QuickNotes
Science summaries from fRI Research

Introducing: Whitebark Pine Gene Conservation for the Northern Range in Alberta

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Challenging access to the northernmost stands of endangered whitebark pine in Alberta limits seed collection opportunities. Whitebark pine seeds are extremely high in fat and protein, which makes them a prized and unique food for wildlife but leads to rapid viability decline in storage. Recent impacts to susceptible host trees caused by northern expansion of mountain pine beetle makes gene conservation of these northern populations more urgent. Irregular seed crops and the need to protect cone-bearing trees from predators to collect viable seeds when the cones are mature make planning difficult and collection technically challenging and costly. There may be an opportunity to predict cone crop abundance at whitebark pine's northern limit in Alberta by monitoring more easily accessible stands in other regions if they are correlated. Assays of seed viability from these other populations are also planned to determine if cone crop abundance is associated with embryo development and proportion of filled seeds – if poor cone years also have poor viability, collections should focus on mast years for the best seed yields.

Objectives

1. To replenish provincial genetic resources of endangered whitebark pine populations at the northern limit of Alberta's populations
2. To determine whether cone production timing and magnitude in accessible stands in other regions is similar to stands in Willmore, therefore whether they provide a lower-cost reliable indicator
3. To evaluate variation in seed viability within and among stands in Willmore to guide future collections

Federal-Provincial MPB Research Partnership

Mountain Pine Beetle remains a severe threat to Alberta's pine forests despite the province making positive progress in controlling its spread within the province and reducing the risk to the rest of Canada.

Natural Resources Canada and Alberta Agriculture and Forestry have provided funding to a suite of projects with the goals of limiting the spread of Mountain Pine Beetle and mitigating damages where it has already invaded.

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Canada

Alberta Agriculture and Forestry

4. to support the capacity of Alberta's restoration and research related to resiliency of whitebark pine populations post-MPB attack and in the face of climate change impacts on high-elevation endangered species

Expected Outcomes

1. New collections of viable seed from Alberta's northernmost whitebark pine stands to support gene conservation of these unique populations
2. Data on cone crop abundance from these stands and other whitebarks stands in different regions to determine whether northern crops can be predicted based on crops in other, more easily accessible regions
3. Data on seed viability (proportion of filled vs empty seeds, regular vs abnormal embryos) to determine whether seed collection is worthwhile in years when cone crops are lower compared to when they are more abundant

Whitebark pine growing from a seed cache.

Expected Social, Economic, and Ecological Value

As whitebark pine grows so slowly and takes 50-80 years to begin producing cones, mortality of cone-bearing trees caused by MPB has impacts lasting decades, even centuries as these trees live and reproduce a very long time. Sustaining the genetic diversity of northern populations is important for ecological resilience and climate change adaptation. Recent research has shown that MPB in northern whitebark pine populations prefer healthy trees, making them even more vulnerable, so conserving a sample of seeds from healthy trees provides a valuable resource to replenish the provincial genetic archives, for Alberta Parks who have jurisdiction and a mandate to conserve these populations, and for partners involved in whitebark pine research and restoration following MPB impacts.

Whitebark pine growth form and habitat.

Expected Completion Date

Whitebark pine is an endangered species in Alberta under the provincial *Wildlife Act* and federally under the *Species At Risk Act.* Although there are still many whitebark pine trees growing in its harsh, high-elevation habitat, its rapid population decline means it is at risk of extirpation or extinction within a few generations. It grows very slowly and takes 50 to 80 years to start producing cones, so impacts take generations to recover.

For more information on this project, contact Jodie Krakowski at jodie@whitebarkpine.ca.

Background Information on Whitebark Pine

Whitebark pine is endangered

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Although it has limited timber value because of its branchy form and twisted wood grain, its seeds have uniquely high value as important wildlife food for birds and many mammal species including squirrels and bears. The seeds are dispersed by Clark's Nutcracker, a bird in the jay family that has evolved special adaptations to forage on and plant the seeds; without this bird, the tree cannot reproduce. The ranges of the bird and the tree completely overlap in Canada, reflecting their mutualistic relationship. Its cones have lost the ability to open when mature, and seeds left on the ground will go rancid because of their extremely high fat and protein content. Clark's Nutcrackers forage on the seeds, caching them in the ground for their main food source, and seedlings grow from seeds that the bird does not dig up and eat. They will often grow in clumps from caches of multiple seeds. The only way to tell if each stem is a separate tree, or just a bushy single tree is by DNA analysis.

Threats to whitebark pine

The main threat to the species in Alberta is the introduced fungal pathogen causing the fatal disease white pine blister rust. It has been spreading through the range of the species for over 100 years and cannot be eradicated. Extensive mountain pine beetle attack mortality of mature whitebark pine trees was observed in the Waterton and Crowsnest areas during the 1980s, in Willmore Wilderness during the mid-2000s, and in Jasper National Park during the mid-2010's. Changes to natural fire regimes that either kill trees directly due to more extensive, severe fires at high elevations, or indirectly through fire suppression where whitebark pine regenera-

Clark's Nutcracker

Blister rust infection with orange sporulating canker.

tion is out-competed by more shade-tolerant species; and climate change, which favours mountain pine beetle outbreaks and blister rust pathology, stresses trees so they are more susceptible to attack, and increases the frequency and severity of wildfires. Trees in some locations are also impacted by development.

The importance of gene conservation

Conserving seeds under proper conditions in the provincial seed archive is one major part of gene conservation. Even if natural populations are impacted, seeds hold the key to restoration. A carefully planned conservation collection contains high genetic diversity, and samples well-distributed trees and populations.

Some rare trees are genetically resistant to white pine blister rust. Collecting seeds from healthy trees in heavily infected stands is the foundation of Alberta's recovery program, as well as partner programs across the species' range. In areas where blister rust is not very high, sampling healthy trees from well-distributed populations is the next best option. This is the case in Willmore Wilderness, the northern limit of the species in Alberta. Northern populations have particular importance because of climate change.

This project aims to collect seeds from healthy trees in several stands in Willmore Wilderness, and assay the seeds for viability because it is important to know whether sparse crops are still worth collecting, or if they will produce few germinants per cone compared to more abundant cone crops. Because of its remoteness, Willmore is a very expensive area to work in. We are also collecting cone crop and seed data from other whitebark pine populations to try and determine if cone crops and seed viability in areas that are easier to access are related to cone abundance in Willmore in order to aid planning for cone collection.

Whitebark pine stand burnt in the 2015 Boundary Fire in Willmore Wilderness. Note the thin bark.

Processing whitebark pine cones to extract the seeds

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