Third Forum on the Conservation of Forest Genetic Resources

"Impact of Climate Change on Forest Genetic Resources: Mitigation Strategies"

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ABSTRACTS

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National Drivers for Adaptation to Climate Change and Assisted Migration

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In 2007, the assessment report of the Intergovernmental Panel on Climate Change (IPCC AR4) stated that warming of the climate system was unequivocal, and evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level. The AR4 also concluded that most of the observed increase in global average temperatures since the mid-20th century was very likely due to the observed increase in anthropogenic greenhouse gas emissions, and that a future minimum warming of about 0.2°C per decade could be anticipated for a range of emissions scenarios.

In the last decades, the domain of climate change research has expanded, starting with a narrow focus on mitigation, and now composed of three complementary strategies: mitigation, adaptation, and geo-engineering. Mitigation efforts are based on approaches that were established to face other environmental challenges, such as pollution, and include regulations, caps, and taxes. Geo-engineering is also in line with more historical approaches based on the idea that innovation and technology can fix nature's problems. In contrast, the adaptation approach is something new that challenges existing mental models.

Although the need for adaptation has long been recognized, taking action is challenging as adaptation requires re-examining the way we manage our environment. Much less information is available about the costs and effectiveness of adaptation measures than about mitigation measures. This is partly due to the fact that the effectiveness of adaptation measures is highly dependent on specific geographical and climate risk factors as well as institutional, political, and financial constraints and, as a result of this complexity, the barriers, limits, and costs of adaptation are not fully understood. Regardless of the many challenges, adaptation is a necessary strategy at all scales – from local to national to global – to complement climate change mitigation efforts. To aid in these efforts, the upcoming IPCC report (AR5) will emphasize socio-economic aspects and implications for sustainable development.

Climate change impacts on Canada's forest are already evident, with important spatial variability in both magnitude of climate change and their impacts. Climate change impacts on forests are particularly complex, multidimensional, and often synergetic. Observed impacts include increased extreme weather events (drought, windthrow, etc.) and altered disturbance regimes (fire, insect outbreaks). Increasing temperatures have also resulted in earlier timing of spring phenological events and northern (and altitudinal) shifts in plant and animal ranges.

The need for adaptation has been recognized in the forest sector, and Climate Change is a cornerstone of the National Forest Strategy of the Canadian Council of Forest Ministers (CCFM). There are many challenges facing adaptation in the forest sector. Climate change impacts are multidimensional and interacting, but our climate change knowledge has evolved within the boundaries of traditional bio-physical disciplines, with focused attention on specific problems. In order to deepen our understanding of climate change on forests, we need to add a new dimension to our traditional approach to ensure that current and future research cuts across the boundaries of traditional disciplines. Integrating knowledge in a multidisciplinary approach will increase our understanding and our ability to make predictions about the potential response of forests to a changing climate, in areas such as productivity, renewal, and succession, and the adaptive capacity of forest-dependent communities.

Knowledge transfer is another challenge in any climate change adaptation process. Scientific knowledge on the observed and expected impacts of climate change on forests is being generated at an accelerating pace, but the rate of transfer to users has not been keeping up. There is an increasing demand for scientific knowledge that is available, usable, and applicable for use by decision-makers, from practitioners to policy-makers. There is also significant uncertainty associated with both the magnitude of projected climate shifts and the contributing and resulting forest processes (i.e., future climate, future climate impacts, future forest response). A significant challenge is to communicate this uncertainty while emphasizing the urgency to take action. To better equip decision-makers grappling with these difficult decisions, we need to provide means to incorporate uncertainty into their analyses and planning. There is also a need to monitor and reassess adaptation processes as they unfold; adaptive management is needed to respond to the unexpected.

Although tree species are already moving north in response to warming temperatures, they are unlikely to "keep up" with the rapid rate of climate change. Assisted migration, the human-assisted movement of plants and animals to areas where the climate is more suitable, is one of the many adaptation options available under continued climate change. Assisted migration represents an illustrative and empowering option for incorporating adaptation into sustainable forest management. The interest in assisted migration has rapidly increased as indicated by an increasing number of research publications and news media reports. Assisted migration is a multifaceted concept that encompasses a large range of practices, with an equally large range of risks and uncertainties. The planting of southern, pre-adapted provenances at more northern locations may enhance the productivity and resilience of forests under continued climate change. This form of assisted migration is already being implemented in various regions in Canada, albeit at a small scale. A team of scientists have been working since the Spring of 2009 to put together a multifaceted review of assisted migration, covering the ecological, ethical, technical, and socio-economical aspects of this adaptation option for sustainable forest management. This comprehensive review will be published in an upcoming special issue of The Forestry Chronicle.

BIOGRAPHY

Catherine Ste-Marie obtained her PhD in biology (forest ecology) at the Université du Québec à Montréal. She joined the CFS in 2007 after working several years establishing and running an organic market vegetable farm in the Outaouais area. She is the Climate Change Science Co-ordinator and Advisor at the CFS, covering the impacts, mitigation (carbon science), and adaption facets of CFS climate change science. She works in Ottawa, and sees her role as an intermediary between science and policy, working to facilitate dialogue and understanding between these disparate but complementary domains.

State of the World Report on Forest Genetic Resources

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Genetic diversity provides the basis for the evolution of forest tree species and for their adaptation to change. Therefore, conserving forest genetic resources (FGR) is vital because they are a unique and irreplaceable resource for the future. Forest genetic resource management can be effective when treated as an integral element of sustainable resource management.

Globally, there is no consolidated picture of the status and trends of forest genetic resources and a lack of estimators of the rate of genetic diversity loss. With the support of the Committee on Forestry, the Commission on Genetic Resources for Food and Agriculture of FAO requested that a State of the World's Forest Genetic Resources report be prepared and presented to the Commission in 2013. The report will be used to:

1. Assist countries to undertake a strategic assessment of their FGRs.
2. Provide a common framework to report globally on the state of their FGRs in order to facilitate regional and global analyses.
3. Populate and update the knowledge information system, REFORGEN.
4. Identify gaps and needs in national, regional, and global policy making.
5. Enable policy makers to take action through the adoption of a Global Plan for FGR.

The primary source of data and information will be Country Reports that will consist of eight chapters covering the following topics:

1. Current state of FGRs.
2. State of *in situ* conservation.
3. State of *ex situ* conservation.
4. State of use of sustainable management of FGRs including genetic improvement programs.
5. State of national programs, research, education, training, and legislation.
6. State of regional and international cooperation.
7. Access to FGRs and benefit sharing.
8. Contribution of FGRs to food security, poverty alleviation, and sustainable development.

In Canada, the Canadian Forest Service was delegated the responsibility of collecting the data and information and preparing the Country Report. A survey was prepared focusing primarily on three chapters dealing with *in situ* conservation, *ex situ* conservation and management of FGRs. The survey is being conducted in full collaboration with CON**FOR**GEN in order to collect the necessary data from the provinces/territories. Data for other chapters is being obtained, compiled, and synthesized by Canadian Forest Service personnel as well as by contract. The Country Report is due January 1, 2012.

Country Reports will be synthesized into a World Report with the ultimate goal of developing national, regional, and global Plans of Action. The Forest Genetic Resources Working Group of the North American Forestry Commission hopes to integrate information from the Canada, USA, and Mexico Country Reports to provide a North American perspective on FGRs.

For more information:
http://www.fao.org/forestry/fgr/en/
http://www.fao.org/nr/cgrfa/cthemes/forest

BIOGRAPHY

Tannis Beardmore is a Research Scientist with the Canadian Forest Service, in Fredericton, NB. Her area of expertise includes seed science and molecular biology. She obtained her MSc and PhD at the University of Guelph in 1988 and 1991, respectively. She did a Post-Doc with the CFS in Petawawa, Ontario following which she was hired by the CFS and has been working there for 15 years. Her current research interests are in gene identification and gene conservation, in particular in developing methodologies for the *ex situ* conservation of hard-to-store or recalcitrant seeds.

Provincial Listing of Whitebark and Limber Pines and Development of Recovery Plans

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The Alberta Endangered Species Conservation Committee recommended that Whitebark pine (*Pinus albicaulis* Engelmann) and limber pine (*Pinus flexilis* James) be listed as *Endangered* to the Minister of Alberta Sustainable Resource Development (ASRD) on September 15, 2008. This recommendation was endorsed on October 24, 2008 and these species were listed in Schedule 6 of the Wildlife Regulation under Alberta's *Wildlife Act* on September 9, 2009.

The *Endangered* designation is based on an ongoing and projected population decline across the species' provincial range caused by the introduction of a non-native pathogen, white pine blister rust (*Cronartium ribicola*) (WPBR) and a native insect, mountain pine beetle (*Dendroctonus ponderosae*) (MPB). Other factors such as climate change and land management practices are also likely contributing to the decline.

Listing under Alberta's *Wildlife Act* requires and triggers development of a recovery plan which establishes the basis for cooperation among government, industry, conservation groups, landowners, and other stakeholders to ensure that species and populations listed as threatened or endangered in Alberta are restored or maintained for future generations. For species listed as *Endangered* in Alberta, recovery plans are to be developed within one year of listing.

Alberta species at risk recovery plans are prepared under the supervision of the Fish and Wildlife Division, ASRD and recovery teams are assembled on behalf of the Minister and by invitation from the Director of Wildlife Management. Recovery teams are generally composed of stakeholders from conservation organizations, industry, landowners, resource users, universities, and government agencies as well as experts in areas pertinent to the recovery of the listed species. Recovery team members working on the recovery plans for limber and whitebark pine in Alberta include members from ASRD Fish and Wildlife and Forest Management Divisions, Alberta Parks Division, Parks Canada, Canadian Forest Service (CFS), Alberta Native Plant Council, and the Alberta Forest Products Association.

This membership reflects well the needs for whitebark pine, a subalpine to alpine species where the majority of the range in Alberta falls within National Parks or Alberta public lands. It does not address as well the needs of limber pine, a montane to lower subalpine species, where most of the Canadian range occurs in Alberta and a significant portion falls on privately held lands.

As is typical for recovery plans developed for species listed as *Endangered* in Alberta, the current plans in draft form are composed of three main sections including:

1. Background information that highlights biology, population trends, and threats;
2. A recovery strategy section that outlines goals, objectives, and strategies to address the threats; and
3. An action plan that profiles priority actions required to maintain or restore the *Endangered* species.

The whitebark and limber pine recovery plans, although completed in draft form, have exceeded the one year preparation guideline due to limited time resources on the part of recovery team members and limited funding to assist with plan development. It is hoped that these plans will be completed shortly for submission to the Endangered Species Conservation Committee for final review and endorsement. They will then be submitted as advice and recommendations to the Minister responsible for fish and wildlife management in Alberta. At this time, a public and stakeholder review will also take place prior to the Minister providing final approval and publishing them as public government documents.

It is understood and recommended that species recovery work should continue during recovery plan development and that once adopted, the recovery plans will be reviewed annually by the recovery team for progress, evaluation, and updating.

Current ongoing work reflects recommendations made by the Endangered Species Conservation Committee to the Minister of ASRD for enhanced program development in the areas of:

1. Cone collections (both to find and propagate rust-resistant trees and to conserve genotypic diversity);
2. Development of species specific inventories to better determine current abundance and distribution; and
3. Monitoring of WPBR and MPB impacts and review opportunities for research into the use of anti-aggregation pheromone to protect trees from MPB.

A recent development which is likely to complicate but also accelerate recovery work for whitebark pine in Alberta is the recommendation for national listing of whitebark as *Endangered* under Schedule 1 of the *Species at Risk Act* (SARA) by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). This will require that a national recovery strategy be developed and work with the provincial plans be adjusted and coordinated. A status report for limber pine has also been submitted to COSEWIC for review.

Many of the current whitebark and limber pine Recovery Team members have been actively working within their agencies on whitebark and limber pine conservation and recovery work for some time. Much of this work was done through an ad-hoc inter-agency committee assembled by the now retired ASRD Forest Health Section Manager, Hideji Ono.

Ongoing conservation and recovery work to date includes the consolidation of numerous provincial inventories to prepare a species specific and more comprehensive inventory for limber and whitebark pine. Several additional projects are underway to try and improve upon and verify the existing inventory information.

Additional effort is also currently underway to establish more and re-measure existing WPBR plots to develop a more accurate picture of the extent of infection and change over time. There has also been an effort to develop and prioritize needed research work and to find sponsors and researchers willing to address identified gaps. Several selected stands of whitebark and limber pine have also had Verbenone anti-aggregation pheromone deployed to determine if this can be effective in deterring MPB attack.

A major effort and significant funding has been directed at wild seed collections to sample native populations, provide seed for restoration work, and to screen and collect seed from putatively WPBR resistant wild parents. ASRD, Alberta Parks Division, Parks Canada, and the CFS have been cooperating in this work for both species. Currently the combined joint seed collections stored at the Alberta Tree Improvement and Seed Centre (ATISC) for limber pine include 103.15 kg representing 265 single tree collections from 12 locations and 18 bulk collections from 12 locations. For whitebark pine, current seed archiving includes 30.69 kg representing 190 single tree collections from 5 locations and 11 bulk collections from 9 locations. Caging has continued this year with over 300 cages placed on limber pine and 550 on whitebark pine.

Initial restoration and conservation plantings for both species have started. Waterton Lakes National Park has initiated restoration plantings within the Park in cooperation with Glacier National Park and the USDA Forest Service. ATISC has raised 2441 limber pine and 419 whitebark pine seedlings as part of a plant propagation pilot project and has initiated outplanting this year onto selected sites as a conservation measure and test for suitable clone banking locations.

BIOGRAPHY

Leonard received a BSc and MSc in Forest Science from the University of Alberta in 1988 and 1996, respectively. He started working for the provincial government in 1986 and is currently Manager of the Alberta Tree Improvement and Seed Centre. He is a CON**FOR**GEN Steering Committee member and Alberta species recovery team member for whitebark and limber pine.

Forest Genetic Conservation Structure and Activities in British Columbia

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Forest genetic conservation activities are conducted by the Genetic Conservation Technical Advisory Committee (GCTAC) that functions as a sub-committee of the Forest Genetics Council (FGC). This does not represent all genetic conservation activities in BC. The committee was formed in 1999 to ensure due diligence (maintaining genetic diversity) was being performed within the context of the tree improvement programs. The original mandate was restricted to commercial species, although the need for more genetic information on other species was recognized. Our current definition of genetic conservation and our mandate is provided below:

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

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 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. Develop genetic conservation measures.

One of the earliest initiatives was to establish a Forest Gene Conservation Centre (now Centre for Forest Conservation Genetics = CFCG) at the University of British Columbia under the leadership of Dr. Sally Aitken. The centre's webpage provides a good overview of current projects, participants, and accomplishments:
http://www.genetics.forestry.ubc.ca/cfcg/index.html.

Key areas of investigation at the **CFCG** are:
1. Strategies for forest gene conservation.
2. Cataloguing *in situ* protection.
3. Species projects (i.e., genetic architecture of non-commercial species).
4. Climate change.
5. Adaptree.

In addition to the CFCG, the Forest Genetics section and the Tree Seed Centre have received project funding. Their respective areas of responsibility are indicated below.

Forest Genetics Section:
1. Genetic Conservation catalogue responsibility.
2. Extension / collaboration efforts. A new set of Genetic Conservation Program and Genetic Resource Management posters can be found at: http://www.for.gov.bc.ca/hfd/pubs/docs/P/P085.htm.
3. Inter situ conservation – maintenance and documentation.
4. Genotyping (in development) – species without information on their genetic architecture.

Tree Seed Centre:
1. *Ex situ* conservation.
2. Research on seed longevity.
3. Improving dormancy breaking treatments (i.e., whitebark pine).

The need for a catalogue of the conservation status of our tree species was recognized early and is a key component of the program. Two publications resulted from this effort and are available online:

1. Forest Tree Genetic Conservation Report 1
In Situ Conservation Status of All Indigenous British Columbia Species. 2009
https://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr053.htm

2. Forest Tree Genetic Conservation Report 2
Genetic Conservation Status of Operational Tree Species. 2009. (summary of *ex*, inter, and *in situ* resources)
https://www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr054.htm

Following development of the catalogue, (please see above references for methodology), the maintenance and monitoring activities were transferred to the provincial government. To verify some of the inventory data, especially with less common, non-commercial species, a ground-truthing project was conducted over the 2009 and 2010 summer field seasons. It is important to clarify objectives of the catalogue and ground-truthing. Are you wanting to determine if a species meets a specific criteria (i.e., 3 populations of >5000 mature individuals per ecological zone) or are you trying to predict population sizes? The first is a more realistic goal and foregiving of the catalogue underestimation found with certain common species. Predicting population sizes has several identified sources of error including the Habitat scale, mapping scale, species density, species distribution patterns, succession stage, and whether inbreeding or clonality are species characteristics.

We believe our genetic conservation catalogue provides us with a good, broad identification of species that are considered threatened, not threatened, or uncertain. More detailed analyses at a finer scale than the broad provincial catalogue may be justified for certain species. How we move forward with the catalogue (i.e., update to include protected areas since 2001) or whether we dedicate resources to understanding the genetic architecture of our non-commercial species is a topical question. Currently we recognize catalogue deficiencies or assumption violations for some of our non-commercial species, but no catalogue updates are scheduled at this time.

Whitebark pine (*Pinus albicaulis*) is a unique species that is being threatened from a variety of sources:

a) White pine blister rust (*Cronartium ribicola*) Introduced Disease;
b) Mountain pine beetle (*Dendroctonus ponderosae*) Native Insect;
c) Fire exclusion favouring lodgepole pine and subalpine fir; and
d) Climate change – where do the mountain-top species go?

In 2009 a "Genetic conservation strategy for whitebark pine in British Columbia" was produced by Jodie Krakowski and is available online at:
http://www.fgcouncil.bc.ca/GCTAC-WhitebarkPine-GenConsStrat-BC-2009.pdf

The strategy identifies five critical components to the genetic conservation of this species:

1. *Ex situ* conservation.
2. Collaboration and extension.
3. Screening for blister rust resistance.
4. *In situ* conservation.
5. Standardize, improve, and monitor inventory of whitebark pine populations.

The report identifies critical components, but these are not GCTAC deliverables – budgets and resources are not available to deliver all of these components at present. Unfortunately time is ticking away quickly for this species and options will become more limited the longer co-ordinated restoration activities are delayed.

For *ex situ* seed collection, this species is our highest priority. We currently have collections from 26 sites representing 317 individual tree collections and approximately 50 kg of seed. We are currently lacking collections from the northern BC Rockies portion of the species' range. The species is also supported by the Whitebark Pine Ecosystem Foundation of Canada:
http://www.whitebarkpine.ca/index.html

An important aspect highlighted at their latest meeting (July 14/15, 2011) was the value of volunteer organizations (i.e., Lillooet Naturalist Society) in moving forward species restoration. Hopefully the federal blue-listing of the species will proceed as planned resulting in provincial restoration plans and incredible synergies among those with a love of the species and its unique and beautiful ecosystem.

BIOGRAPHY

Dave has been at the BC provincial Tree Seed Centre since 1992 and conducts research, extension, and continuous improvement activities - primarily within the context of the Seed Handling System. He currently supervises the testing area at the BC Tree Seed Centre and chairs the Genetic Conservation Technical Advisory Committee (GCTAC) of the BC Forest Genetics Council. Dave is also actively involved in the national Tree Seed Working Group and various international tree seed committees. He has a BScF from UNB; a MScF in Forest Genetics from UBC and is a registered professional forester.

Chloroplast DNA Polymorphisms in Eastern Hemlock: Range-wide Genogeographic Analyses and Implications for Gene Conservation

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Eastern hemlock (*Tsuga canadensis* (L.) Carrière) is a conifer species endemic to the temperate forest region of eastern North America. The eastern and southern portions of its United- States distribution are being decimated by the hemlock woolly adelgid (*Adelges tsugae* Annand). Westward and northward expansion of this invasive insect is expected. Furthermore, the rate of global climate change predicted in the near future could catalyse the extirpation of eastern hemlock through host–pathogen–climate interactions.

The objective of this study was to determine if the genetic diversity of *T. canadensis* is uniformly distributed or structured. Individuals were sampled in 60 range-wide populations of *T. canadensis* and genotyped at seven polymorphic chloroplast DNA loci. All 16 chlorotypes identified in *T. canadensis* were highly divergent from the unique chlorotype detected in Carolina hemlock (*Tsuga caroliniana* Engelm.). Among-population differentiation in *T. canadensis* was low (G_{ST} = 0.020) and the distribution of chlorotypes did not show any strong geographical pattern, which is likely due to the homogenizing effect of pollen gene flow during the Holocene. Nevertheless, a spatial Bayesian approach revealed two distinct groups of populations. Furthermore, an analysis of relative genetic distances indicated that southeastern Appalachian populations harboured greater population differentiation while conserving relatively high allelic richness, which might represent the imprint of an ancient glacial refugium in the region. In-depth mitochondrial and nuclear DNA loci screening efforts or other more exhaustive paleobotanical investigations would be required to strengthen the inferences regarding the distribution of eastern hemlock during the last glacial maximum and whether or not the Appalachian mountain range acted as a vicariance factor between eastern hemlock populations during the last glacial period.

The risk of *Tsuga* decline following climate warming combined with the introduction of the hemlock woolly adelgid indicates that the southern part of the range should be considered of high priority for *ex situ* conservation. Moreover, the presence of rare and private chlorotypes in the southeastern United States might offer an indication that a reserve of relic genetic variation with potential adaptive importance could exist in the southeastern Appalachians. Further research is required with regards to adaptive trait variation in eastern hemlock.

This study was made possible by financial contributions from the Nova Scotia Department of Natural Resources to M.J. Lemieux, from the Natural Sciences and Engineering Research Council of Canada to J. Bousquet, and from the Canadian Forest Service to J. Beaulieu. Material from certain Canadian locations was collected by Dale Simpson, Bernard Daigle, Donnie McPhee, Kathleen Forbes, and Judy Loo of the Canadian Forest Service – Atlantic Forestry Centre, Daniel Plourde, René Pâquet, and Gaëtan Daoust of the Canadian Forest Service – Laurentian Forestry Centre, and Howard Frame of the Nova Scotia Department of Natural Resources. In addition, preliminary cytoplasmic DNA marker screening conducted by Sauphie Senneville, qPCR genotyping performed with Brian Boyle, and data analysis support from Julie Godbout and Sébastien Gérardi were instrumental for the completion of this research.

BIOGRAPHY

Mr. Lemieux received his undergraduate degree in forest science from Université de Moncton in 2001. He then worked as a forester (2001–2005) with Fraser Papers in Edmundston, New Brunswick and was responsible for a variety of silvicultural operations, nursery production, and tree improvement activities. After which, he worked as nursery forester (2005–2008) at the Nova Scotia provincial tree nursery. He completed his Master's degree (2008–2010) in forest science at Université Laval under Professor J. Bousquet. He is currently employed by the Nova Scotia Department of Natural Resources and oversees the province's tree gene conservation initiatives.

The International Protocol on Access and Benefit-sharing of Genetic Resources (ABS) and Development of a Domestic ABS Regime for Canada

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International Protocol

The *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity* (the ABS Protocol) was adopted in October 2010 with the objective of achieving the fair and equitable sharing of the benefits arising from the utilization of genetic resources. Genetic resources are "*any material of plant, animal, microbial or other origin of actual or potential value containing functional units of heredity*".

In the Protocol, "utilization of genetic resources" means to "*conduct research and development on the genetic and/or biochemical composition of genetic resources, including through the application of biotechnology*[1]". Utilization of genetic resources (e.g., researching plant extracts for active components that could be used as the basis for developing cancer drugs) may result in benefits that could be monetary, such as royalties or up front payment, and/or non-monetary, such as collaboration in scientific research and institutional capacity-building. The Protocol also covers traditional knowledge (TK) associated with genetic resources from indigenous and local communities (e.g., knowledge about the healing properties of certain plants).

Under the Protocol:

Access to genetic resources will be subject to the **prior informed consent (PIC)** of the Party providing the resource (unless otherwise determined by that Party); and

Genetic resources will be accessed and used according to **mutually agreed terms (MAT) negotiated between users and providers**. The terms serve as a contract, stating

[1]

"Biotechnology"…means any technological application that uses biological systems, living organisms, or derivatives thereof, to make or modify products or processes for specific use.

"Derivative" means a naturally occurring biochemical compound resulting from the genetic expression or metabolism of biological or genetic resources, even if it does not contain functional units of heredity.

how the resources are to be used, by whom, for what purpose, and how monetary and non-monetary benefits will be shared.

Parties will also be required to have compliance measures in place to implement the Protocol, as well as measures related to monitoring, such as designated checkpoints to collect relevant information. For further information: http://www.cbd.int/abs/.

Development of a domestic ABS regime for Canada

In parallel with the international agenda, federal, provincial, and territorial governments have been working toward developing a national ABS regime for Canada in consultation with stakeholders and Aboriginal communities. Forest sector stakeholders, especially the forest genetics community, have been engaged in this process to some extent, although more widespread engagement would be welcome as development of the domestic regime continues over the next couple of years. The general feeling is that a domestic regime will need to be as simple and efficient as possible to avoid slowing the transfer of genetic resources unnecessarily.

Impacts on the Forest Sector

Effects in the forest sector would primarily be felt in the academic, biotech, and non-forest products communities where there would be additional administrative requirements when exchanging forest genetic resources for research and development (e.g., having an agreement covering conditions for use and sharing of benefits). It should be noted that forest genetic resources are found in trees, non-timber forest species (e.g., shrubs, fungi, forest herbs) and forest soil (e.g., fungi, bacteria).

BIOGRAPHY

Jessica Thomson received a BSc in Botany from the University of Toronto, a MSc in Botany from Guelph, with a focus on ectomycorrhizae, and a BA in Political Science from Carleton. She has worked for Environment Canada and the Treasury Board Secretariat, and is now a Senior Policy Advisor with the International Affairs Division in the Canadian Forest Service, Natural Resources Canada. Current work covers a range of international forest files including the United Nations Forum on Forests (UNFF), the Food and Agriculture Organization (FAO), and the Convention on Biological Diversity (CBD).