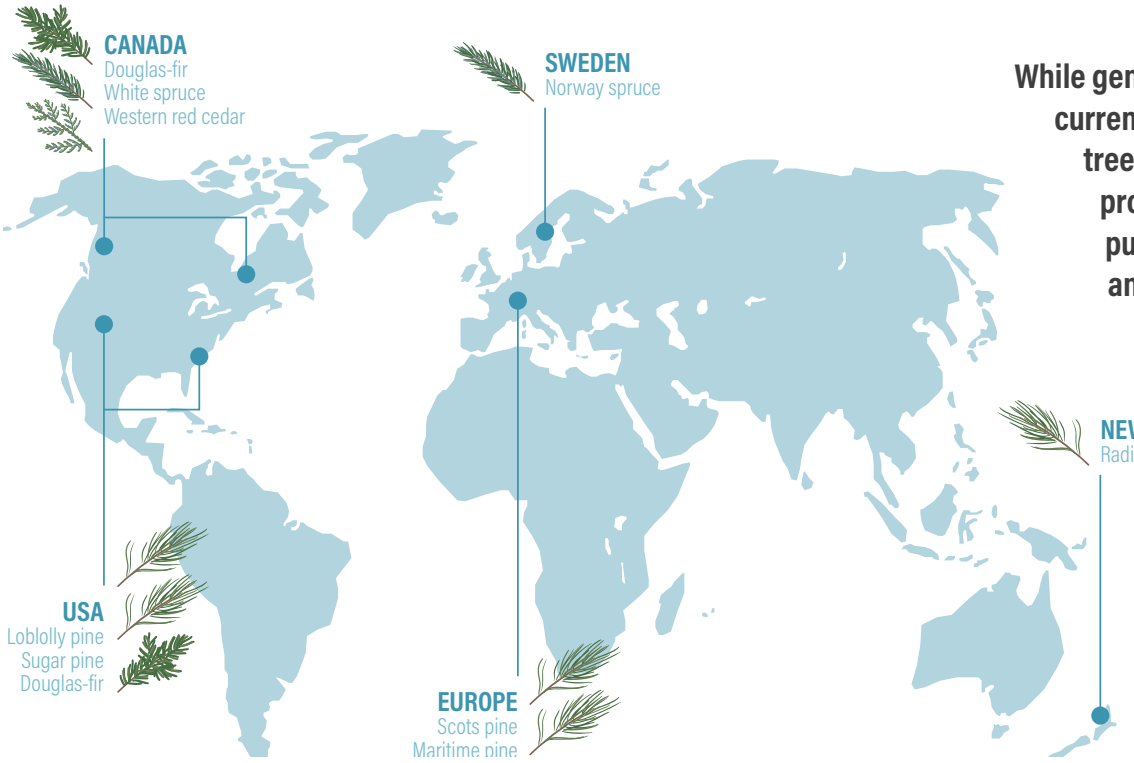
The Context of Developing Genomics Technology in Forestry

MAY 22, 2020

White spruce and lodgepole pine are the two most important commercial tree species in Alberta. **Tree improvement programs for these species have been an important part of reforestation in the province,** with available improved seed (selected primarily for growth) from seed orchards.

Trees are long-lived plants with life cycles spanning decades to several centuries, which limits generation turnover and the rate at which improved seeds can be developed. Furthermore, traditional tree improvement cycles take decades for a single generation of improvement to be realized. These considerations make it difficult to respond quickly to emerging challenges, such as changing wood product markets or climate change.

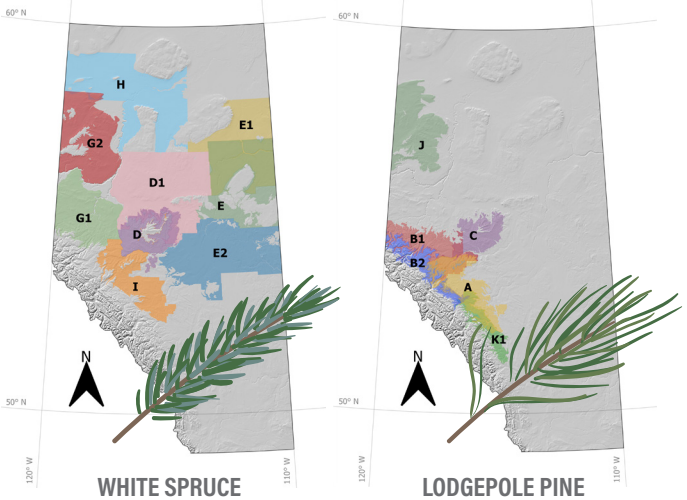


While genomic selection is not currently used in Alberta's tree improvement programs, it is actively pursued both nationally and internationally.

EXAMPLES OF CONIFER TREE IMPROVEMENT PROGRAMS USING GENOMIC SELECTION

Genomic selection models are not universal and separate models must be "trained" for each population. Alberta organizes tree breeding programs into areas known as Controlled Parentage Program (CPP) regions. Improved seeds are produced in seed orchards from parent trees originating from a CPP region and seedlings are then planted back into the same CPP region. If genomic selection is adopted into tree improvement programs in Alberta, **a unique genomic selection model will be needed for each region and adjusted as the parents in a particular program change over time.** Specialists with unique technical skills will be needed to develop these models. Under current regulations, the use of genomic selection would need to be reviewed and approved by the Alberta government, regardless of who the owner of the program is (i.e., industry or Government).

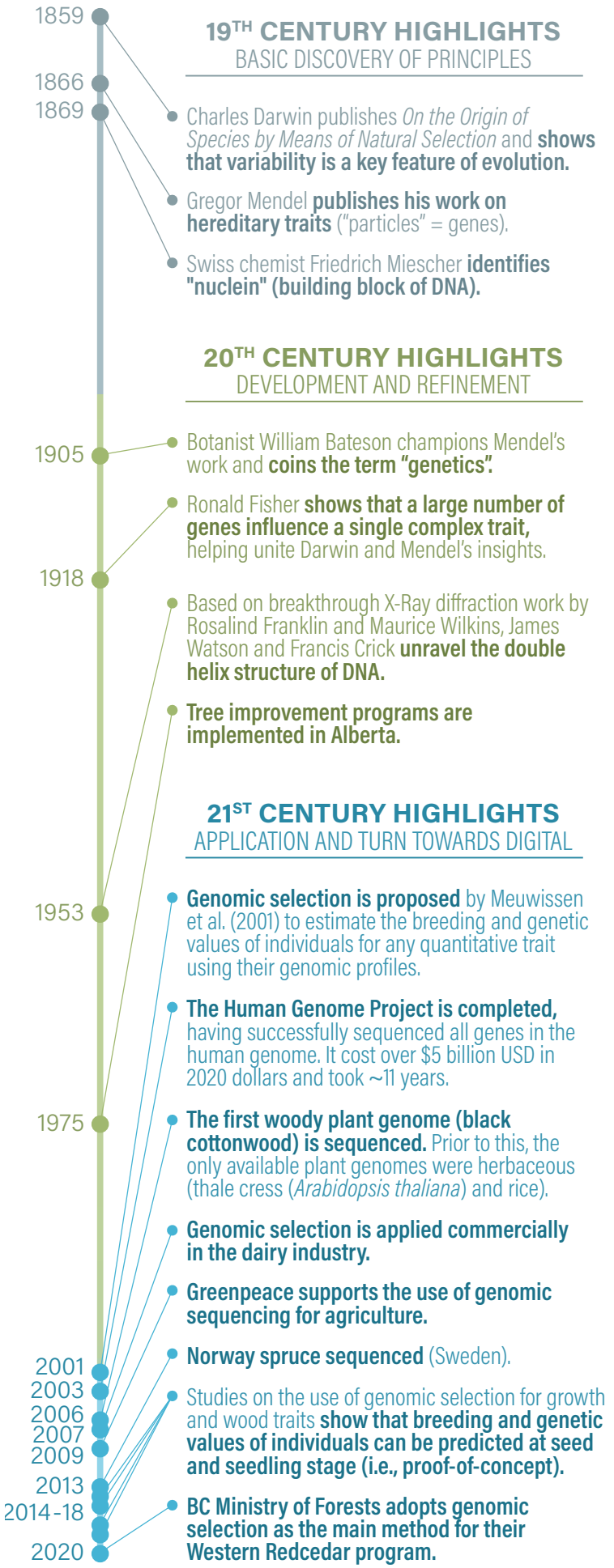
INDIVIDUAL CONTROLLED PARENTAGE PROGRAM (CPP) REGIONS ARE INDICATED BY COLOUR AND LETTER FOR EACH PROGRAM IN ALBERTA.



WHITE SPRUCE LODGEPOLE PINE

CPP region maps (right) created by J. S. Azcona.

RESFOR
https://resfor.ualberta.ca/



History of Genetics, Genomics and Genomic Selection

The 20th century saw gradual improvements to our understanding of evolution, DNA, and genetics. These discoveries spurred a wide range of technological and societal transformations.

Improvements to DNA sequencing technology in the 21st century greatly accelerated the development of genomic tools and their adoption into commercial industries such as agriculture.

Today, genomic tools and genomic selection are fast-moving areas of technological change. Applications that were wholly unfeasible a short time ago are now possible, as a result of advances in DNA sequencing technology, decreasing costs, newly assembled genomes of previously unmapped species, and the availability of large digital databases. As with any rapidly evolving technology, **what we "know" and "don't know" will continue to change.**

Questions for Consideration

Since genomic technologies are quickly changing, **it is impossible to know in advance, what all the implications of adopting genomic selection will be.**

Several questions need to be considered:

- **What changes could genomic selection bring to tree breeding practices?**
- **What are the potential limitations?**
- **Who is included or excluded from decision making about genomic selection?**
- **Who benefits and who might stand to lose from the implementation of genomic selection?**

RES FOR
https://resfor.ualberta.ca/

For further information contact:
Barb Thomas: bthomas@ualberta.ca
Gwen Blue: ggblue@ucalgary.ca