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## Establishment of White Pine Blister Rust in New Mexico

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White pine blister rust (WPBR) (*Cronartium ribicola* Fischer) is a recently bushed pathogen of southwestern white pine (*Pinus strobiformis* Engelm.) and *Ribes* L. (currants and gooseberries) in New Mexico (Hawksworth, 1990). Based on the apparent age of the oldest canker found, the outbreak began about 1970 on the western escarpment of the Sacramento Mountains, Otero County (Geils et al., 1999). By 1999, the rust was found in several additional areas in New Mexico and on 62% (111 of 180) of plots distributed across the range of white pine in the Sacramento Mountains (Geils et al., 1999).

Several hypotheses propose to explain the spread of WPBR from infested areas in Wyoming, California, and Idaho, 900 to 1500 km (600 to 900 miles) to the north and northwest. Van Arsdel et al. (1998) argue that introduction by long-distance, aerial transport of aeciospores from pine to *Ribes* is more plausible than by transplanted, infected stock (either pine or *Ribes*). They cite how other rusts are observed to spread similar long distances. They also relate that the oldest rust cankers in the Sacramento Mountains predate the first recorded planting of white pine seedlings from Idaho and that the oldest cankers are far from the nearest home sites (where infected *Ribes* may have been planted). A study of the population genetics of WPBR conducted by R.C. Hamlin (personal communication) suggests the outbreak in the Sacramento Mountains resulted from a single introduction of inoculum from somewhere in western North America. His study found the rust in the Sacramento Mountains to have low genetic diversity (founder effect) and greater genetic similarity to other western populations than to eastern populations. Preliminary examination of regional air flow patterns into Arizona and New Mexico during the late spring suggests the origin of the rust was the southern Sierra Nevada where the rust has been established since the 1960s. The dispersal capacity of the rust in the southwestern United States is demonstrated by its spread throughout the Sacramento and adjacent White Mountains, into the Capitan Mountains, across a gap in host distribution of 50 km (30 miles), and to Gallinas Peak, a gap of 90 km (50 miles). Additional populations of southwestern white pine are located to the west in the Gila Mountains and to the northwest in the Magdalena and San Mateo Mountains (Little, 1971).

Geils et al. (1999) established a series of vegetation plots and meteorology stations at randomly selected sites in six areas across the Sacramento Mountains to determine rust history, distribution, incidence, severity, and relationship to *Ribes*. The first summaries of that survey indicate that following initial establishment of the rust, infection of pines occurred frequently after 1983 and spread the rust throughout the range of the host. The rust appears to have become common in the northwest portion of the forest by 1985 and elsewhere several years later. Once established locally, intensification occurred in most years. Meteorological summaries confirm that favorable conditions for infection of pines prevailed across the forest at least several times during 1998 and 1999. The most obvious trend was for greater rust infestation, incidence, and severity at elevations above 2400 m (8000 ft). Over 85% (97 of 113) of the higher elevation plots were infested; whereas only 22% (14 of 63) of the lower elevation plots were

infested. On higher elevation, infested plots 55% of the white pine were infected with an average of 2.5 cankers per tree; on lower elevation, infested plots only 32% of white pines were infected with an average 0.9 cankers per tree. These results are consistent with findings reported by Van Arsdel et al. (1998). Girdling stem cankers were generally and quickly lethal on small trees and the cause of topkill to larger trees (leading to reduction of growth, survival, and reproduction). *Ribes* were found to occur mostly at higher elevations in patches of various sizes (several to hundreds of meters of live stem per bush). Although white pines and *Ribes* were sometimes found within meters of each other, the density of *Ribes* (in terms of meters of live stem per hectare) was low and extremely variable. Additional plots and analyses are required before more quantitative relationships can be described.

White pine blister rust is a special threat in the southwestern United States because white pines are generally isolated into small populations and therefore subject to local extinction. When infested these scattered populations could provide a bridge for rust migration into northern Mexico or the southern Rocky Mountains. Potential impacts from the loss of the white pine include many adverse effects on ecological processes and biodiversity. Further spread of the rust may be hastened by landscape planting of currants, gooseberries, and white pines in forest-urban areas. Research is underway on WPBR epidemiology and *Ribes* ecology to provide for better evaluations of rust hazard and impact and recommendations for control. For example, the orange gooseberry (*R. pinetorum* Greene) appears to support a greater production of rust spores capable of infecting pines than many other *Ribes* species native to New Mexico. Cultivation of this species may therefore be discouraged to protect white pines.

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