USDA Forest Service
U.S. DEPARTMENT OF AGRICULTURE

Rocky Mountain Research Station
Science You Can Use *(in 5 minutes)*
JULY 2024

Promoting Healthy Forests: Limber Pine in the Rockies is vulnerable to long-term decline

Limber pine is an ecologically vital species that provides food for wildlife, facilitates the establishment of other tree species, and grows where other species struggle. A nonnative disease, white pine blister rust (WPBR), and native bark beetles are killing limber pines faster than they can grow back.

A team led by Kelly Burns, a forest pathologist with the USDA Forest Service, Forest Health Protection, monitored 106 limber pine plots from southern Colorado to northern Montana. They assessed trees and regeneration within plots three times between 2004 and 2017. By the end of the study, only half of mature limber pines were healthy, limber pine regeneration was low or absent on most sites, and WPBR was the most common cause of damage.

Wade Tinkham, a Rocky Mountain Research Station research forester, modeled the data to reveal that more arid environments had lower infection probabilities. However, once infected a tree's health declines faster in these arid areas. These results suggest that climate change could exacerbate the effects of the disease. The team also found that the growing season is becoming longer, which could make infection of limber pine more likely. Says Jane Stewart, associate professor of plant pathology at Colorado State University: "Understanding the complex interactions between WPBR and limber pine under drought conditions will allow us to better determine how infected limber will respond long term in new environmental conditions.".

"Time is not on our side," says Rocky Mountain Research Station research plant ecophysiologist Anna Schoettle. "Populations are declining, the climate is changing, and the decline is likely to accelerate. Managers need to act now to conserve limber pine genetic diversity and their ecosystems."

The monitoring data clearly show the difference in the temporal pattern of impact by bark beetles and blister rust. Bark beetle populations are cyclical, and their impact peaked early in the monitoring period and are currently at endemic, or lower, levels. In contrast, WPBR steadily continues to spread and intensify. Also, unlike some bark beetles that prefer to attack and kill larger trees, WPBR kills trees of all ages, which makes it difficult for the younger generation to take hold. Planting more limber pines would therefore help offset mortality.

A white pine blister rust canker on a young limber pine in early summer with characteristic orange blisters (aecia) that recently ruptured, releasing spores (aeciospores). USDA Forest Service photo by Kelly Burns.

A small proportion of limber pine trees have natural genetic resistance to WPBR. Schoettle and colleagues are using this information to their advantage to accelerate adaptation. Even before the forest population could be decimated, they are proactively identifying those parent trees with genetic resistance to WPBR. Seedlings grown from seed from these resistant trees can be planted in the forest to increase the number of trees on the landscape that can survive in the presence of the disease.

Kevin Gaalaas, forest ecologist for Rock Mountain National Park, has been putting into practice a proactive conservation strategy that Schoettle and Burns developed before the rust became widely established in the National Park.

"It's definitely scary, but I think it's exciting too because if there's going to be some solutions, there's a good chance they're going to come out of this southern Rocky Mountain region," says Gaalaas. "So, it's interesting to be at the heart and center of the frontlines of that battle."

"We need to do more testing to identify trees with durable resistance to WPBR. This will greatly expand our ability to implement management strategies that promote forest health and adaptation," says Burns.

The team continues to study how aridity and growing season length affect disease development and to identify and understand genetic resistance to WPBR to support management and healthy forests.

Heavily infected mature limber pines with branch flagging (right) and topkill (left). USDA Forest Service photo by Anna Schoettle.

Further Reading

Burns, K.S.; Tinkham, W.T.; Leddy, K.A.; Schoettle, A.W.; Jacobi, W.R.; Stewart, J.E. 2023. Interactions between white pine blister rust, bark beetles, and climate over time indicate vulnerabilities to limber pine health. Frontiers in Forests and Global Change. 6: 1149456.

Key Management Considerations

- White pine blister rust and bark beetles were the most common causes of damage to limber pines in the U.S. Rockies.
- White pine blister rust is spreading into the drier southern areas. While aridity makes infection less probable, these same conditions correlate with faster disease progression following infection.
- Managers can improve the chances of sustaining limber pine ecosystems by identifying rust early and planting trees with genetic resistance to offset mortality. More testing for WPBR resistance is needed.

Study Contributors

Kelly Burns is a forest pathologist with the USDA Forest Service, Forest Health Protection in Golden, Colorado, focusing on detection, monitoring, and management of forest diseases.

Anna Schoettle is a research plant ecophysiologist with the Rocky Mountain Research Station studying ways to accelerate the adaptation of high-elevation forests to changing abiotic and biotic conditions.

Jane Stewart is an associate professor of plant pathology at Colorado State University studying the genetics of emerging tree/plant pathogenic fungi; **Kaitlin Leddy** was a graduate student in Jane's lab during this study.

Wade Tinkham is a research forester with the Rocky Mountain Research Station studying ways to improve the reliability of data and tools available to managers to support decisionmaking.

Lauren Hines-Acosta is the author of this Science You Can Use in 5min.