

Transitioning British Columbia to Climate Based Seed Transfer

Introduction

Based on the knowledge that trees are genetically best adapted to the environment and climate in which they evolved, establishment of seed transfer limits has long been a fundamental component of reforestation. With BC warming an average of 1.4 degrees Celsius per century between 1900 and 2013,¹ trees have been unable to move or adapt fast enough to find their preferred climate niches.

In pursuit of adapting to and mitigating the impacts of climate change, while achieving the goals of forest ecosystem resilience, and health and productivity, the Forest Improvement and Research Management Branch (FIRM), has been working towards a climate based seed transfer (CBST) system for over a decade. The CBST system improves the match between seed and plantation climates through assisted migration. The approach, developed by FIRM staff with assistance from Dr. Tongli Wang at UBC, was published in 2017.²

Science Overview

The Province's existing seed transfer system uses a geography based methodology that limits seed transfers on the basis of longitude, latitude, elevation, and biogeoclimatic zone. The new climate based seed transfer system matches the climate and latitude of a seed source, as represented by a Biogeoclimatic Ecosystem Classification (BEC) subzone/variant, with the current and near-future climate of a planting site. The nine variables matched include:

- latitude,
- mean annual temperature,
- mean cold month temperature,
- summer/winter temperature differential,
- mean annual precipitation,
- mean summer precipitation,
- degree days above 5 degrees Celsius,
- extreme maximum temperature, and
- precipitation as snow.³

BC's approach to assisted migration in CBST is conservative. Most of the migration distance accounts for past climate change (1940's – 2016), or "adaptation lag"; future climate change is projected for only 15 years on the coast and 20 years in the Interior (representing a quarter of a rotation). This balances adaptation for ongoing climate change without compromising plantation establishment. Another way to look at this is we are currently planting into sites that are too

warm for the seed. With CBST, we will be planting into sites that are colder than the best climate match — in anticipation of ongoing climate change. This approach to migrating seed sources is combined with provenance data to determine an acceptable transfer distance. The oval in Figure 1 identifies the set of eligible seed deployment BEC variants for the seed source BEC variant. The resulting BEC variant matrix is the foundation of CBST transfer standards.

Species Selection and Seed Selection

Under the *Forest and Range Practices Act* (FRPA), the tree species selected to reforest each site are specified in a forest stewardship plan (FSP)⁴ and a seedlot is subsequently selected to achieve the *Chief Forester's Standards for Seed Use*. Given this approach, assisted migration under CBST will not move seed outside of its current species range, unless policy is also developed to apply assisted migration to tree species selection in the FSP.

Ministry of Forests, Lands, Natural Resource Operations and Rural Development (FLNRORD) research ecologists⁵ are currently developing an approach to climate change informed species selection (CCISS). This project is quantifying potential shifts in tree species suitability caused by climate change, and interpreting these results at the BEC site series (stand) and landscape levels. The model and decision aids are currently undergoing refinement and review.

Collaboration efforts between the CBST project and the CCISS project will continue to ensure integration and consistency between decision tools and policy realms.

CBST Policy Development and Implementation

As part of CBST policy development, FIRM worked with GIS consultants to develop a CBST tool⁶ to demonstrate shifts to areas of use for seed of each species in each BEC variant. An example of a shift is shown in Figure 2.

The parameters and science behind the CBST tool were recently incorporated into the FLNRORD's Seed Planning and Registry System (SPAR) to align with the planned first amendment to the *Chief Forester's Standards for Seed Use*. This amendment is being timed to enable optional use of CBST transfer limits, starting with the 2019 seedling request season (August, 2018). Initially, seed users will be able to use the current (geographically based) transfer standards, the CBST standards, or a mix of both. The option to use the current transfer standards will be discontinued at the end of the transition period.

Further impact assessment and gap analysis, as well as stakeholder engagement, is needed to help determine the most appropriate length for the transition period. At this time, a two-year period is planned, subject to results of the impact assessment, gap analysis, and further engagement.

The adaptive policy development approach used for CBST will be ongoing. FIRM will be hosting future training and information sharing sessions to support the planned phased implementation of CBST over the coming years. More information, including training opportunities, is available at www.gov.bc.ca/climatebasedseedtransfer. ●

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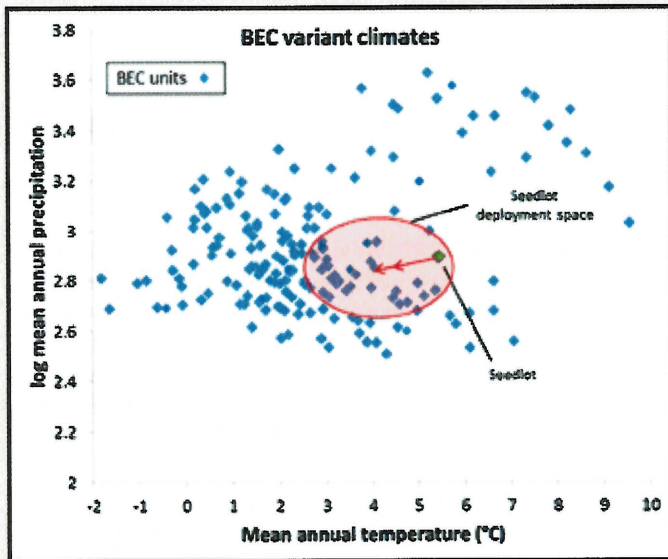


FIGURE 1: Schematic diagram (using two of the nine CBST geoclimatic variables) illustrating how assisted migration is achieved in CBST. The seed deployment space is shifted to a location slightly colder than the seed source origin. The long arrow represents the migration distance required to account for evolutionary lag since 1945. The short arrow represents the migration distance required to account for evolutionary lag anticipated to arise in the next quarter rotation. Each point represents one BEC variant. (Source: Dr. Greg O'Neill, RPF, FLNRORD).

Climate Base Seed Transfer and Risk

- Doing nothing about climate change is high risk.
- CBST is a climate change adaptation strategy intended to reduce the risk associated with climate change impacts.
- CBST takes a conservative approach, focusing on catching up with climate change that has already occurred, rather than projecting too far into the future; this is intended to balance establishment risk with the risk of maladaptation and loss of productivity.
- BC's network of forest genetic provenance trials has allowed scientists to use space in place of time to measure impacts of potential seed movements and advance the CBST project.
- There is no risk free approach to addressing climate change; all future climates are projections.

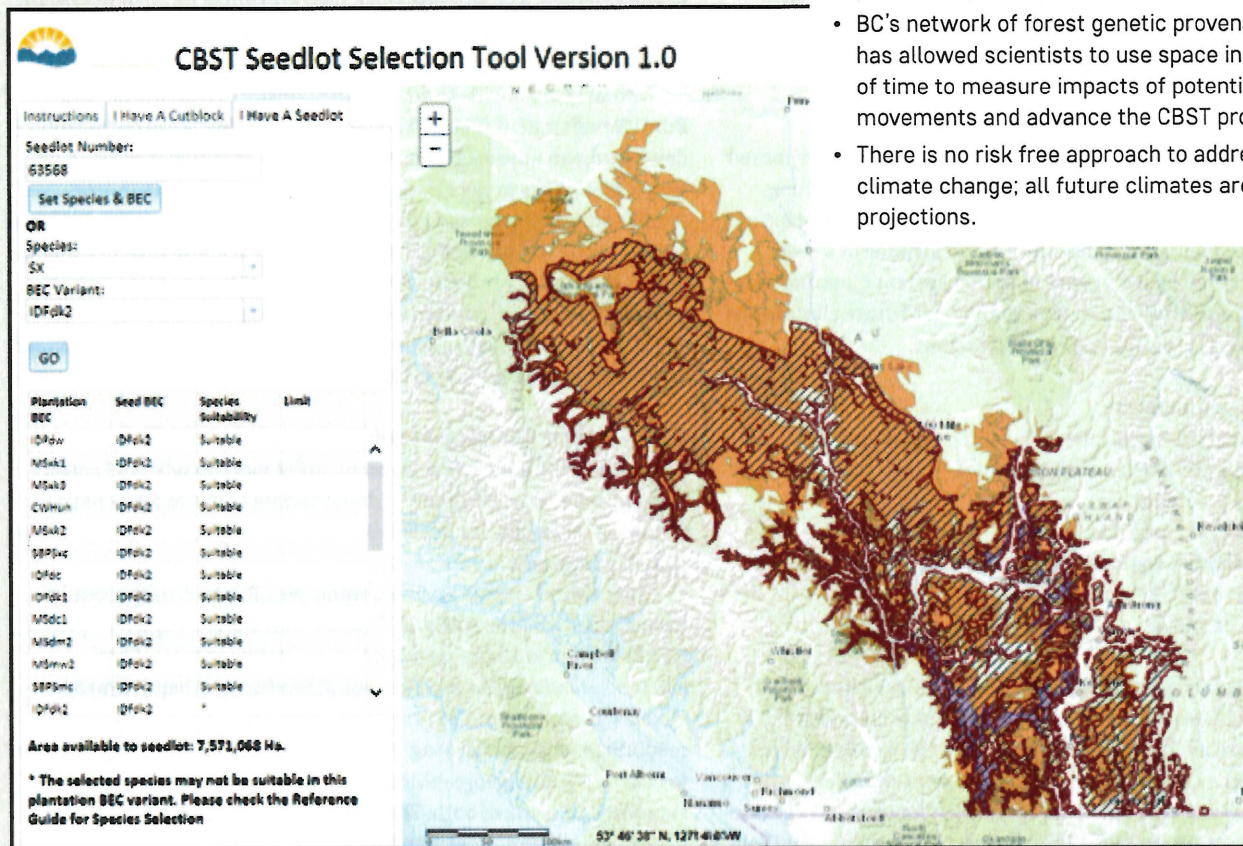


FIGURE 2. Example of a shift to a seedlot area of use. The red hatched area is the existing area of use for seedlot #63568 (Sx from seed BEC variant IDFdk2). The area marked in orange is the new CBST area of use, represented by the following BEC variants: IDFdw, MSxk1, MSxk3, CWHun, MSxk2, SBPxc, IDFdc, IDFdk1, MSdc1, MSdm2, MSmw2, SBPsmc, IDFdk2, MSxv, MSdm3, MSdc2, IDFdk4, ESSFxc1, MSdc3, MSdm1, SBPsmc3, ICHmk2, MSdv, SBPsmk, ESSFdv1, IDFdk3, SBSmm, ESSFdc2, SBPsd, ESSFxc3 and ESSFdc3.

References

1. Indicators of Climate Change for BC, Ministry of the Environment, 2002 (2016 update).
2. O'Neill, G. T. Wang, N. Ukrainetz, L. Charleson, L. McAuley, A. Yanchuk, and S. Zedel. 2017. A proposed climate-based seed transfer system for British Columbia. Prov. B.C., Victoria, B.C. Tech. Rep. 099. www.for.gov.bc.ca/hfd/pubs/Docs/Tr/Tr099.htm
3. Precipitation as snow was added as a result of genomics information provided through the AdapTree genomics project led by Dr. Sally Aitken, at UBC.
4. The Reference Guide for Forest Development Stocking Standards provides information to assist in tree species selection.
5. Initiative led by Will Mackenzie, Provincial Ecologist, North Area; and Pamela Dykstra, Research Leader, Forest Ecology Interpretations, Resource Practices Branch, Office of the Chief Forester
6. The CBST tool can be accessed at: www.gov.bc.ca/climatebasedseedtransfer.