The U.S. Forest Service's Renewed Focus on Gene Conservation of Five-Needle Pine Species

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Abstract

Abstract—The U.S. Forest Service (FS) has been actively working with five-needle pine species for decades. The main focus of this interest has been in restoration efforts involving disease-resistance screening activities in western white (*Pinus monticola*), sugar (*Pinus lambertiana*), and eastern white (*Pinus strobus*) pines in the face of white pine blister rust (WPBR), caused by the non-native invasive pathogen, *Cronartium ribicola*. There has also been some effort in whitebark pine (*Pinus albicaulis*) and limber pine *(Pinus flexilis*) disease-resistance work, but to a lesser degree. Recently the FS has been actively pursuing a gene conservation effort in whitebark, Rocky Mountain (RM) bristlecone (*Pinus aristata*), southwestern white (*Pinus strobiformis*), foxtail (*Pinus balfouriana*) and limber pines to conserve germplasm as a result of increased mortality from WPBR, mountain pine beetle (*Dendrotonus ponderosae*) (MPB) and the warming effects of climate change. This paper will describe the renewed focus of gene conservation of these iconic species.

Currently, we are experiencing the worst epidemic in recorded history of MPB, a native insect. About 8.8 million acres had some level of mortality in 2009. Part of this current epidemic is the result of large, relatively even-aged homogeneous forests of susceptible lodgepole pine (*Pinus contorta*) that are mature and have thus become beetle-prone. In addition, the warming effects of a changing climate have resulted in MPB being able to survive winters that aren't as cold as they used to be. This warming effect has allowed beetles to attack high elevation tree species that normally were not affected. The combined effects of WPBR, MPB and the effects of climate change have resulted in many high-elevation five-needle pine forests of whitebark, limber, foxtail and RM bristlecone pine being heavily impacted.

In 2007, the Forest Health Protection (FHP) Program developed a framework for gene conservation to save seed of these important species for later replanting. The "Forest Service General Framework for Genetic Conservation of US Forest Tree Species" is a multi-step plan that includes assessment and planning activities, as well as outlining pertinent actions that need to occur to conduct proper gene conservation efforts. We used the Framework for four species or groups of species that were at risk from various pests or climate change. These include ash (*Fraxinus* sp.) (at risk from emerald ash borer), butternut (*Juglans cinerea*) (at risk from butternut canker), eastern hemlock (*Tsuga canadensis*) and Carolina hemlock (*Tsuga caroliniana*) (at risk from hemlock woolly adelgid, *Adelges tsugae*) and the five-needle pine species group. In this paper I focus strictly on the activities concerning the five-needle pine group.

A group of specialists assembled a plan for gene conservation of four species of five-needle pine (whitebark, limber, foxtail and RM bristlecone pine). Using existing seed zones and expert judgment about ecological and genetic differentiation, a target of about 2830 individual trees was established to cover these four species. With good cone crops in 2008 and 2009 and acceptable cone crops in 2010, extensive collections were made and are discussed elsewhere in this proceedings. At this juncture, we have collected about 1350 trees (families). We are storing the seed in FS facilities, as well as establishing back-up collections at the Agricultural Research Service National Center for Genetic Resources Preservation (ARS-NCGRP) facility in Fort Collins, CO.

This stored seed will allow for the re-establishment of populations of these species, as needed, in the future. This seed provides a representative sample of conserved material tied to current seed zones of each species. Conceivably, in the future we will need/want to use the seed to re-establish plantations or seed orchards through seedlings or vegetative propagation of the material.

We are linking these *ex situ* gene conservation efforts with ongoing restoration efforts taking place within the FS. These restoration efforts include screening trees for resistance to WPBR, reforestation efforts planted with WPBR-resistant seedlings, pruning western white pine plantations, prescribed burning of sites to promote regeneration of whitebark pine, etc.

We will continue to collect seed, as cone crops permit, of the four species of five-needle pines in order to meet our initial goal of 2830 families. Afterward, other activities will be contemplated. These might include collecting more seed of these species or collecting other at-risk tree species.

Our hope is that we will never really need this collected material because we hope the existing populations are resilient enough to adapt and survive long into the future. However, it's a good policy to hedge our bets in these uncertain times and have at least *ex situ* genetic resources available for future reforestation needs if needed.

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