the early 1970's, a new breeding approach started under the leadership of Chris Heaman. Working with Bob Hattie, many controlled crosses were undertaken and field trial establishment began on a large scale, with about 100 sites planted over a period of 10 years. This work set a solid basis for the selection of parent trees and for seed orchard development by forest companies and the BC Forest Service. The work also led to today's recurrent breeding and selection program that produces selected parent trees for seed production in orchards. Genetic realized-gain trials and other research have also established protocols for quantifying stand-yield gains from the use of orchard seed.

Beginning in the 1990's, Jack Woods led the development of a second-generation breeding strategy that took the best performing parent trees from all progeny trials and brought them together in a mating and testing strategy that would lead to further selections for orchards and a third round of breeding. Orchard production increased and newer orchards began to incorporate 2nd generation selections. This work was taken over by Dr. Michael Stoehr who, working with Keith Bird, advanced progeny testing, selections and breeding to a third generation. Today, orchards are beginning to incorporate high-gain third-generation selected trees and virtually all of the seed used for reforestation comes from advanced-generation seed orchards.

Photos – Top: Dr. Alan Orr-Ewing: The founder of forest genetics and tree improvement programs in British Columbia. *(FLNRO archives)* **Middle:** A fast growing tree in a coastal Douglas-fir progeny test. *(J. Woods photo).* **Bottom:** Controlled mating underway at the Cowichan Lake Research Station. *(J. Woods photo)*

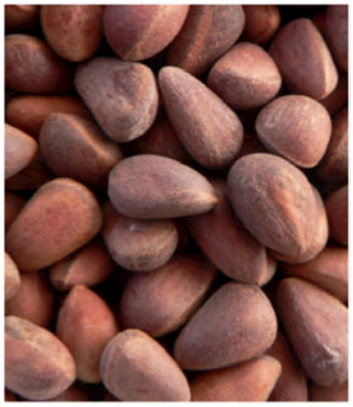
3.3 Adequately conserve genetic diversity

Objective

Adequately conserve the genetic diversity of key populations of all forest tree species native to BC by 2015, through a combination of *in situ*, *ex situ*, and *inter situ* conservation

Performance

During the period of this report, the Genetic Conservation Technical Advisory Committee developed a new genetic conservation plan to guide efforts and investment. The plan reduces the number of indigenous tree species to be considered for conservation purposes from 49 to 41, based on a new definition of what constitutes a tree species. Three broad activities are emphasized; understanding issues and needs through research and knowledge acquisition, applying this knowledge, and measuring progress and conservation status. This plan will be updated in 2014, in conjunction with updates of the FGC 5-year strategic plan. There will continue to be a subdivision of effort between FLNRO staff and the Center for Forest Conservation Genetics (CFCG) at the University of British Columbia.



Whitebark pine seed.
(J. Woods photo)

During the period of this report a number of projects undertaken by the CFCG were completed. Climate modeling, partially supported by FGC funding, advanced with improved methods for consensus projections of BC ecosystems under a range of climate-change scenarios. This modeling identifies where climate-change-caused ecosystem shifts are most probable, and where potential losses to the genetic diversity of tree species are most likely to be felt. A PhD project evaluating the responses of whitebark pine and lodgepole pine to climate change was completed. A legacy of this project is a set of long-term field trials of whitebark pine stretching from southern BC to Alaska. The hybridization patterns of white, Englemann, and Sitka spruce were also investigated using new genomics techniques. Two PhD projects were completed as part of this work and have added substantially to knowledge on the geographic patterns of hybridization and on the impacts of tree breeding programs on the management of these species.

Conservation work within the FLNRO included continued maintenance of about 8500 seed collections from 33 tree species at the Provincial Tree Seed Center (TSC) for conservation purposes. During 2011, 282 collections from six species were added to the collection. Work also progressed at the TSC on seedlot drying to ensure moisture contents were below 10% for long term freezer storage. Genomics work was started with grand fir and poplar that will aid understanding of the geographic patterns of genetic diversity in support of cataloguing and evaluating the genetic conservation status of these species.

Feature

ClimateBC; modeling climates in BC forest ecosystems

Ecosystems in BC develop primarily in response to climate. Climate is defined using long-term meteorological data such as mean annual temperature, growing season precipitation, and a host of other measured or calculated variables. The problem facing researchers trying to better understand ecosystem and tree growth response to climate is that there are relatively few meteorological stations across BC and there are rarely any long-term data available for specific ecosystem locations. Faced with this problem when beginning to reanalyze components of the Illingworth lodgepole pine provenance trials, Dr. Tongli Wang and Dr. Andreas Hamann, then both working in the UBC Center for Forest Conservation Genetics (CFCG), used existing techniques to interpolate meteorological data to specific provenance and test site locations without weather stations. As their work progressed, they recognized the value of having a user-friendly model available for a broad range of applications, including better understanding climate-change impacts on forest ecosystems.

Initially funded through an NSERC Strategic Grant, the modeling work started by Wang (UBC) and Hamann (now at the University of Alberta) quickly expanded and was refined to become the ClimateBC model. Other researchers contributed to its development, including Dr. Dave Spittlehouse from the FLNRO and Dr. Sally Aitken, UBC professor and CFCG Director. With additional funding support through the FGC and other organizations over a period of some 8 years, the ClimateBC model was improved and refined to provide accurate estimates for a large number of climate variables, including biologically-relevant variables, at any point in BC. These estimates can be derived for past years, and well into the future, and provide the climate database for modeling BC forest ecosystems and tree species range. The now well known "flying BEC zone" maps are one of the applications supported by ClimateBC.

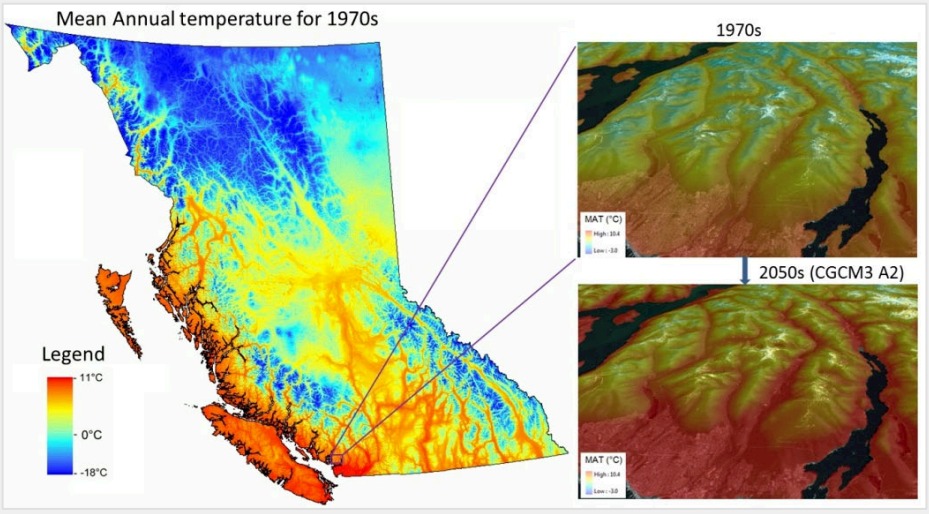
The forecasts of ecosystem change were initially used to predict climate envelopes suitable for populations of native tree species to better understand seed transfer for operational planting. It was also used to assist with genetic conservation cataloguing. The value of the model has since been widely recognized and is used in an increasing number of applications, including forecasting species range changes with climate change, expected future fire risk scenarios, wildlife habitat, and a range of forest management implications. The ClimateBC model, developed with substantial funding through the FGC and the Future Forest Ecosystem Science Council, has now been expanded to include all of western North America (ClimateWNA) and its application is being extended to other parts of the world. More information on the ClimateBC/WNA models are on the CFCG website at http://www.genetics.forestry.ubc.ca/cfcg/climate-models.html

Photos

Top: Dr. Tongli Wang, UBC

Middle: Climate is the primary driver of forest ecosystem geographic patterns in BC. *(J. Woods photo)*

Bottom: Images of modeled changes in mean annual temperature from the 1970's to 2050 using the lower mainland as an example. *(images courtesy of Tongli Wang)*



3.4 Climate-based seed transfer

Objective

By 2020, high-quality genecology[4] research information will guide operationally efficient climate-based seed transfer policy and practice for all trees planted in BC.

Performance

Seed transfer under changing climates is emerging as a priority for genetic resource management activities in BC. To this end, Council approved a substantially increased budget under this objective for the 2011/12 fiscal year.

The maintenance, measurement, and analysis of existing long-term genecology field trials dominated subprogram activities. Further investment in the assisted migration adaption trial (AMAT) was also a priority. An additional 12 test sites were planted for this study, bringing the total number of test plantations established to 37 of a planned 48. Work continues on the development of analysis methods that interpret the genetic adaptation patterns of commercial tree species to climate parameters. This work is key to understanding how existing tree populations will respond to changing climates and how seed transfer adjustments can be made.

An interior spruce genecology trial established on the Skimikin seed orchard site near Salmon Arm, BC. *(J. Woods photo)*

A significant new project called AdapTree was initiated at UBC with funding support of over $1 million per year from Genome Canada. Led by Dr. Sally Aitken at UBC and Dr. Andreas Hamann at the University of Alberta, this project assesses the adaptive portfolio of reforestation stocks under future climates, with the focus on interior spruce and lodgepole pine. Funds through the FGC are leveraged by the AdapTree project to support additional development of the ClimateWNA model (see article on page 12). The AdapTree project has expanded the expertise focused on BC tree species and issues by bringing together local expertise and scientists normally focused on other species.

Development of an administrative system for climate-based seed transfer in BC continues. This important work attempts to develop a policy framework that can accommodate new research information as it comes available and is sensitive to the operational needs of seed orchards and companies with seed inventories and reforestation obligations.

[4] Genecology is the study of the geographic distribution of genetic differences among tree populations.

Feature

From breeding to timber supply: quantifying gain supports investment

Tree improvement is a silviculture investment focused on increasing timber supply and adding value to provincial forest lands. A larger timber supply means more opportunities in the forest sector with the increased benefits of jobs, community stability, and Crown revenues in the form of taxes and stumpage.

Increases in timber supply due to tree improvement are the result of faster-growing and healthier stands of planted trees. Quantifying growth gains from tree improvement involves a complex series of steps that begins with calculating a growth breeding value (BVg) for parent trees tested in tree breeding and selection programs. Using consistent methods developed for BC, tree-breeder estimates of BVg quantify the expected incremental growth of tested parent trees. For example, a stand of trees grown from seed collected from selected trees with an average BVg of 15 would be expected to produce 15% more timber volume at a specific rotation age (usually 60 years) than a stand grown from non-selected wild seed.

Parent tree BVg estimates are then used by seed orchard managers to estimate a genetic worth for growth (GWg) for all seedlots they produce. The GWg is an average BVg of all parent trees in an orchard, weighted by the seed and pollen contribution each parent tree made to a seedlot. Seedlots are registered for use on Crown land and the GWg value associated with each seedlot is recorded. As harvested areas are replanted, the registered numbers of the seedlots used to replant each opening are recorded, along with other information, in a provincial data base.

Estimating incremental stand growth due to the use of high GWg seedlots across the broad range of ecosystems, species, and stand characteristics found in BC requires a link to the highly regarded TASS[1] stand development model and its associated user-friendly growth and yield program, TIPSY[2]. These tools allow foresters to estimate gains in timber growth and yield due to the use of select seed, based on the GWg of seedlots used.

Estimating incremental timber supply across the many stands growing in a geographical area (management unit) is a process of inputting information on stands, including seedlot GWg, in timber supply models. Output from these models provides information on the expected timber supply over long periods of time, and helps managers make decisions on harvest levels and allowable annual cut (AAC) determinations. Such decisions are extremely important to communities and to the forest industry as they establish parameters for the amount of wood that will be available for harvest now and in the future. Connecting the links in the value chain from breeding programs to AAC determinations is a key part of realizing the value from tree improvement programs.

1. *TASS – Tree and Stand Simulator;*
2. *TIPSY – Table Interpolation Program for Stand Yields. Both were developed and are maintained by staff from the Ministry of Forest Lands and Natural Resource Operations.* http://www.for.gov.bc.ca/hre/software/

Photos

Top: Second-growth Douglas-fir logs on southern Vancouver Island *(J. Woods photo)*

Bottom: Second and third growth Douglas-fir on Vancouver Island. *(J. Woods photo)*

3.5 Coordinate stakeholder activities

Objective

Coordinate stakeholder activities and secure the resources needed to meet Business Plan priorities.

Performance

During the period of this report, the FGC led completion of

- An activity plan and associated budget recommendations for the Land Based Investment Strategy Tree Improvement Program for 2012/13
- A published Business Plan and full set of species plans for 2011/12
- A published FGC Annual Report and Projects Report for 2010/11
- New bylaws to guide business processes
- Ongoing management of committee work and collaboration on issues.

Council convened four times during the fiscal year. These meetings, in combination with subcommittee work done under the overall FGC structure, resulted in the efficient coordination of activities among a broad range of stakeholders, including the FLNRO, major licensees, smaller licensees, universities, the Canadian Forest Service, other provincial ministries, and non-licensee private firms. Business planning and final budget recommendations were made for the LBIS Tree Improvement Program and subsequently accepted by the FLNRO. Other activities included final approval of an updated genetic conservation plan and facilitating ongoing activities to ensure collaboration among stakeholders. In addition, Council provided direction to the SelectSeed Ltd. board of directors and oversaw SelectSeed operations and financial reporting.

UBC graduate students and faculty touring a lodgepole pine progeny trial and learning about the pine breeding program from FLNRO research scientist and breeder, Nicholas Ukrainetz. *(J. Woods photo)*

3.6 Monitor and report progress

Objective

Monitor and report progress in genetic resource management activities

Performance

This objective was met through the development and publication of a comprehensive Business Plan for 2011/12 and "species plans" that outline breeding programs, seed orchards, historic seed use and production, and other data relevant to an efficient multi-stakeholder provincial program. Performance indicators for objectives set out in the FGC Strategic Plan are reported in this document. Project level reporting is summarized in the Tree Improvement Project Report for 2011/12.

Table 2
Number of seed orchards and ramets established by site and owner.

Site and owner[5]	Number of seed orchards	Total #of ramets established	Ramets under contract with SelectSeed Ltd.
Vernon Seed orchard Company Ltd. (including Quesnel orchards)	17	29,949	8,567
Kalamalka Seed orchards (FLNRO)	15	20,588	
Skimikin Seed Orchards (FLNRO)	13	18,109	
PRT Growing Services Ltd.	7	11,161	7,779
Kettle River Seed Orchards Ltd.	2	7,850	7,850
TimberWest Forests Ltd.	11	5,703	
Tolko Ltd.	4	4,990	4,990
Sorrento Nurseries Ltd.	2	4,835	4,835
Western Forest Products Inc.	12	3,622	
Saanich Seed Orchards (FLNRO)	5	3,526	
Prince George Tree Improvement Stn. (FLNRO)	3	3,226	
Small private (2 sites)	5	1,981	
Canadian Forest Products Ltd.	4	1,863	
Bowser Seed Orchards (FLNRO)	2	1,122	
Total	102	118,525	34,021

[5] Excludes yellow cedar hedge orchards for rooted cutting production owned by Western Forest Products Inc. and the FLNRO, Cowichan Lake Research Station.

4.0 2011 Orchard Seed Crops

Cone and seed crops in 2011 were generally low for all species, relative to the large crops produced in 2010, with the exception of moderate crops for coastal Douglas-fir and lodgepole pine (Table 3). Lodgepole pine orchards again had acceptable seed set (filled seeds per cone) from most orchards, although seed set issues continue to impact production.

Overall, the total harvest of 428.6 kilograms of seed is sufficient to grow approximately about 38 million seedlings, with the bulk of this being lodgepole pine. Shortfalls in orchard seed from lodgepole pine and interior Douglas-fir continue to limit the use of high-genetic-worth seed in some seed zones. Figure 5 shows orchard seed production by year and species.

Table 3
Summary of 2011 seed crops from all provincial orchards.

Species	Seed produced (kg)	Seedling equivalents (million)
Interior spruce	0	0
Lodgepole pine	161.7	20.2
Western larch	79.1	7.7
Interior Douglas-fir	20.9	0.9
White pine	5.7	0.1
Western redcedar	7.5	2.1
Sitka spruce	0	0
Coastal Douglas-fir	147.9	6.7
Western hemlock	5.8	1.1
Total	428.6	38.7

Healthy first year lodgepole pine cones at the Vernon Seed Orchard Company site.
(J. Woods photo)

Figure 5
Orchard seed production by species and year.