

Whitebark pine restoration under way at Crater Lake

Preemptive strike against blister rust based on disease-resistant seedlings

By Laura E. Hudson and Elena Karnaugh Thomas

RESOURCE MANAGERS AT CRATER LAKE

National Park in Oregon are fighting the die-off of whitebark pine (*Pinus albicaulis*) from blister rust fungal infection (*Cronartium ribicola*) through a series of experimental restorations. The project is a major part of the Whitebark Pine Conservation Program at the park and relies on collecting cones from apparently disease-resistant whitebark pines to obtain seeds for use in propagation studies. Disease resistance is a qualitative measure based on amount of blister rust infection apparent on a tree historically and at the time of seed collection. Infections are generally in the form of dead branches with old canker swelling, active cankers, or flagging (dead needles on the end of a branch).

Seeds collected from these disease-resistant parent trees in 2005 and 2006 were processed and sown at the USDA Forest Service's Dorena Genetic Research Center, Oregon. A subgroup of these seedlings is involved in a five-year blister rust assay; they were inoculated with blister rust in a separate, specially designated greenhouse in fall 2008, and final assessment of resistance will be available in 2013. Two other subgroups of the seedlings were returned to Crater Lake for (1) the Rim Village restoration project of a former parking lot, and (2) the Horse Trail project, involving an experimental rust-resistant endophyte study. The latter is to look at long-term success of seedlings that were inoculated with a

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potential blister rust-resistant endophyte, and compare them with a control group. (An endophyte is a fungus that lives inside a plant, in a parasitic or mutualistic relationship.)

Prior to planting our first-ever disease-resistant whitebark pine seedlings from Dorena, we had to review the restoration history of the former parking lot at the Crater Lake Rim Village. The century-old parking area was removed and relocated in 2006 during a major rehabilitation of the historical cafeteria and gift shop area. In 2007, a contractor replanted the site with native grass and wildflower seeds, and many older hemlock tree transplants. Success with the transplanted trees was minimal. This provided us with an opportunity to test restoration methods for planting whitebark pine seedlings that naturally occur alongside hemlocks. The timing was significant since the rust infestation was increasing dramatically on trees near the former parking lot. However, to improve restoration success, we decided to create microsite enhancements for each cluster of two to four seedlings. The park road crew assisted us by bringing in large boulders to the former parking area in fall 2008 (fig. 1). The following summer, an equipment operator assisted us by drilling more than 150 holes into the heavily compacted soil using a backhoe and auger. We also brought in woody debris and needle/duff litter from nearby sites to further establish the microhabitat. In mid-September 2009, we planted 331 whitebark pine seedlings, representing 16 disease-resistant parent trees from Crater Lake, in the former parking lot. We watered these seedlings on a regular basis until the first snowfall in early October (fig. 2). In summer we plan to monitor these seedlings for survival, herbivory, and disease.

Figure 1. Whitebark pine restoration at Crater Lake Rim Village involved bringing in boulders to the former parking area, drilling holes in the compacted soil, and scattering woody debris. These microhabitat manipulations help protect the seedlings from exposure to high winds and heavy snowpack.



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Figure 2 (above). Seasonal plant technician Janelle Cossey waters endophyte-inoculated and untreated (control) whitebark pine seedlings along the Horse Trail experimental restoration site.



Figure 3 (right). Professor George Newcombe and vegetation ecologist Laura Hudson inoculate whitebark pine seedlings with endophytic fungus at the Dorena Genetic Research Center.

The second planting (Horse Trail study area) involved the experimental endophytic-inoculation study comprising 200 seedlings from five disease-resistant parent trees. Studies have shown endophytic fungi (i.e., those living within a plant) increase resistance of western white pine (*Pinus monticola*) to white pine blister rust; this experimental inoculation is intended to determine whether endophytes also can increase disease resistance in whitebark pine seedlings. We obtained the endophytic fungus (*Myrothecium roridum*) for the study's inoculant from needles collected from 10 apparently disease-resistant whitebark pine trees around Rim Village in summer 2008. George Newcombe, professor of forest pathology and plant symbiosis at the University of Idaho, cultured the inoculant in his lab. For the experimental planting, we treated 100 seedlings with the endophytic fungal culture and, as a control, left 100 seedlings untreated. Treatment consisted of pulling the seedlings from their planting tubes. Half of these were then dipped briefly in the fungal solution and the other half (the control seedlings) in distilled water (fig. 3). All seedlings were returned to their original tubes. We planted the surviving 192 endophytic study seedlings south of Rim Village in a more natural environment and away from the public to minimize disturbance to these treated seedlings. After initial planting, we measured seedling height. We plan to evaluate the seedlings annually for sur-

vival, growth (height), endophyte communities, blister rust symptoms and other diseases, and herbivory. Professor Newcombe plans to return to the park this summer to confirm successful inoculation of the trees. This is done through a process of limited sampling and surface sterilization of treated trees to isolate the inoculant.

In addition to these two planting projects, we will continue to monitor the status of disease-resistant parent trees in the park as de facto permanent plots. This will allow us to determine and assess the older trees' resistance to blister rust in conjunction with monitoring the survivability of their progeny at the Rim Village and Horse Trail planting sites. Our first-year planting results should be available for reporting at the end of the 2010 growing season.

About the authors

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