ALBERTA FOREST GENETIC RESOURCES COUNCIL

2003-'04 ANNUAL REPORT

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Alberta Forest Genetic Resources Council

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table of
CONTENTS

MESSAGE *from the* CHAIR

The Alberta Forest Genetic Resources Council facilitates the sound management of forest genetic resources by focusing on four pillars: Conservation, Genetic Diversity, Adaptation and Genetic Gain.

Conservation of Alberta's native forest gene pool continues to be a major priority for the Council, as illustrated by the related article later in this report. From this foundation, Council addresses the maintenance of genetic diversity to ensure natural variation, ecosystem resilience and health; managed and successful adaptation addressing the evolutionary imprint and biological suitability to site and climate, and finally genetic gain addressing quality and quantity of wood fibre produced.

The successful delivery of programs guided by these fundamental pillars was greatly facilitated by the Alberta government's approval of the policy document *Standards for Tree Improvement in Alberta* (see www3.gov.ab.ca). The document falls under the Alberta Forest Genetics Framework, which has occupied a significant portion of Council's agenda in years past. The way is now clear for significant progress in the deployment of genetically improved trees in the province.

Council has also identified some strategic priorities from a large number of issues calling for attention. One of these, external communications, is now being acted upon with creation of a communications plan and some communications products that will help explain forest genetics work and Council's role to our stakeholders.

Some shifts occurred in Council membership during the year. Bruce Macmillan, industry hardwood representative, Bob Udell as the industry's softwood representative and Neil Barker as a government representative all stepped down. All of these gentlemen toiled hard for council and the advancement of the forest genetics program, and their participation will be sorely missed. Fortunately the vacancies were taken up quickly by some very experienced people. Pat Wearmouth initially took the hardwood seat, then later in the year moved over to the softwood side. The hardwood seat was subsequently filled by Steve L. Luchkow. Dr. Ken Greenway joins Council as a provincial government representative and forest management expert.

Cliff Smith,
Chair,
Alberta Forest Genetic Resources Council

FOREST genetics in ALBERTA

The forest genetics and tree improvement program in Alberta is now nearly three decades old. It has made a successful transition from its early days as a growth-and-yield enhancement endeavor to today's comprehensive genetic resources management program addressing issues and research related to genetic diversity, conservation and productivity.

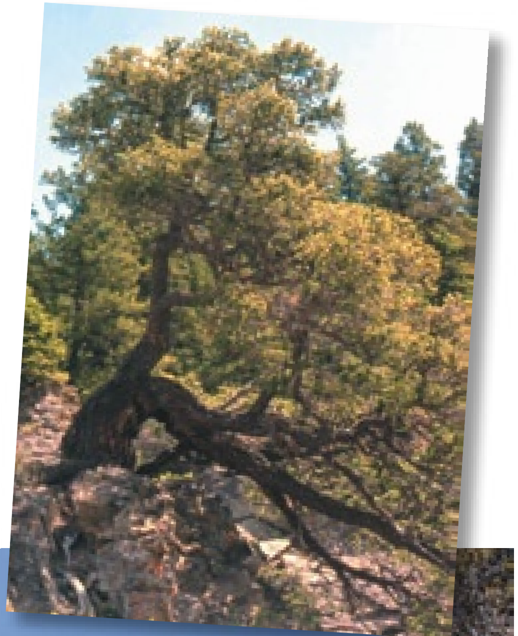
Tree improvement and genetic conservation are of critical importance to all Albertans. They are areas of science that ensure the diverse native store of forest properties and characteristics are conserved for future generations. They provide practical solutions to communities and companies that depend on the economic value of the forest. And they offer a helping hand to forest species that must adapt quickly to changing climate regimes.

The Alberta Forest Genetic Resources Council was formed in 2000 to bring together some of the numerous scientific threads and partnerships involved in the work. The Council's interest is in the biodiversity, productivity and conservation of forest gene resources. Its responsibilities are to facilitate policy development, identify opportunities in forest genetic resources management, stimulate innovation, promote partnerships and networking, and foster research and education.

Council provided the provincial government with reviews and input for the *Standards for Tree Improvement in Alberta,* implemented during the year in review. The standards address the need for rules and protocols that will guide the use of improved genetic stock on public lands while conserving genetic diversity, forest health and the evolutionary potential of forests to adapt to climate change. The standards have been broadly welcomed, while Council and others continue their monitoring and review of possible improvements and adjustments as operations unfold.

Council's membership includes representatives of two genetics and tree improvement cooperatives in the province, as well as the Alberta Tree Improvement and Seed Centre. The three agencies represent the cooperative involvement of 15 companies engaged in forest management, and the results of their work continue to grow in credibility and value.

Recent years have seen increasing interest in hardwood programs (pure species and hybrid varieties) as industry learns to extract more value from previously under-utilized aspen/poplar resources. Council's discussions have reflected industry's increasing involvement in these programs, and the allocation of more resources to tree selection, genetic testing, mass vegetative propagation and research. A major direction has been exploration of short rotation (15 –20 year growth cycle) plantation opportunities on private agricultural land. A better understanding of growth and yield issues for tree improvement and timber supply modeling for sustainable forest management is another priority.



GENE *resources* CONSERVATION

Work in cooperation with Alberta Parks and Protected Areas (APPA) continued on the development of a forest gene conservation plan for Alberta. A list of tree species native to Alberta along with their descriptions was completed. Of the 28 native tree species recognized western red cedar *(Thuja plicata)*, western hemlock *(Tsuga heterophylla)*, western larch *(Larix occidentalis)* western white pine *(Pinus monticola)* and western yew *(Taxus brevifolia)* are designated as rare in Alberta. A review of potential data sources for determining tree species' ranges and abundance has also been completed.

The plan calls for the *in situ* (within the original habitat) and *ex situ* (away from the original habitat) conservation needs of all native tree species to be addressed through gap analysis based on their distribution and status. Conservation activities and the implementation of the provincial plan are required under the *Standards for Tree Improvement in Alberta* and are achieved through cooperative efforts of the Alberta government and forest industry companies. The process will lead to gene conservation becoming an integral part of forest management planning and operations in Alberta.

Work has continued within Alberta Sustainable Resource Development (ASRD) and in cooperation with APPA, Parks Canada, the Canadian Forest Service, the Whitebark Pine Ecosystem Foundation and the British Columbia Forest Service on conservation efforts for whitebark pine *(Pinus albicaulis)* and limber pine *(Pinus flexilis)*. These two tree species have been provincially recognized as watch list species due to declining populations. Declines are related in part to serious infection and mortality from white pine blister rust, a disease introduced to North America in the last century. To date, conservation efforts have included cone collections from nine populations of limber pine and two populations of white bark pine. Work has continued by all partners on a survey of the distribution of these two species as well as the extent of infection by blister rust. Based on this information, Parks Canada is preparing a status report on whitebark pine for submission to the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) for assessment. A similar process is being considered for limber pine. Within ASRD, information gathered from whitebark and limber pine field surveys has been used for management planning and protection for these species in forest operations, and for making strategic cone collections for reforestation.

TREE *improvement* PROGRAMS

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 (GM) is involved. Conservation of genetic diversity and maintenance of adaptability to natural environments are two 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 Sustainable Resource Development (ASRD) and single or multiple companies. Several programs are also being developed by ASRD alone.

The first coniferous programs were initiated in 1976, and new programs have been continuously 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* reserves. In conjunction with the Alberta Genetic Resources Conservation Plan, a system of *in situ* 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, 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 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, is expected to encourage investment in tree improvement activities. These standards establish a framework for program development and accrual of benefits, while ensuring that genetic diversity and

	# of programs	parents in programs	parents under test	genotypes in orchards	trees in orchards	total seed produced (kg)
Douglas-fir	1	45	0	38	108	0
Western larch	1	27	0	18	82	0
Jack pine	1	68	0	51	310	0
Lodgepole pine	6	1,923	1,633	518	8,849	134.07
Black spruce	3	254	179	191	2,571	0.13
White spruce	9	1,255	580	807	8,235	868.46
Total	**21**	**3,572**	**2,392**	**1,623**	**20,155**	**1,002.66**

MANAGEMENT SURVEY
processes and practices

In 2002, the Alberta Forest Genetic Resources Council began development of a survey of processes and practices in management of forest genetic resources. The goal was to conduct a survey on topics relevant to forest genetic resources management, focused on policy and planning . The intent of the survey was to prompt an exchange of ideas at the policy level and, if desired, at more technical levels. The topics covered by the survey were:

- Seed transfer policy
- Genetic resources conservation
- Genetic diversity
- Tree improvement
- Genetically modified organisms
- Non-native tree species
- Education in forest genetics and tree improvement
- Forest genetics advisory councils/boards

From an initial focus on provinces with forest genetics councils or boards, the survey was expanded to include all provinces and territories. It was formally endorsed by Alberta, British Columbia, Ontario and New Brunswick.

Completed surveys were received from 11 jurisdictions. Most surveys included comments that helped to clarify responses about specific topics. After additional clarification through correspondence with respondents, an initial summary of responses was made and distributed to respondents with an option to review responses and make changes. Another option was to have results distributed with provincial identification or to be included anonymously in an aggregate tally. Six provinces agreed to identify their responses.

Responses revealed that some survey questions could be open to interpretation. For example, do policies and plans have to be written? Related to the formality of policy and planning is the wide range among jurisdictions in the need for formal approaches to gene resource management of forest trees. As a measure of complexity, jurisdictions were asked how many seed zones they manage. The range from one to 81 illustrates a range of complexity. In addition, recording the existence of a policy or plan makes no assessment of the adequacy of that policy or plan in gene resource management.

With the reservations noted above, the following general conclusions were made.

1. The survey reveals a general appreciation of issues in forest genetics and tree improvement although several of the respondents have job titles that emphasize silviculture or ecology. The actualization of that appreciation in organizational structures and formal plans varies widely among jurisdictions.

2. Jurisdictions in which the implementation of tree improvement is shared in public/private cooperative formats have the most codified activities. Where implementation of tree improvement is an exclusively governmental function, written standards are less common and, perhaps, viewed as unnecessary or undesirable.

3. Even where written policies and standards are in place, the resources and commitment to implement and monitor rarely seem available.

At the very least, the survey results offer guidance on important elements of a sound forest genetic resources management program and a preliminary “directory” of jurisdictions where specific issues have been addressed.

REFORESTATION *and* CLIMATE CHANGE

Global climate models project global temperature increases ranging from 1.4°C to 5.8°C by the end of the 21st century, accompanied by changes in precipitation. In Alberta, temperature changes are expected to be more pronounced in the northern areas of the province than in the south. Similarly, winters are expected to warm more than the summers. Estimates are based on a variety of scenarios which account for changing greenhouse gas emissions due to population growth, energy use, technology changes, economic activity, etc.

Climate change is expected to occur over the coming decades. There is an opportunity to develop new strategies, do research and find science based solutions to adapt to the new future. It is a future that offers us challenges and opportunities on a scale perhaps not envisioned before. Alberta's forests also face a significant adjustment and we must assist in the transition to new forests or alternate land uses better suited to the future climate. A changing climate would see Alberta's natural regions gradually "migrate" northwards or into higher elevation bands in the mountains. Some ecosystems and vegetation species may no longer be sustainable in the far future.

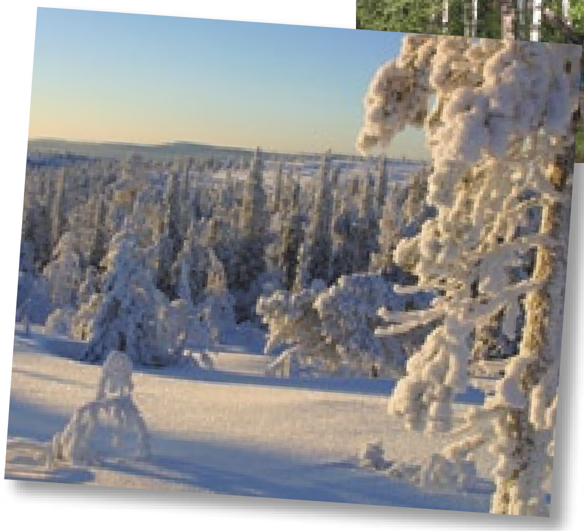
Tree species and their regional populations have adapted to their present climates through natural evolutionary processes, by adjusting their genes, gene combinations and genetic responses. The rate of climatic change expected may require human intervention if successful adaptation is to occur. Genetic diversity is the key to natural selection and evolution, as well as to human-assisted adaptation.

Fortunately, most of the tree species native to Alberta have wide natural ranges and possess a large amount of genetic variation. Genes suitable to adapt to the future's warmer climates may be found in tree populations south of their present locations in Alberta or in some cases outside Alberta, such as southeastern British Columbia. In some cases entirely new species may have to be imported, tested and established.

Reforestation practices would have to be gradually adjusted to increase genetic diversity of the reforestation seedlots, modifying seed source prescriptions, adjusting seed deployment zones more often (e.g. on decadal basis), increasing tree planting densities to compensate for higher than expected mortality in the future and reducing rotation ages of the planted trees.

Key to successful reforestation in a changing climate will be good estimates of future regional climates in Alberta, and assessment of their impacts on ecosystems and ecosystem boundaries. Genetic testing of forest tree populations in a variety of environments through provenance testing is also indispensable. This will help identify adapted genotypes and explain adaptation mechanisms to assist in seed source selection and breeding new tree varieties for climates of the future.

Work now in progress at Alberta Environment, Alberta Sustainable Resource Development and the Canadian Forest Service will assist in this endeavor.



GENETIC RESOURCES management and FOREST PLANNING

With greater local, national and international pressure from the public to manage forests for a broad set of values, products and services, a great deal of complexity has been introduced to forest management planning over the last half century. This has been compounded in the last couple of decades by a shift from a multiple-use, sustained yield, integrated resource management planning paradigm to one of Sustainable Forest Management (SFM).

On an international level, many groups and individuals have demanded assurance that forests are being managed in a sustainable manner. This is manifested through international consumer pressure and the widely adopted use of forest certification systems by companies and agencies involved in forest management.

Canada's national commitment to SFM is reflected in such initiatives as the Canadian Criteria and Indicators sponsored by the Canadian Council of Forest Ministers (CCFM). This was in response to agreements on implementation of SFM coming out of the 1992 UNCED (Earth) summit as well as a longer-term development of a forest strategy culminating in the Canada Forest Accord on SFM, signed by Alberta in 1992. Linked to these SFM initiatives, Canada's commitment as a signatory to the Biodiversity Convention links the maintenance of biodiversity and genetic diversity directly to these SFM initiatives. This in turn requires integration of forest genetic resource management into forest planning.

Alberta has undertaken a number of initiatives to meet its commitment to implement SFM. Overall guidance for policy development and implementation of SFM for Alberta's public forests is provided by the *Alberta Forest Legacy* (www3.gov.ab.ca) document, developed through extensive discussions with the public and stakeholders on the desired state and role of future forests. With guidance provided by the Legacy document, and with consideration of certification objectives and CCFM Criteria and Indicators, forest management planning standards are being developed and implemented based on the SFM paradigm. Planning, implementation and performance are directed through the forest management planning and review process.

The variation of genes within a species and its populations, the ultimate source of biodiversity at all levels, is critical to effective and sustainable management of forest genetic resources. Loss of this variation may have negative consequences for ecological fitness of forest populations and prevent adaptive change to future climates, pests and diseases. In order to prevent loss of biodiversity, both coarse and fine filter strategies are employed in forest management planning. Coarse filter strategies involve maintaining landscape level conditions that address the habitat requirements for a wide range of species. Fine filter approaches are utilized for species whose habitat requirements were not captured by coarse filter strategies, for species at risk, and for species of unique value to society. By using these strategies in integrating forest genetic resource management as part of forest management planning, Alberta has made significant steps in conservation and protection of forest biodiversity at the ecosystem, species and within-species levels.

Management of genetic diversity in trees, and enhancement of forest productivity in forest management activities, are achieved through the use of seed-use standards and seed zones for deployment of natural seed sources, controlled parentage programs and deployment zones for genetic tree improvement, and *in situ* (within original habitat) gene conservation areas for conserving representative wild tree gene pools.

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