Figure 1

Photo: Mike Carlson

Adapting to Adaptation:
Assisted Migration Addresses Climate Change

Fossil and pollen evidence indicates that species and populations of species have migrated thousands of kilometres repeatedly, while adjusting to past climate shifts. However, the current rate of climate change far exceeds that of the past. Species and populations will once again migrate and re-assort themselves naturally to climates where they are better adapted; however, this process may require several hundred years or longer, during which significant ecosystem disturbance is expected. Fortunately, forest professionals are in the position of being able to contribute to the solution proactively.

Provenance tests are *de facto* climate change laboratories—providing insight into the effects of a range of climates on the growth and health of populations of trees. Populations generally perform poorly in climates that depart significantly from the climates in which they have evolved. Rapid climate change is expected to result in increased frequency and intensity of maladaptation and pest and disease epidemics, with significant maladaptation expected in most areas of BC toward the end of the rotation for trees planted today.

Maladaptation manifests itself in the form of reduced productivity, poor stem form, increased susceptibility to insects and disease and occurs when the annual growth cycle of planted trees and the annual climate cycle of plantations become unsynchronized. Pest and disease problems may be exacerbated as the climate changes, with trees finding themselves exposed to new pests to which they have little or no resistance.

Several silvicultural strategies have been proposed to help mitigate the effects of climate change on planted forests. The strategy that has received the most attention is assisted migration—establishing plantations with trees that are adapted to future climates. The strategy can be applied to both species and seedlots, and involves anticipating the climate expected at the planting site at approximately one third of the rotation into the future, and selecting both species and seedlots suited to that climate. In this manner, it is expected that planted trees will be optimally adapted throughout the rotation.

In order to understand how assisted migration can be incorporated into BC's seed transfer system, it is important to understand BC's framework of forest management policy and current seed transfer system. In BC, Section 31 of FRPA requires forest professionals who are responsible for establishing a free growing stand to comply with the Forest Planning and Practices Regulation Section 43(4), which states that in establishing a free growing stand, forest professionals must comply with standards set out by the chief forester. The Chief Forester's Standards for Seed Use regulates the collection, registration, storage, testing, and use (transfer) of seed.

While assisted migration is conceptually simple, BC's current geography-based system of seed transfer described in the Chief Forester's Standards for Seed Use which uses longitude, latitude, elevation, biogeoclimatic zones and seed zones to limit seed transfer, does not lend itself to incorporating assisted migration comprehensively or effectively. Nonetheless, interim changes to seed transfer were made recently via the Chief Forester's Standards to encourage assisted migration through greater upward movement of seed. The Ministry of Forests and Range and UBC

Viewpoints

By Nicholas K. Ukrainetz, MSc, RPF, and Gregory A. O'Neill, PhD, RPF

Figure 1. These seedlings species will be planted from northern BC to southern Oregon as part of the Assisted Migration and Adaption Trial (AMAT).

researchers are currently developing a new system of seed transfer based on climate that will incorporate assisted migration effectively, while exploiting technological advances (GIS, ClimateBC, and genecology models) to guide seed transfer better and expand seed deployability. A prototype of the new system is expected by November 2010, and once completed, an implementation phase will allow seed users a period to adjust seed stocks where necessary.

Like the current seed transfer system, the new climate-based system will rely heavily on data from provenance and progeny tests established as early as the 1950s. These tests were designed for objectives other than climate change and assisted migration, and most were established over relatively small climate ranges with populations from small areas, so they do not provide complete information.

As a result, a new long-term project—the Assisted Migration and Adaptation Trial (AMAT)—has been initiated to fill gaps in provenance and progeny data. Selected populations of BC's 16 commercial species (Fig. 1), including three broadleaf species, will be planted side-by-side at 48 sites from northern BC to southern Oregon. By planting these materials far outside their comfort zone, their climatic tolerance can be better understood, helping to identify the species and populations best adapted to the range of climates anticipated at each planting site during the coming rotation.

The AMAT has benefited greatly from collaboration and generous support of members of the forestry community, particularly industry and BCTS staff. We thank the many people who have helped us by providing advice, test sites for field trials, and seed for testing. We encourage forest professionals and other researchers to become involved and lend support as the project continues.

References

References available at www.abcfp.ca

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Greg O'Neill, PhD, RPF, works as a scientist in the Research Branch of the MFR. His research focuses on understanding the adaptation of BC's tree species and developing approaches to apply this understanding to reforestation policy in the face of a changing climate.