Rust Committee Report
Chair: Holly Kearns

The Rust Committee meeting on the afternoon of July 20, 2009 was well attended. An extended meeting allowed for two formal presentations in addition to individual reports on current and upcoming rust-related projects. The following abstract, reports, and work summaries were submitted for inclusion in the Committee Report.

Anna Schoettle Resistance to white pine blister rust in *Pinus flexilis* and *Pinus aristata* of the Southern Rockies – initial findings Schoettle Anna W.[1]; Sniezko, Richard A.[2]; Kegley, Angelia[2]; Hill, Jerry[2], and Burns, Kelly S.[3] ([1] USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO; [2] USDA Forest Service, Dorena Genetic Resources Center, Cottage Grove, OR; [3] USDA Forest Service, Forest Health Management, Lakewood, CO; Corresponding author: aschoettle@fs.fed.us).

The non-native fungus *Cronartium ribicola*, that causes white pine blister rust (WPBR), is impacting or threatening limber pine, *Pinus flexilis*, and Rocky Mountain bristlecone pine, *Pinus aristata.* In the Southern Rockies, where the rust invasion is still expanding, we have the opportunity to be proactive and prepare the landscape for invasion. Genetic resistance to WPBR is essential to the future of pine populations given the lethality of the disease and its continued spread. Options for increasing the frequency of resistance in a stand includes (1) supplementing resistance by outplanting rust resistant stock and (2) stimulating natural regeneration to increase the numbers of individuals and genetic combinations for rust resistance selection (see Schoettle and Sniezko 2007).

Past studies have shown that resistance exists in both limber and RM bristlecone pine but did not address the genetic basis of resistance or its geographic distribution. We currently have six artificial inoculation rust screening studies examining complete and partial resistance traits for limber pine and RM bristlecone pine. Complete resistance to WPBR in limber pine has been evaluated in progeny of 113 limber pine seedtrees from 13 sites across the Southern Rockies and varies among sites from a frequency of 1 to 29% and demonstrated Mendelian segregation within some families suggesting that it is controlled by a single dominant gene (Schoettle, Sniezko, and Burns, unpublished data). Assessment of the frequency of the partial resistance mechanisms in limber pine is underway (Schoettle, Sniezko, Pineda-Bovin and Burns, in process). The frequency of partial rust resistance in progeny from 184 RM bristlecone pine seedtrees from 11 sites in Colorado varies among sites from a frequency of 17 to 60% (Schoettle, Sniezko, Kegley, and Burns, in progress) and varied among families.

These initial findings confirm that rust resistance is present in limber pine and RM bristlecone pine and has a genetic basis. The mechanisms of resistance are still unclear and field plantings are required to verify the expression and durability of the resistance traits in native habitats. The geographic variation in rust resistance in both species support the hypothesis that rust resistance is not independent of other adaptive traits or evolutionary legacies. As a result, identifying appropriate resistant stock for outplanting in populations with low frequencies of resistance may be challenging. Alternatively, stimulating natural regeneration to accelerate selection for rust resistance is only a viable option in those populations with higher frequencies of resistance. Additional research is needed to address the expression and durability of these mechanisms in a changing climate.

Other activities include:

To examine the ecological efficacy and economic trade-offs of management options for mitigating WPBR impacts in high elevation white pines, projections from population and epidemiology modeling are being integrated into a dynamic economic model. The research team includes Craig Bond (PI - CSU), Patty Champ (RMRS), Anna Schoettle (RMRS), Bill Jacobi (CSU), Cara Nelson (U MT) and Richard Sniezko (DGRC).

Maintaining a broad genetic base within and among populations is also essential for sustainability into the future in the presence of WPBR, mountain pine beetle and climate change. *Ex situ* gene conservation collections of seeds, leaf material and pollen for RM bristlecone and limber pine are ongoing. To date Schoettle and colleagues have archived genetic material from over 350 RM bristlecone and 500 limber pine individuals over 30 and 45 populations, respectively. With funding in 2009 from RMRS and the FHP Gene Conservation Program and collaborations with the R1 and R2 Forest Health Protection, National Park Service, Bureau of Land Management, National Forest Systems, Mountain Studies Institute and Colorado State University, limber pine collection sites now extend from Colorado to Montana. *In situ* conservation is underway, in the Southern Rockies, with protection from mountain pine beetle of high value trees and rust resistant populations of both limber pine and RM bristlecone pine using chemical and pheromone approaches.

Dave Conklin

Blister rust arrived in southern New Mexico by the early 1970s, and has more recently appeared in other several other locations in the Southwest. *Pinus strobiformis* is experiencing major damage on high hazard sites in the Sacramento Mountains (our original outbreak area), although lower hazard sites there are much less affected. We can expect a major expansion of the disease in the next few decades. Low hazard sites will provide important "genetic refugia" for white pines. A recent report, *White Pines, Blister Rust and Management in the Southwest*, quantifies our white pine resource, discusses our work with genetic resistance, and makes recommendations for favoring (retaining) white pines in all harvest and thinning operations.

Mary Lou Fairweather

After decades of looking, white pine blister rust was observed in Arizona for the first time in May 2009. Southwestern white pines are infected in high hazard areas (e.g. along canyon bottoms and creeks) in eastern Arizona, on the White Mountain Apache Reservation and adjacent Apache National Forest. The infected area encompasses approximately 40 square miles.

Marcus Jackson

Impacts from white pine blister rust, mountain pine beetle, and Dothistroma needle disease have spurred the need for an assessment of limber pine in Montana. This assessment is drawing on historical information and data collected in the state to describe current understanding of the amount, distribution, and condition of limber pine in Montana. In addition to data collected from sixteen Evaluation Monitoring (Forest Health Monitoring) plots, data collected by the United State Geological Survey, US Forest Service Forest Inventory and Analysis program, and the MT DNRC will be used in addition to publications identified through the Whitebark and Limber Pine Information System database. This information will be compiled and analyzed to produce an assessment in early 2010.

Bill Jacobi

Pruning studies at Sand Dunes National Park and Vedauwoo Campground on the Medicine Bow NF are doing well. We have not lost any trees to treatment but have lost about 10% of the trees at Vedauwoo to a mountain pine beetle outbreak. We have also started a project to determine how to plant limber pine seedlings by testing the impact of amount of crown closure, nurse objects and hydrogels.

Robin Mulvey

As a MS Candidate at Oregon State University, Robin is studying the role played by species of *Castilleja* and *Pedicularis* in whitebark pine ecosystems of the Cascade Range and determining if there is sufficient time for *C. ribicola* to complete its lifecycle in high-elevation whitebark pine ecosystems.