ALBERTA FOREST GENETIC RESOURCES COUNCIL

productivity

biodiversity

conservation

2004-05 annual report

Scientific Sector	Dr. Bruce Dancik, Dr. Ken Mallett Dr. John Spence
Biological Sector:	Dr. Chris Shank
Industry Sector:	Mr. J.P. Bielech, Dr. Sally John, Mr. Steve Luchkow, Dr. Barb Thomas, Mr. Pat Wearmouth
Government Sector:	Dr. Narinder Dhir, Dr. Ken Greenway, Mr. Doug Sklar
Chair:	Mr. Cliff Smith

For further information, or to request additional copies of this report, please contact:

Cliff Smith, Phone: (780) 449-5626 Fax (780) 449-5626
Web Site: www.abtreegene.com
E-mail: afgrc@shaw.ca

ISBN No. 0-7785-4091-X (Printed Edition)
ISBN No. 0-7785-4092-8 (On-line Edition)
Pub No. T/082

Editorial/production management:
MediaMatch West Communications Inc.

Photos courtesy of:
Alberta Community Development, Alberta-Pacific Forest Industries Inc., Alberta Sustainable Resource Development, MediaMatch West Communications Inc.

table of contents

minister's message

I wish to extend my congratulations and thanks to the Alberta Forest Genetic Resources Council for the work it performs on behalf of all Albertans, helping to safeguard the viability and diversity of our treasured forests. Your contributions are important and much appreciated.

As Alberta's Minister of Sustainable Resource Development I am aware of the many – and sometimes challenging – expectations people have of our tremendous forest resource. Our publicly-owned forests, covering 60 per cent of this province, face growing pressure for increased recreational and tourism opportunities, for additional conservation and more protected areas, and for greater job creation and community sustainability.

Against this backdrop, it is imperative that we focus increasingly on integrated, sustainable land management strategies that balance conservation and consumption for the benefit of all Albertans. For example, there will be areas of the forest where various uses might be curtailed, and areas where increased fibre production might be desirable and appropriate.

For these reasons – and because of looming questions about the effects climate variability might have on forest productivity – we are fortunate indeed to have in place this Council and the expertise and dedication of its members. Their deliberations, and the advice they provide to government, are greatly appreciated as we continually search for new and better ways to sustain our forests, and the Alberta way of life they support, for future generations.

David Coutts, Minister,
Alberta Sustainable Resource Development

message from the chair

The year 2004-2005 was marked by some very gratifying successes as we moved forward on a number of strategic priorities.

Funds were secured from industry, provincial and federal sources to allow creation of some much-needed communications products. These will help us provide clear and credible information to Albertans who express an interest in forest productivity, biodiversity and conservation.

Along the vein of forest productivity, Council was successful in its joint application, with Foothills Growth and Yield Association and Foothills Model Forest, for FRIAA (Forest Resource Improvement Association of Alberta) funds to support a major Post Harvest Stand Development Conference in early 2006. This conference will focus on the integration of knowledge from the disciplines of genetics, silviculture, and forest health into the prediction of stand development and growth and yield following harvesting. In addition, Council members and partners discussed the need for systems of access and benefit sharing of genetic resources, as called for under a 1992 Biological Diversity Convention. Canada has signed the convention, but does not yet have a policy in place, so Council is working to stay abreast of developments.

Work was completed during the year to organize a very successful workshop identifying concerns related to forest genetics and climate change. On another front, Council agreed that the issue of reporting under Canada's national criteria and indicators of sustainable forest management – as it applies to genetic diversity – should become a standing item on its agenda.

All of these items and issues are intimately related to the maintenance of public forests that are sustainable over the long term for the full range of social, environmental and economic values. Thanks are certainly due to all Council members and support staff for their work and commitment over the year.

Our gratitude extends to AFPA representative Bob Udell, who provided strong leadership and contribution since Council's formation in 2000 and who retired during the year. His seat as AFPA Conifer representative was taken by Pat Wearmouth, who vacated his position as AFPA Deciduous representative. Pat's role in the latter position was taken by Steve Luchkow.

Cliff Smith, Chair,
Alberta Forest Genetic Resources Council

standards for tree improvement

The *Standards for Tree Improvement in Alberta* (STIA) were implemented May 1, 2003. The standards guide traditional reforestation activities, enable industry to plant genetically improved stock on crown land, and direct reforestation and conservation efforts necessary to preserve the genetic diversity and health of Alberta's crown forests. The standards consist of five sections, which are:

- Ownership and Data access
- Material Collection, Handling, Registration and Storage
- Green Area Deployment
- Breeding, Testing and Verification
- Production of Controlled Parentage Material

These standards were developed by more than 40 scientists and resource managers working within the Alberta Forest Genetics Framework (AFGF). This framework process was guided by a Primary Task Group (PTG), which delegated technical work and oversaw completion of the standards to a publishable form. Built into the framework process was the provision for an annual review for the first two years after implementation. These reviews were undertaken by the PTG with user and stakeholder input in the fall of 2003 and 2004.

The Primary Task Group has completed a first and second year review of the standards. Most of the recommended and approved revisions coming out of this review process have been incorporated in the standards manual and took effect July 1, 2005.

Revisions coming out of the review process were generally minor in nature; however, a few of the more complex issues were referred to a special genetics technical group which will be working to resolve them for future revisions. One major change to the standards was implementation of the new digitized seed zones for Alberta. These seed zones guide collection, handling and deployment of wild seed used in reforestation of crown land to ensure that deployed stock is adapted and sufficiently diverse to maintain forest health and productivity. The seed zones were developed in conjunction with, and are nested within, the recently revised Natural Regions and Subregions of Alberta. Both the revised seed zones and Natural Subregions are now available in digital form. Revisions to both were made using improved data availability, much of it GIS based. To improve the resolution for resource management activities, line work for both was done at 1:250,000 scale.

The *Standards for Tree Improvement in Alberta* manual can be found on the web at http://www3.gov.ab.ca/srd/forests/fmd/manuals/index.html.

status of tree improvement programs in alberta

Tree improvement in Alberta involves more than 20 active programs in eight native species, of which six are coniferous and two are deciduous. All programs are based on traditional plant breeding methods, and no genetic modification is involved. Conservation of genetic diversity and maintenance of adaptability to natural environments are primary objectives of all native species programs. Most programs include genetic gain as a primary objective, although some are designed primarily to alleviate seed shortages. Several exotic species are under consideration, either as pure species or as parents in hybrid programs. While some companies have initiated independent programs, most programs are being developed through cooperative arrangements either among companies, or between Alberta Land & Forest Division of Sustainable Resource Development and single or multiple companies. Several programs are also being developed by SRD alone.

The first coniferous programs were initiated in 1976, and new programs have been added. The older programs are beginning to mature, and some orchards have produced considerable amounts of seed for operational deployment. A broad genetic base has been accumulated, and thousands of wild genotypes have been preserved by grafting in *ex situ* (off site) reserves. In conjunction with the Alberta Genetic Resources Conservation Plan, a system of *in situ* (on site) reserves is also being initiated for species involved in breeding programs.

Progeny tests associated with the older programs are yielding fast-growing healthy individuals for inclusion in the next generation's breeding populations.

Coniferous programs are summarized at right.

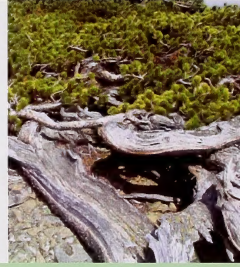
Programs for deciduous species were initiated more recently. Since the early 1990s, several forest products companies have been investigating and developing programs in aspen and aspen hybrids, balsam poplar, hybrid poplars and birch. The first aspen cooperative program was formally initiated in 1992 by a group of companies. Priorities for hardwood programs include breeding and testing for adaptation, growth rate, disease resistance, and wood quality traits. Research in stock production, establishment, silviculture, and breeding techniques has proven essential for working with both aspens and poplars.

Hundreds of genotypes have been selected, and tests have been established on a number of sites. Deployment of hybrid poplars on private land began in 2000; public land deployment of native hardwoods is expected by 2007.

Provincial genetics policy (*Standards for Tree Improvement in Alberta*), enacted in 2003 and revised in 2005, encourages investment in tree improvement activities. These standards establish a framework for program development and accrual of benefits, while ensuring that genetic diversity and conservation objectives are met.

	# of programs	parents in programs	parents under test	genotypes in orchards	trees in orchards	total seed produced (kg)
Douglas-fir	1	45	0	39	119	0
Western larch	1	27	0	18	80	0
Jack pine	1	68	0	52	320	0
Lodgepole pine	6	1,664	1,477	503	8,413	138.98
Black spruce	3	254	179	294	3,065	0.19
White spruce	9	1,275	794	817	8,622	868.46
Total	**21**	**3,333**	**2,450**	**1,723**	**20,619**	**1,007.63**

biodiversity and forest genetic conservation



Biodiversity, short for "biological diversity," means the variety of life or the great number of ways that living things differ at the genetic, species and ecosystem levels.

Many individuals, programs and organizations are working to conserve Alberta's biodiversity at the species and ecosystem levels. For example, Alberta's system of protected areas ensures that representative ecosystems are preserved while Alberta's Species at Risk Program works to identify and recover species at risk of extinction. The Alberta Forest Genetic Resources Council is unique in having an important role in conserving the genetic diversity of Alberta's forest resources.

The genetic component of biodiversity provides the raw material allowing species to adapt to changing environments. It is impossible to predict what genetic combinations will be most suited to future conditions. Populations possessing a wide variety of genetic types are more likely to have the right adaptations for future circumstances while those with narrow genetic diversity will be too specialized to be able to respond. The genetic variability of wild tree populations is considered a "heritage resource" because of the vital role it plays in sustaining vibrant and productive ecosystems.

The Council is working to maintain genetic diversity in Alberta's tree populations through a variety of programs. One program ensures that the seed and seedling stock used in reforestation maintains genetic diversity. Council has endorsed the document *Standards for Tree Improvement in Alberta* that has been adopted as policy by the government of Alberta. This document provides detailed instructions on how tree breeding, tree orchard operation and collection and deployment of seed must be undertaken to ensure sufficient genetic variability in timber harvest areas.

A second program ensures that wild populations of trees retain the natural genetic variability that has evolved over millennia. Over the past year, Council has worked with SRD and Community Development in developing a gene conservation strategy. When completed, the strategy will provide a detailed plan to protect the natural genetic variability of priority Alberta tree species. The plan emphasizes *in situ* (on site) conservation involving protecting wild tree populations in their natural habitats and subject to the influence of natural evolutionary processes. The number of trees to be protected is determined using the scientific principles of quantitative population genetics. Buffer zones will surround the protected trees to protect them from pollen contamination from surrounding planted forest. The genetic conservation plan also recognizes that in some cases, *ex situ* (off site) conservation is needed to supplement *in situ* efforts. *Ex situ* conservation generally entails storing representative samples of wild tree genes in seed banks and is particularly important for populations whose survival is threatened.

The global Convention on Biological Diversity states that a fair and equitable portion of the benefits accruing from the development of genetic resources must revert back to the provider of the genes. International negotiations are currently in progress towards development of legal structures ensuring that owners and providers of genetic resources benefit from their work. Council, through the *Standards for Tree Improvement in Alberta*, has anticipated these developments in providing clear guidelines for ownership of tree genetic resources and the intellectual property rights entailed in development of genetically improved tree stock.

climate change

Alberta's forests and forest ecosystems are the result of thousands of years of natural evolution and ecological processes. Predicted climate change due to global warming is expected to disrupt these forest ecosystems. The magnitude and nature of these disruptions will depend on the extent and rate of climate change.

A study sponsored by Alberta Environment (http://www.parc.ca/research_pub_scenarios.htm) and regionally scaled and adjusted to the 1961-90 climate normals using the Alberta Climate Model (http://www3.gov.ab.ca/env/info/infocentre/publist.cfm) demonstrates some plausible climate change scenarios for Alberta. These future climate scenarios indicate that by 2050, average mean annual temperature in the province may increase by 3°C to 5°C accompanied by annual precipitation changes in the range of -10% to +15%. These changes are expected to be gradual but the cumulative change over the lifespan of trees, which usually is 80 – 200 years or more, will be substantial.

The changed climate will affect tree species and their distribution ranges. It can be expected that over time, tree species' natural ranges will migrate northwards and to higher elevations than they are found at present. Since trees are the dominating species in most forest ecosystems, significant changes in associated plant communities and ecological processes at the landscape level can also be expected.

With the change in climate and ecology of the forest, genetic change will be necessary for tree species and populations to adjust to the new environment. This change occurs gradually in nature through the genetic processes of mutation, migration, genetic drift and natural selection. With a rapidly-changing climate, particularly with the warmer and drier growing seasons indicated by the scenarios for Alberta into the 2050s, these processes will likely be inadequate to maintain adaptation in all cases, and human intervention will be required. Effective intervention is complicated by the fact that the expected impact of climate change on forest genetic resources in Alberta is not well understood.

Recognizing this problem, significant work now focuses on the development of a better understanding of possible future climates at the regional level and the response of forest trees and ecosystems. Such knowledge is key to developing an adaptation strategy for forest management for the future. In the area of forest genetic resources management, an important concern is the choice of appropriate seed sources and tree varieties for use in reforestation today and their suitability for the future. Trees planted today will need to grow for many decades under climate conditions that are expected to change more rapidly than in the recorded past. Genetic composition and diversity levels of the seedlots may need adjustment to decrease risks of maladaptation in future climates. In some cases different or entirely new species may be needed for reforestation. Provenance research in forestry is key to providing some of these answers. Work in Alberta over the past 25 years and ongoing is providing some preliminary information to guide future activities, but much more needs to be done.

examples of work by partners

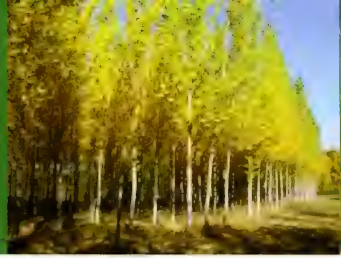
ATISC
The Alberta Tree Improvement and Seed Centre (Alberta Sustainable Resource Development) carries out applied research in support of the provincial forest genetic resources management program and practical tree breeding to enhance growth, yield, timber quality and the climatic and pest hardiness of the future forest. The focus is development of scientific knowledge on genetic variation in wild populations and species, inheritance patterns and their relationship to important adaptive and commercial traits. The current emphasis of work is on summarizing results from provenance trials of white spruce, black spruce, lodgepole pine, jack pine and tamarack. These trials were established during 1976 – 1990 throughout Alberta and are providing valuable scientific information on natural genetic variation among species-populations, their adaptations to regional geography and climate, time trends in growth and survival, pest damage, and field performance under varying site conditions. A new area of work is to develop mathematical models to extend our understanding of adaptive genetic variation and climate relationships to future climates using global warming climate change scenarios for Alberta.

Alberta-Pacific
Alberta-Pacific Forest Industries Inc. (Al-Pac) has an active research program supporting its activities in tree breeding and poplar farming. The company is fully committed to developing the best practices possible, and making sound decisions based on science. Al-Pac is pursuing four separate tree improvement programs including a clonal native balsam poplar program, hybrid aspen and poplar breeding programs and a birch program. Clonal selections (~400) for the balsam program will be completed during the winter of 2005-06 and three years of hybrid poplar breeding has produced thousands of new genotypes for testing. Initial clonal selections have been made from the hybrid aspen breeding program and the last of a series of birch trials installed.

Some of the recent or ongoing research topics include developing protocols for selecting disease and drought resistant seedlings and clones, determining wood quality and pulp yields of poplars, establishing optimum fertilizer regimes, developing an economically viable mass propagation system for hybrid aspen, understanding the potential risks associated with the planting of non-native poplars, determining carbon sequestration values for hybrid poplar plantations, undertaking growth-and-yield modeling of hybrid aspens and poplars, and investigating the community perceptions of growing hybrid poplars as an alternative agricultural crop.

Al-Pac's poplar research program is conducted in conjunction with partners from a diversity of sectors including Oil & Gas, Universities and the Natural Sciences Engineering Research Council (NSERC).

Canadian Forest Service
Natural Resources Canada, Canadian Forest Service (CFS), operates the Northern Forestry Centre (NoFC) which services Alberta, Saskatchewan, Manitoba and the Northwest Territories. Broad research themes at NoFC include biodiversity, carbon budget modeling, fire ecology and fire systems, impacts and adaptations to climate change, innovative forest management practices, socio-



economic issues, and sustainable forest management. The Laurentian Forestry Centre in Quebec has research programs in tree biotechnology and advanced genetics. The Atlantic Forestry Centre in New Brunswick is home to the National Tree Seed Centre and conducts research into tree gene conservation. CFS laboratories also collaborate and partner with provincial government genetic programs. Several CFS researchers provide advice and help with pest problems associated with tree seed orchards and have helped with programs in breeding for resistance.

FGAA

The Forest Genetics Alberta Association (FGAA) is up and running as of the summer of 2005. The four founding members are the Alberta Tree Improvement and Seed Centre, Tolko-High Level, Northlands Forest Products and Manning Diversified Forest Products.

The association was created to administer members' cooperative tree improvement programs and to carry out selected research and conservation activities. Reduced staffing for all partners, along with increasing workload to run the programs and meet requirements of the *Standards for Tree Improvement in Alberta,* also prompted the decision to put a formal organization in place.

Two geographic areas are covered, one in the northwest and the other in the northeast. The northwest area covers the tree improvement programs for region G2, white spruce and region J, lodgepole pine. The northeast area covers the tree improvement program for region E1, white spruce and region P1, jack pine. These programs are in various stages of development but are mostly younger in age.

Poplar Council of Canada

A new poplar clone directory for Canada will be available later in 2005, accessible to members only. It includes such categories as codes, parentage, origin, commercialization status, trial status and who to contact regarding the material. The council held a Genomics to Production Workshop April 7-8, 2005, in Edmonton with support from Genome Canada and CFS. A summary of the workshop will be available on the council's web-site. The workshop brought together government, industry and academics to discuss how to put genomics tools to use. The herbicide working group is working to get licences for additional herbicides for use with poplar.

HASOC

HASOC, a consortium of five forest companies, was established in 1995 to provide a cooperative framework for coniferous tree improvement in west-central Alberta. Member companies are Canadian Forest Products Ltd.; Weyerhaeuser Company; Hinton Wood Products, a Division of West Fraser Mills Ltd.; ANC Timber Ltd. and Millar Western Forest Products Ltd. HASOC orchard research focuses on operational trials related to health and productivity. The five programs managed by HASOC involve parent selection and breeding, progeny testing, orchard establishment and management, and related research. Seed orchard establishment at HASOC's 320-acre orchard site began in 1986. The site now contains three lodgepole pine orchards, two white spruce orchards and one black spruce orchard. A total of 262.56 kg of seed, or 81.3 million seeds, have been harvested from the four orchards currently in production.

All programs are managed to maintain high levels of genetic diversity in both breeding and orchard populations. Comprehensive white spruce and lodgepole pine progeny tests will enable continued gain through breeding and confirm adaptation of orchard stock.

WBAC

Western Boreal Aspen Corp. has four industrial members: Ainsworth Engineered Canada LP, Daishowa-Marubeni International Ltd., Footner Forest Products Ltd. and Weyerhaeuser Company. Collectively these four companies harvest 4.5 million cubic meters of hardwood (approx. 90% aspen, 10% balsam poplar) to supply three OSB mills and one pulp mill (DMI). Significant accomplishments in 2004-05 include:

Plantation silviculture: a) initial planting density – five year data from plaid factorial spacing trials on two sites were analyzed to determine the impacts of initial density on growth and yield of aspen; and b) rootling propagation – a study investigating the influence of origin, orientation and root segment size on rootling propagation was completed in 2004. This has conclusively demonstrated the importance of segment size and planting orientation on propagation success. Alberta Forestry Research Institute (AFRI) funded mass vegetative propagation experiments are continuing through 2005 using the stacked styroblock system and rootling propagation methods in a series of operational trials at four Alberta forest nurseries.

Native aspen and balsam poplar tree improvement: a) first-generation breeding of aspen was completed in 2004, progeny tests are being established in 2005-07. Controlled pollination of balsam poplar using the cut branch technique was initiated in the winter of 2004-05 as part of an AFRI-funded hybrid balsam poplar breeding project; and b) clone testing of wild aspen selections continues: in the first phase, WBAC plans to test 300 wild selections from each of two breeding regions; future candidates for clonal screening will be sourced from controlled crosses in the breeding program. WBAC members have begun assembling wild balsam poplar collections for multi-location screening trials.

Hybrid aspen and hybrid poplar: breeding and clone testing: a) a first cycle of aspen hybrids has completed four growing seasons in field trials. Some of the tested trees are achieving over one metre in height increment per year. (This is about 10 times the average height increment of white or black spruce tested in Alberta). A second cycle of hybridization has begun with funding from AFRI; and b) WBAC initiated a balsam poplar hybridization program in 2004 with funding assistance from AFRI. This will generate hybrids with North American cottonwoods and European black poplar.

AFGRC Communications

A workshop in late 2003 identified a need to institute some procedures and products that would help Council communicate clearly with government, industry and public stakeholders.

Sustaining Alberta's forests through emerging and unprecedented changes in social and ecological environments can only occur with the support and informed understanding of these stakeholders. For this reason, communications was included as one of Council's strategic priorities.

The Chair has worked with suppliers to create a foundational Strategic Communications Plan, from which several useful products have flowed over the year in review. Industry and government made some specific financial contributions to make this happen, and Council's

thanks goes to them for their generosity and vision.

Three fact sheets are now available, providing a clear overview of the mandate and objectives of the Council, and the rationale and processes behind coniferous and deciduous tree improvement. These fact sheets were designed to be housed on the Council's website (abtreegene.com) and available for printable download by anyone interested in the subject.

A clear and attractive annual report was created for Council, and is also available on our website. Work on creating the structure of the website was begun in the year in review.

Sponsors have committed to a three-year communications plan that will see completion of a comprehensive suite of products designed to help communicate our message clearly and honestly to all interested, from students to Open House visitors to partners in the research community. Plans have already been finalized for further fact sheets to be produced in the coming year (Year Two), as well as to officially launch our website at abtreegene.com.

Trees of Renown

The purpose of the Trees of Renown program, sponsored by the Devonian Botanic Garden, is to identify and preserve the oldest, biggest, most unusual, or locally or historically significant trees or stands, as a heritage resource for future generations of Albertans.

The Alberta Forestry Association announced in 1983 the program was "designed to gather and record information about unique trees, to help identify and locate them, and to protect them as much as possible." Two editions of a Trees of Renown Honour Roll were produced, the second with 115 trees.

Recently, in cooperation with founding members Dr Bruce Dancik and Dr Peter Murphy, individuals from within ASRD have revived the concept, the name, and the program.

The new Trees of Renown program will complement other conservation initiatives and programs, such as the Rare and Exceptional Stands program and the Heritage Tree Foundation of Canada. Land reservations, designed to protect the trees from harvest or other industrial activities, will be placed on an area around the most deserving or outstanding nominations.

Two trees have been verified as new additions to the Trees of Renown Honour Roll. The first is a 47 m white spruce on the Christina River, in the Fort McMurray area. The second is a Limber pine with an estimated age in excess of 1,000 years and a diameter of over a metre. It stands on a slope overlooking Crowsnest Lake. Other trees have been proposed and as they are verified, will be added to the roll.

ALBERTA FOREST GENETIC RESOURCES COUNCIL
Secretariat

402 Meadowview Terrace
Sherwood Park, Alberta T8H 1X7
Phone: (780) 449-5626 Fax: (780) 449-5626
Website: wwwabtreegene.com
E-mail: afgrc@shaw.ca