Whitebark and Limber Pine Fact Sheet 3
Plus trees: criteria, methods, data collection and sharing

Plus trees are trees selected in the field based on physical indications that they are **likely to be disease resistant**. They have not been tested yet and confirmed to have heritable resistance (those are "**elite trees**"). Given their rarity, focusing exclusively on plus trees for seed collection will still increase the frequency of disease-resistant regeneration on the landscape.

Whitebark and limber pine mature very slowly, only producing cones after age 50 to 80 years. Trees must survive until beyond that age to effectively sustain the population.

Un-selected trees are assumed to have zero resistance. **Do not plant seedlings grown from un-selected trees** in areas with moderate or higher rust hazard because they are very likely to die before maturity, wasting the effort and cost to collect seeds, register and store them, grow seedlings, and plant them. Do not select plus trees in stands with low rust infection levels. There is no way to reliably identify a disease resistant tree without a stringent comparison to a heavily infected stand.

GOA has a recovery program with **many plus trees already selected** that are undergoing rust resistance testing, with permanent unique ID tags. The identities of these trees have been compiled in a database.

To select new plus trees, they must conform to GOA standards of selection and data collection**. Field training is required**. Submit to the recovery team to add to the program database by emailing GOA.EndangeredPine@gov.ab.ca. Permanent unique ID tags conforming to the GOA numbering system must be installed on each selection. Only select in heavily infected stands (>80%), otherwise selections are considered unreliable. The chance of confirming heritable resistance is much higher if nearly all trees in a stand are infected and you select a healthy tree.

Data on plus trees must include Tree ID tag, detailed GPS location, measurement, age, and a detailed health assessment of the tree using high-powered binoculars, following GOA data standards. A health assessment of the stand, using standardized methods of the WPEFC or a 100-tree survey, is required. Data must be submitted to the recovery team to add to the program database to ensure it meets GOA criteria for selection.

Plus trees, plus a 30-m buffer around the roots, should be **protected** – these are **irreplaceable** and rare genetic resources fundamental to recovery of the species. New selections are added annually to GOA spatial data sets as high-value resources for incorporation in wildfire management and land use planning.

Plus trees should **be screened for heritable rust resistance to confirm suspected status**. This is costly and takes 7 years from submission of seed to final results. Interim results may be available. Facilities accepting seeds for testing are: 1) USDA Forest Service nursery in at Coeur D'Alene, 2) USDA Dorena Genetic Resource Centre in Oregon, and 3) BC forest ministry Kalamalka Forestry Centre in Vernon. A CFIA phytosanitary certificate is required to ship seeds to the USA, but not an export permit. Inoculation protocols are fairly consistent between facilities, but sample size and mechanisms assessed vary. USDA facilities provide very detailed interpretations of different resistance mechanisms; the BC facility focuses on survival. Costs range currently from $1000 CAD per tree in BC to around $1700 CAD per tree in the USA, varying with exchange rate and inflation. It may or may not be possible to get resistant tested "winners" back from the USA - it has been done before, but no guarantee.

Where plus trees have poor test performance, do not remove the tags in the field. That way we know they were already considered and evaluated and can look up the results.