Genetic Conservation Technical Advisory Committee (GCTAC) Strategic Plan 2012-2014

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Prepared by the

Genetic Conservation Technical Advisory Committee

FGC Forest Genetics Council of British Columbia

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EXECUTIVE SUMMARY

This plan was developed by the Genetic Conservation Technical Advisory Committee (GCTAC) at the request of the Forest Genetics Council (FGC). It updates a previous plan approved by Council in 2007. The following are key points and recommendations contained in the body of this plan.

1. **Genetic conservation activities will focus on:**
   - **Measuring** and reporting conservation status,
   - **Understanding** needs, developing scientifically-sound approaches, and adjusting methodology to ensure efficiency and effectiveness, and
   - **Applying** conservation measures.

2. **The following GCTAC mandate is recommended:**
   1. Provide guidance and recommendations to the FGC on genetic conservation issues for indigenous forest trees, including conservation issues associated with climate change and forest health.
   2. Lead the development of genetic conservation research, strategies, and programs.
   3. Provide business planning direction and recommend project budgets to the FGC for GCTAC funded activities.
   4. Review reports submitted for GCTAC funded activities.
   5. Lead the development of genetic conservation measures.

3. **The following working definition of genetic conservation is recommended:**
   The conservation of forest-tree genetic resources is the combination of policies and actions that maintain the genetic diversity of indigenous tree species to provide economic value, environmental services, and biodiversity for the present and future.

4. **The following objective is recommended for the next FGC 5-year Strategic Plan (2015-2020)**
   "Adequately conserve the genetic diversity of representative populations of all forest tree species native to BC by 2015, through a combination of in situ, ex situ, and inter situ conservation"

5. **Definition of tree species**
   The working definition for tree species to be considered in-scope for this plan is modified and results in a reduction to 40 species from 49 in the previous plan (see Appendix 1).

6. **Subdivision of effort**
   Table 2 in Section 8 of this report outlines a subdivision of genetic conservation work among staff within the Tree Improvement Branch of the MFLRNO, the UBC Center for Forest Conservation Genetics (CFCG), and GCTAC members, with collaborations to be developed with other agencies and interested groups.

7. **Resource needs**
   Human and financial resource needs are discussed in section 10. These include Land Base Investment Strategy funding through the FGC of approximately $210,000 per year for the next 5 years.

8. **Significant new project recommended**
   Evaluate policy on the genetic diversity of reforestation materials from a conservation and species adaptation perspective.

1. Introduction

The Forest Genetics Council of BC (FGC) Strategic Plan for 2009-2014 sets a genetic-conservation objective to "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". At the request of the FGC, the Genetic Conservation Technical Advisory Committee of the FGC (GCTAC) prepared this document to set out the technical direction, activities, and resources required to meet this conservation objective.

In 2007, the GCTAC prepared a report (*Indigenous-Tree Genetic Conservation in BC*) that clarified scope, described current activities, and identified resource needs to meet the FGC conservation objective. This strategic plan updates the 2007 document and is considered a "living" document that will guide work and receive periodic updating and adjustment to ensure genetic conservation objectives are met and the most recent scientific procedures are followed. Activities will focus on:

> **measuring** and reporting conservation status,
> **understanding** needs, developing scientifically-sound approaches, and adjusting methodology to ensure efficiency and effectiveness, and
> **applying** conservation measures.

2. GCTAC Mandate

The GCTAC mandate was originally set out in the 2007 plan. The following is recommended as a new GCTAC mandate:

1. Provide guidance and recommendations to the FGC on genetic conservation issues for indigenous forest trees, including conservation issues associated with climate change and forest health.
2. Lead the development of genetic conservation research, strategies, and programs.
3. Provide business planning direction and recommend project budgets to the FGC for GCTAC funded activities.
4. Review reports submitted for GCTAC funded activities.
5. Lead the development of genetic conservation measures.

3. Definition and FGC Strategic Plan objective

3.1 Genetic conservation definition:

The following definition of genetic conservation is recommended.

> ***The conservation of forest-tree genetic resources is the combination of policies, plans and actions that maintain the genetic diversity of tree species to provide economic value, environmental services, and biodiversity for the present and future.***

3.2 Change FGC Strategic Plan objective

The current genetic conservation objective in the FGC Strategic Plan for 2009-2014 refers to "key" populations (see introduction of this report). The word "key" is difficult to define and does not convey an accurate meaning from the context of genetic conservation. The following definition is recommended for subsequent FGC strategic plans:

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

4. Context and linkages

Genetic conservation activities undertaken through FGC-supported activities reside within the context of international, national, and provincial agreements and programs (Table 1). Further, the activities of the FGC and this TAC directly relate to the provincial Great Goal "To lead the world in sustainable environment management, with the best air and water quality and the best fisheries management, bar none". Specific goals that are directly relevant to this plan and GCTAC-led activities are:

Goal 1: Effective action on climate change.

Goal 3: Healthy and diverse native species and ecosystems, and

Goal 5: Sustainable use of British Columbia's environmental resources.

The Forest Genetics Council reports to the Chief Forester who provides overall leadership to the Forest Resource Stewardship division. Key activities at this level that influence the FGC role are developing the Stewardship framework and developing the Cumulative Effects and Management Framework.

Table 1. Policies and actions that influence BC's tree genetic resources.

Acts and agreements	
International • Convention on Biological Diversity • Montreal process Federal • Species at Risk Act • Canadian Biodiversity Strategy	Provincial • Park Act: protects natural resources • Ecological Reserves Act • Protected Areas of British Columbia Act: list ecological reserves, parks and conservancies • Forest and Range Practices Act: landscape and stand level biodiversity objectives required in forest stewardship planning • BC Conservation Framework
Actions	
International • Montreal Process Criteria 1: Conservation of biological diversity, 9 indicators Federal • Habitat Stewardship Program for Species at Risk	Provincial • Protected areas • National Parks • Other Conservation designations (i.e. OGMA's) • BC Conservation Data Centre

5. Scope of activities

5.1 Species

All tree species indigenous to BC that are capable of growing to a height of 10 or more meters, typically with a single stem, are considered in this plan and for genetic conservation investments

under activities organized by the GCTAC. This results in a list of 40 species (see Appendix 1) that are considered "in scope" for genetic conservation investments. This new definition reduces the number of in-scope species from 49 in the previous plan.

5.2 Geographic Area

All public and private lands in British Columbia, on which species listed in Appendix 1 naturally occur, are considered in this plan.

5.3 – Supported Activities

The following types of activities are recommended for investments organized through the FGC and participating agencies or companies:

1. ***In-situ conservation:***
   a) Collect and maintain information to monitor the status of populations of tree species in existing reserves, and
   b) Work with other agencies to identify priorities for additional in-situ conservation.
2. ***Ex- situ*** **conservation:** Develop a comprehensive seed bank with adequate samples of geographically representative populations of species that can be stored successfully in the long term.
3. ***Inter-situ***[1] **conservation:** Set conservation criteria for inter-situ reserves; collect and maintain information on inter-situ populations.
4. ***Research:***
   a) Develop conservation methods and strategies specific to the biology of each species,
   b) Understand levels and patterns of genetic diversity for efficient conservation and restoration,
   c) Predict and monitor the impacts of climate change on species and populations as it relates to genetic conservation, and
   d) Evaluate the genetic diversity of reforestation materials to help develop seed use policies that adequately consider genetic conservation needs and long-term species adaptation.

6. Current Efforts and Direction

6.1 Genetic Conservation Catalogue

Several inventories of genetic resources have been compiled in past years, with each effort increasing the complexity of data and analysis. These reports include Lester and Yanchuk (1996), Hamann et al. (2004), Hamann et al. (2005), and Chourmouzis et al. (2009) for all indigenous species, and Krakowski et al. (2009) for timber species.

Cataloguing work done to date has shown that the procedures used appear adequate for timber species, but are less effective for non-timber species. This difference is due largely to better inventory and genetic architecture information for timber species. In addition, assumptions of what constitutes an adequate population for genetic conservation purposes is dependant upon genetic architecture, species density, and reproductive systems. These assumptions will need

[1] *Inter-situ* resources are trees established in progeny tests, provenance tests, and clonebanks throughout BC. These resources were planted for other purposes, but provide genetic information on the populations represented and expose these populations to natural selective pressures.

refinement through further research efforts and ground-truthing . Uncertainty caused by the lack of adequate information for many non-timber species leads to small and conservative geographic delineations in a cataloguing approach and, potentially, to inefficiencies in applied conservation efforts such as ex-situ collections.

6.2 In-Situ Conservation

The network of conservation areas that make up the provincial and federal protected areas in British Columbia cover nearly 15% of the province, and is the backbone of the forest genetic conservation resource. Cataloguing work has evaluated the degree to which these areas capture representative populations of tree species. While most tree species are protected at levels well above the thresholds required for adequate in situ conservation for maintenance of genetic variation, some gaps appear to exist, particularly for species in the more highly populated areas of the province. Mechanisms need to be developed for addressing these gaps in conservation, and for integrating information on conservation on private lands and in new provincial and federal protected areas that are not included in these analyses. In addition, "working" forest areas within the timber harvest land base are contributing to the overall source of genetic diversity considered in cataloguing efforts. This resource needs to be considered within the context of cataloguing efforts and methodology developed for doing so.

6.3 Ex-Situ Conservation

Ex-situ conservation is represented primarily by the provincial tree seed bank, and by clone banks. This seed bank includes approximately 8,000 conservation samples, most representing timber species. Krakowski et al. (2009) showed that that nearly all Seed Planning Units (SPU) for timber species met the criteria of having three or more samples of seed with greater than 1,000 viable seeds. For non-timber species many gaps exist at both the level of species and population-within-species levels. Ex-situ work to date has focussed primarily on obtaining seed samples from these under-represented non-timber species.

For most tree species, seed will stay viable in storage for a very long time (50+ years) if conditions are suitable. For some non-timber species, there is minimal or no information regarding long-term seed longevity or optimal conditions. Some effort has been put to better understanding seed storage needs where gaps in knowledge exist.

6.4 Inter-Situ Conservation

Previous work has identified and documented key field installations that meet the intent for *inter-situ* conservation populations (Krakowski et al., 2009). Approximately one third of the species by seed zone combinations (seed planning units) in BC (32 of about 90) have representative inter-situ populations established. Most of these are first generation open-pollinated progeny trials, with some SPUs represented only by genecology trials. These 32, however, are the larger SPUs with respect to harvest and trees planted, representing over 85 percent of the total annual provincial planting. Inter-situ populations are a significant resource for genetic conservation purposes and will continue to be integrated with cataloguing work. No new field plantations are proposed for inter-situ conservation purposes only, but breeding strategies must consider genetic conservation needs as consideration is given to SPU adjustments with climate change and the risk to representative genetic resources in ex- and in-situ reserves.

7. Needed work

7.1 Catalogue

The objectives of a genetic conservation catalogue are to: a) set priorities for genetic conservation, and b) measure progress to objectives. Catalogue updates will build on previous work, primarily Chourmouzis et al. (2009) and Krakowski et al. (2009). Ground-truthing work undertaken after the development of these documents has shown that poor inventory and genetic architecture information for many non-timber tree species will require modifications to the method used to meet cataloguing objectives. Development of revised cataloguing procedures will be a priority over the 2012 to 2014 period. Changes will be designed to incorporate an increasing set of information on non-timber tree species genetic architecture and the need to recognize geographic zones that differ by species.

The following specific activities are recommended:

2012-2014:

- review and modify catalogue structure to include only species listed in Appendix 1,
- continue ground-truthing to better understand catalogue structure needs and specific status for priority non-timber species,
- summarize and incorporate existing knowledge on genetic architecture for species that have been studied in genecology experiments or with genetic markers.

2014-2015:

- populate the catalogue with up-to-date conservation information.

2015+:

- Report on progress to the provincial conservation objective,
- Continue catalogue updates as ground-truthing and genetic architecture work provides additional information.

7.2 *In-situ* reserves

Work will focus on collaborations with other agencies with responsibilities for the provincial network of conservation areas to support information needs on the genetic resources of tree species, to champion genetic conservation needs for tree species, and to help facilitate needed activities associated with genetic conservation or restoration of in-scope species.

7.3 *Ex-situ* collections

During the period 2011 to 2015, ex-situ seed collections will continue to focus on non-timber species. A management plan will be produced. Priorities will be to fill gaps where identified in the conservation catalogue. As seed crops are periodic for most species, annual work will be adjusted to take advantage of crops as they appear. The level of effort and expenditure in a given year will vary depending upon budgets, crops, and the urgency of priorities identified in the conservation catalogue.

7.4 *Inter-situ* reserves

The primary focus for the period 2011 to 2015 will be to develop management plans for the provincial network of over 1,000 progeny and genecology field trials that form the *inter situ* reserve network. Plans will consider protection, rejuvenation in the face of climate change, the integration of this network with *ex situ* and *in situ* conservation efforts in the conservation catalogue and in setting priorities for actions.

7.5 Research

Genetic conservation of indigenous forest trees can be made more efficient by using the best scientific methods and knowledge to guide activities. Research efforts will be directed primarily at:

1. Genetic architecture of species listed in Appendix 1,
2. Conservation strategies for species with different reproductive systems, genetic architecture, geographic distributions, and vulnerability to climate change,
3. Cataloguing methods,
4. Genetic diversity needs for operational seedlots in the context of a comprehensive genetic conservation strategy,
5. *Ex situ* seed storage techniques,
6. Climate-change impacts on species distributions and genetic conservation needs.

7.6 Extension

Extension of genetic conservation needs, concepts, and status is viewed as an important component of the overall genetic conservation effort. This will include maintaining relevant and up-to-date information on the CFCG and Tree Improvement Branch websites, contributions to articles and interviews through the news media, and support for extension efforts undertaken by the Extension TAC of the FGC.

8. Program delivery

Genetic conservation activities described in Section 7 will be delivered through a combination of work undertaken directly by FLNR Tree Improvement Branch staff, contracted to the UBC Center for Forest Conservation Genetics, coordinated through collaborating agencies and companies, and carried out by GCTAC members. The following table outlines in broad terms who will undertake activities.

Table 2. Genetic conservation activities and responsibilities.

Group	Type of activity	Funding sources	Review and priority setting
FLNR Tree Improvement Branch	• Catalogue updates • Ground truthing • Strategic planning • GCTAC support and participation • Maintenance of *ex situ* collections • Maintenance of *inter situ* trials • Collaboration with other agencies • Research on genetic architecture	• Land Based Investment Strategy (LBIS) • FLNR salary and operating • Seed sale recoveries	• In collaboration with GCTAC and the FGC • Business plan approved annually by the FGC
UBC Center for Forest Conservation Genetics	• Research on catalogue methods, genetic architecture, genetic diversity needs, conservation strategies, and climate-change impacts • Technical support for the GCTAC • Maintenance of online technical resources • Student training (graduate and undergraduate)	• LBIS • Leveraged grants from other funding agencies (NSERC, Genome BC, Genome Canada, UBC, etc.)	• GCTAC and FGC approved annual business plan
GCTAC members	Strategic and business planning Project review Reporting to the FGC	NA	In conjunction with the FGC
Others	Collaboration on projects as needed	Individual agency LBIS	Done by the GCTAC

9. Business planning and reporting

9.1 Business planning

The GCTAC will lead the development of annual business plans and prepare LBIS budget recommendations for the FGC. Priorities set through this planning process will be communicated to affiliated agencies to help guide their investments in genetic conservation.

9.2 Reporting and performance indicator

Reports on conservation activities will take the form of project-level reports that outline activities, accomplishments, and spending for the fiscal year and performance to the provincial conservation objective of the FGC. This latter report is not expected to be available until methods are fully developed (about 2014).The genetic conservation catalogue is expected, however, to continue to form the basis for a performance indicator at the provincial level and for reporting.

Based on *in situ, inter situ,* and *ex situ* conservation information, the conservation catalogue will report each population as:

- Stable
- Uncertain, or,
- Of conservation concern

The total number of "stable" representative genetic populations, expressed as a percentage of the total number of representative genetic populations in BC, for all species will be the performance indicator at the provincial level. This single statistic will be compiled annually and presented in FGC Annual Reports in graphic form, along with previous years, to illustrate status and progress.

Individual genetic-conservation projects undertaken as part of annual plans approved by the FGC and supported with LBIS funds will provide quarterly financial updates to the Tree Improvement Program Administrator in TIB, and annually on performance indicators that are specific to the project and set out in approved plans.

9.3 Planning and reporting schedule

Planning and reporting will proceed on the following annual schedule:

October: Review of projects and needs. Setting priorities.

January: Submission of project plans, proposals, and budgets

February: Review of projects and budgets

March: Budget recommendation to the FGC

10. Resource needs

This section considers only resources that will be applied directly to meeting the objectives set out in this plan, as well as associated human resources that support activities and provide expertise, but are not directly linked to this program.

11.1 Human resources

Human resource needs must balance against available staff, budgets, and expertise. The following are considered reasonable within this context:

FLNR Tree Improvement Branch:

- Lead planning and interactions with other agencies, carry out ground truthing and other activities supported by the GCTAC and FGC, coordinate cataloguing and annual reporting on genetic conservation status, coordinate research with the GCTAC, and lead some research projects.

UBC Centre for Forest Conservation Genetics

- Associate Director (1 FTE). Position is supported partially through other funding sources to varying extents.
- Graduate students and technical staff as required for contracted research needs.

Others affiliated with genetic conservation

- FLNR Tree Improvement Branch scientific staff participation in discussions and planning, and related support through breeding and genecology programs.
- SelectSeed Ltd. staff support for planning and review.
- MOE and other organizations staff support for planning and review.

10.2 Funding

Only Land Base Investment Strategy (LBIS) funding directed by the FGC is considered here. Additional funding for staff is the responsibility of participating organizations. Table 3 outlines

anticipated 5-year LBIS funding needs and FLNR Tree Improvement Branch staff needs. Annual budget requirements may vary as projects develop and information changes.

Table 4. Five-year LBIS resource needs to meet genetic conservation program objectives ($ x 1000).

	Year				
Group and activity	**2012/13**	**2013/14**	**2014/15**	**2015/16**	**2016/17**
LBIS Tree Improvement program					
TIB program work	70	70	75	75	75
Ex situ seed collections	20	20	20	20	20
UBC Centre for Forest Conservation Genetics (projects assigned by GCTAC)	115	115	120	120	120
Total for LBIS TIP	$205	$205	$215	$215	$215

Citations:

Chourmouzis, C., A.D. Yanchuk, A. Hamann, P. Smets, and S.N. Aitken. 2009. Forest tree genetic conservation status report 1: *In situ* conservation status of all indigenous British Columbia species. Centre for Forest Conservation Genetics, Forest Genetics Council of B.C. and B.C. Ministry of Forest and Range. For. Sci. Prog. Victoria, B.C.Tech. Rep. 053

Hamann, A., S.N. Aitken, and A.D. Yanchuk. 2004. Cataloguing *in situ* protection of genetic resources for major commercial forest trees in British Columbia. For. Ecol. Manage. 197:295-305.

Hamann, A. P. Smets, A.D. Yanchuk, and S.N. Aitken. 2005. An ecogeographic framework for in situ conservation of forest trees in British Columbia. Can. J. For. Res. 35: 2553-2561.

Krakowski J, Chourmouzis C, Yanchuk AD, Kolotelo D, Hamann A, Aitken SN. 2009. Forest Tree Genetic Conservation Status Report 2: Genetic Conservation of Operational Tree Species. B.C. Ministry of Forests and Range, Forest Science Program, Victoria, B.C. Technical Report No. 54.

Lester, D. and A.D. Yanchuk. 1996. A survey of the protected status of conifers in British Columbia: In situ gene conservation. B.C. Min. For., Res. Br. Victoria, B.C. Res. Rep. 04.

Appendix 1: Indigenous Tree Species considered in-scope

Conifers		
Code	**Species**	**Knowledge**
ABIEAMA	Pacific silver fir	A
ABIEGRA	Grand fir	A
ABIELAS	Subalpine fir	A
CHAMNOO	Yellow-cypress	A
JUNISCO	Rocky Mtn. juniper	B
LARILAR	Tamarack	B
LARILYA	Subalpine larch	A
LARIOCC	Western larch	A
PICEENG	Engelmann spruce	A
PICEGLA	White spruce	A
PICEMAR	Black spruce	A
PICESIT	Sitka spruce	A
PINUALB	Whitebark pine	B
PINUBAN	Jack pine	B
PINUCON	Lodgepole pine	A
PINUFLE	Limber pine	B
PINUMON	Western white pine	A
PINUPON	Ponderosa pine	A
PSEUMEN	Douglas-fir	A
TAXUBREV	Pacific yew	B
THUJPLI	Western redcedar	A
TSUGHET	Western hemlock	A
TSUGMER	Mountain hemlock	B

Broadleaves		
Code	**Species**	**Knowledge**
ACERCIR	Vine maple	B
ACERGLA	Douglas maple	B
ACERMAC	Bigleaf maple	A
ALNURUB	Red Alder	A
ARBUMEN	Arbutus	B
BETUNEO	Alaska paper birch	B
BETUOCC	Water birch	B
BETUPAP	Paper birch	B
CORNNUT	West. flowering dogwood	B
MALUFUS	Pacific crab apple	B
POPUTRE	Trembling aspen	B
POPUTRI	Black cottonwood	A
PRUNEMA	Bitter cherry	B
QUERGAR	Gary oak	B
RHAMPUR	Cascara	B
SALILUC	Pacific willow	B
SALISCO	Scouler's willow	B

Knowledge level

A = considerable knowledge

B = incomplete knowledge