

Joining Forces for Genetic Conservation¹

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Facing a Challenge

Non-native diseases and insects as well as a changing climate pose serious threats to native trees in North America. Genetic variation in a species is key to its enduring persistence in the face of these abiotic and biotic threats. Efforts to conserve genetic diversity of North American tree at-risk species will ensure the genetic resources of a species are available to help foster management activities to preserve tree species in native and urban forests, retain their invaluable roles in providing ecosystem services, and commercial and cultural uses.

One species facing such challenges is whitebark pine (*Pinus albicaulis*), an ecologically important and much beloved tree warranted for listing under the Endangered Species Act (USFWS 2011). White pine blister rust (WPBR) (caused by the non-native fungal pathogen *Cronartium ribicola*), mountain pine beetle (*Dendroctonus ponderosae*), and climate change are severely impacting the health of whitebark pine stands across the range of the species (USFWS 2011). Collaboration between groups such as public gardens and the U.S. Department of Agriculture Forest Service (USDA FS) can bolster efforts to conserve whitebark pine and other threatened tree species by offering opportunities for sharing resources, conservation education, and genetic conservation. The USDA FS is a leader in mitigating whitebark pine decline through its support of personnel and active programs that evaluate the frequency and level of genetic resistance to WPBR (Snieszko et al. 2011a) and the development of protocols to initiate restoration activities. Successful restoration of whitebark pine will require collaboration with and the contributions of many other groups as well.

Public Gardens' Role

Public gardens (including botanic gardens and arboreta) offer a unique and highly accessible set of sites for research, public education, and detailed monitoring of abiotic and biotic events that affect threatened tree species like whitebark pine. Many gardens hold well-documented plant collections, including data that track wild origin, propagation protocols, weed risk assessments, phenology, health/hazards, permits, images, and more. The professionalism with which many public gardens managed the diversity of trees and other plants in their care provides a wealth of opportunity to learn about and study a wide range of species in a controlled setting. Public gardens are also experts at educating the public about the challenges facing tree species and the ways in which the public can help, an important component to the success of

¹ A version of this paper was presented at the Gene Conservation of Tree Species – Banking on the Future Workshop, May 16-19, 2016, Chicago, IL.

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any dynamic genetic conservation program. More information and further details about online data systems can be found on each public garden's website.

Communication within a network of professionals in the field of public horticulture is also essential to strengthening collections and the conservation of plant material. One particular organization serving as a link across public gardens is the American Public Gardens Association (APGA). Through collaborative efforts in preservation, education, research, and various management practices, the APGA contributes to the conservation of at-risk plants.

USDA Forest Service's Role

The USDA FS is the federal natural resource agency that serves as the steward of 780,000 km² (193 million ac) of National Forest System lands and provides technical and financial assistance to state and private entities for forest health and conservation related activities. USDA FS geneticists have been at the forefront of genetic conservation activities for many decades. For example, the nine white pine species, including whitebark pine, native to the United States are highly susceptible to WPBR. They are all currently being screened for genetic resistance to WPBR at regional USDA FS facilities. The first resistance trials of whitebark pine indicated higher than expected levels of genetic resistance to WPBR, at least in some Pacific Northwest populations (Snieszko et al. 2007, 2011a), and the USDA FS and partners have an active program to conserve its genetic diversity and restore the species and across its range (Mangold 2011, Snieszko et al. 2011b). Seed from over 1,000 individual tree collections is now stored for long-term genetic conservation at National Laboratory for Genetic Resources Preservation, a USDA Agricultural Research Service facility in Fort Collins, Colorado (documented in the Germplasm Resources Information Network (GRIN-Global) database). Successful seed storage for >25 years has been documented in some whitebark pine seedlots (Snieszko, unpublished data).

Joining Forces

There are many organizations that have a wealth of knowledge concerning genetic conservation. In an effort to take advantage of these riches to improve conservation outcomes and to improve communication among scientists and between the scientific community and the public, the USDA FS formally joined forces with public gardens in 2016. The USDA FS's Dorena Genetic Resource Center (DGRC) in Cottage Grove, Oregon is actively involved in WPBR resistance screening in whitebark pine. In 2015, DGRC had surplus seedlings of whitebark pine representing a range of populations in Oregon and Washington (fig. 1). The DGRC sent out informal inquiries to gauge potential interest in accepting the seedlings through APGA. Eight botanic gardens and arboreta across the country expressed interest (fig. 2). By the spring of 2016, 138 whitebark pine seedlings from 17 families (family = offspring from one parent tree) were distributed to participating institutions: Hoyt Arboretum, Minnesota Landscape Arboretum, Denver Botanic Gardens, Cornell Botanic Gardens, Morton Arboretum, Missouri Botanical Garden, Arnold Arboretum, and the United States National Arboretum. The number and source of the seedlings varied, but seedlings of two common families were shipped to seven out of the eight public gardens (one to two seedlings per garden), creating a linkage across the gardens. This core collection of whitebark pine seedlings came from two source populations found on the east side of the Cascade Range (Wallowa Whitman National Forest (NF) and Colville NF). Seedlings from the remaining 15 families were distributed amongst the gardens with some overlap (table 1). In addition, seedlings of *Pinus lambertiana* (sugar pine), *Pinus strobiformis* (southwestern white pine), *Pinus flexilis* (limber pine), and *Chamaecyparis lawsoniana* (Port-Orford-cedar, whose populations are threatened by the non-native *Phytophthora lateralis* pathogen) have also been distributed to some public gardens (fig. 3).

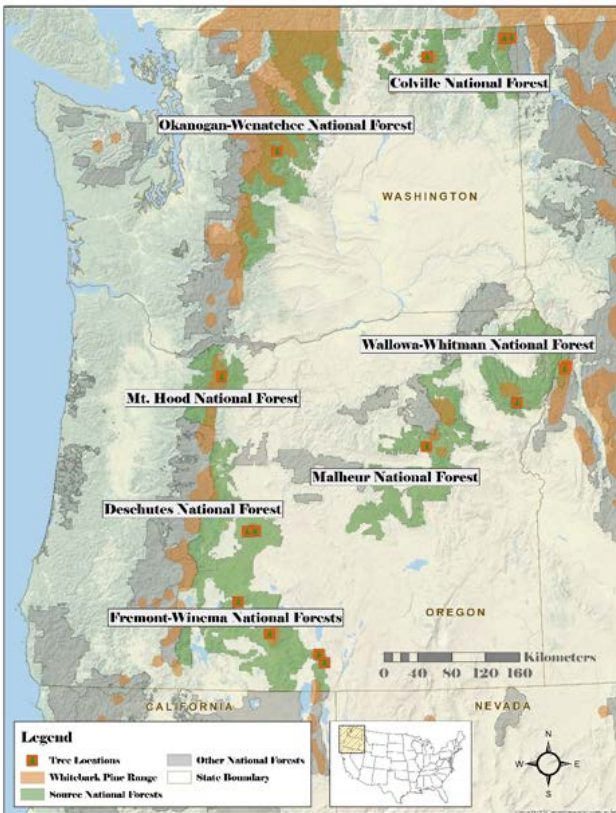


Figure 1—Geographic origins of whitebark pine seedlings sent to public gardens.



Figure 2—Participating public gardens.



Figure 3—Port-Orford-cedar, sugar pine, and southwestern white pine await transplant at Cornell Botanic Gardens. (Photo credit Phil Syphrit)

These plantings will serve to monitor each species' adaptability in different climates, as sentinels for new biotic and abiotic threats, and as resources to initiate research. Public gardens have excellent public visibility, and this partnership between the USDA FS and the public gardens will assist in conservation education.

A joint Memorandum of Understanding (MOU) was signed in May 2016 between the USDA FS and the North American Plant Conservation Initiative. The MOU will help foster a wider array of cooperation between the USDA FS and the groups (the American Public Gardens Association, the Botanic Gardens Conservation International, the Center for Plant Conservation, and the Plant Conservation Alliance non-federal cooperators) involved in the conservation initiative. As native tree species are facing increasing and serious threats such as climate change, invasive pests and pathogens, and changing fire regimes, further collaboration between the USDA FS and public gardens on genetic conservation of forest trees will pay enormous dividends for conserving trees and protecting the public's forest resources.

Table 1—Number and source location of whitebark pine seedlings shipped to each botanical garden and arboretum

National Forest, State	Accession #	Cornell Botanic Gardens	Hoyt Arboretum	Denver Botanic Gardens	Minnesota Landscape Arboretum	U.S. National Arboretum	The Arnold Arboretum of Harvard University	Missouri Botanical Garden	Morton Arboretum
Colville, WA	214738	2	1	2	2	2	2	1	
	223206	3		3			4		
	223223						2		
Deschutes, OR	011176	2		2					
	011251	3	2	3	2	2			
Fremont-Winema, OR	005107		2						
	005062				2				2
	005153					2	7		
	005081							1	
	005045	2		2					2
Malheur, OR	044664	3		3		2			
Mt Hood, OR	066016	1		2					
Okanogan-Wenatchee, WA	170835	3	2	3	2	2		1	
Wallowa-Whitman, OR	160956	5		5					
	160960	2	2	2	2	2	2	2	
	160963	2	2	2	2	2	4		5
	166260			4					5

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