Southwestern White Pine (*Pinus strobiformis*) Regeneration Ecology Along Disease and Management Gradients in the Southwestern United States

B.A. Goodrich[1] and K.M. Waring[1, *]

[1] *Northern Arizona University, School of Forestry, Flagstaff, Arizona, USA*

[*] *kristen.waring@nau.edu*

Southwestern white pine (*Pinus strobiformis*, SWWP) is a component of dry and wet mixed-conifer forests in the southwestern United States and provides ecological function and diversity. The species is geographically limited to Arizona, New Mexico, parts of Texas, southern Colorado, and northern Mexico, but occurs on a wide range of habitats within its distribution. Historically, SWWP regeneration has not been well studied or monitored in mixed-conifer forests of the Southwest, although our understanding of the species' ecology is increasing. Introductions of *Cronartium ribicola*, the pathogen responsible for causing white pine blister rust (WPBR), are fairly recent compared to other areas in North America, and disease intensity is variable in the Southwest. Heavy disease occurs in south-central New Mexico, whereas many forests in Arizona are not affected yet. However, the disease continues to spread west through isolated mountain ranges in the Southwest.

Our research seeks to quantify SWWP regeneration responses to various silvicultural strategies across a range of WPBR intensities, and to determine how disease incidence has been affected by recent management in the Southwest. The opportunity to study regeneration in stands not yet affected by WPBR allows us to make baseline comparisons for management goals and to determine if stand trajectories in areas where WPBR has been present for several decades are occurring in areas with more recent infestations.

Fifty-five stands were surveyed across the region, including stands with no recent management and stands with recent uneven-aged (UEA) treatments (leaving two-aged and multi-aged structures). Seedling ages (by whorl count) demonstrate germination following treatments; survey results indicate that UEA treatments successfully regenerate SWWP in areas with and without WPBR. Results suggest that SWWP grows most successfully in two-aged structures, but models interpreting the effects of management, disease, and other species' presence on SWWP densities across the region are in progress. Regeneration stem mapping will also allow comparisons of species distributions and possible competitive interactions between similar and different size classes in the understory.

Regeneration success of species at risk of biotic invasions is critical to the sustainability of current and future distributions, and SWWP regeneration ecology must be better understood in order to make sound management decisions in the face of climate change and other disturbances. Previous work addressing proactive management in other North American five-needle pine systems advises that increases in regeneration diversity and densities are critical to maintaining populations on the landscape. These results will help guide management efforts in sustaining SWWP in the presence of an invasive pathogen.

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