Study explores long-term impacts of ponderosa pine restoration treatment

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Credit: Northern Arizona University

In 1996, a group of researchers from NAU's Ecological Research Institute (ERI) embarked on an ambitious mission to study restoration across 5,224 acres of dense ponderosa pine forests on the Arizona Strip, a dry region of northern Arizona located between the Grand Canyon and the Utah state boundary line.

After more than 20 years of hands-on investigation, monitoring the dry landscape with evolving fieldwork technologies and high crew turnover rates, these same ecologists successfully decreased the area's tree density and vulnerability to wildfire.

They recently published their findings on the effort's long-term effects in the journal *Restoration Ecology*.

The ERI has led countless research expeditions to revitalize and protect local ecosystems from unnatural wildfires. In the past, limited time, human effort and study-specific data collection restrictions constricted these experiments to studies covering less than 1,000 acres.

As wildfires throughout the western United States grew more intense, and as counterproductive fire exclusion measures led to overly dense forests at greater risk of drought, competition, pathogens and fires that spread at the top of the forest canopy, the ERI saw a need to expand its forest restoration research across thousands of additional acres.

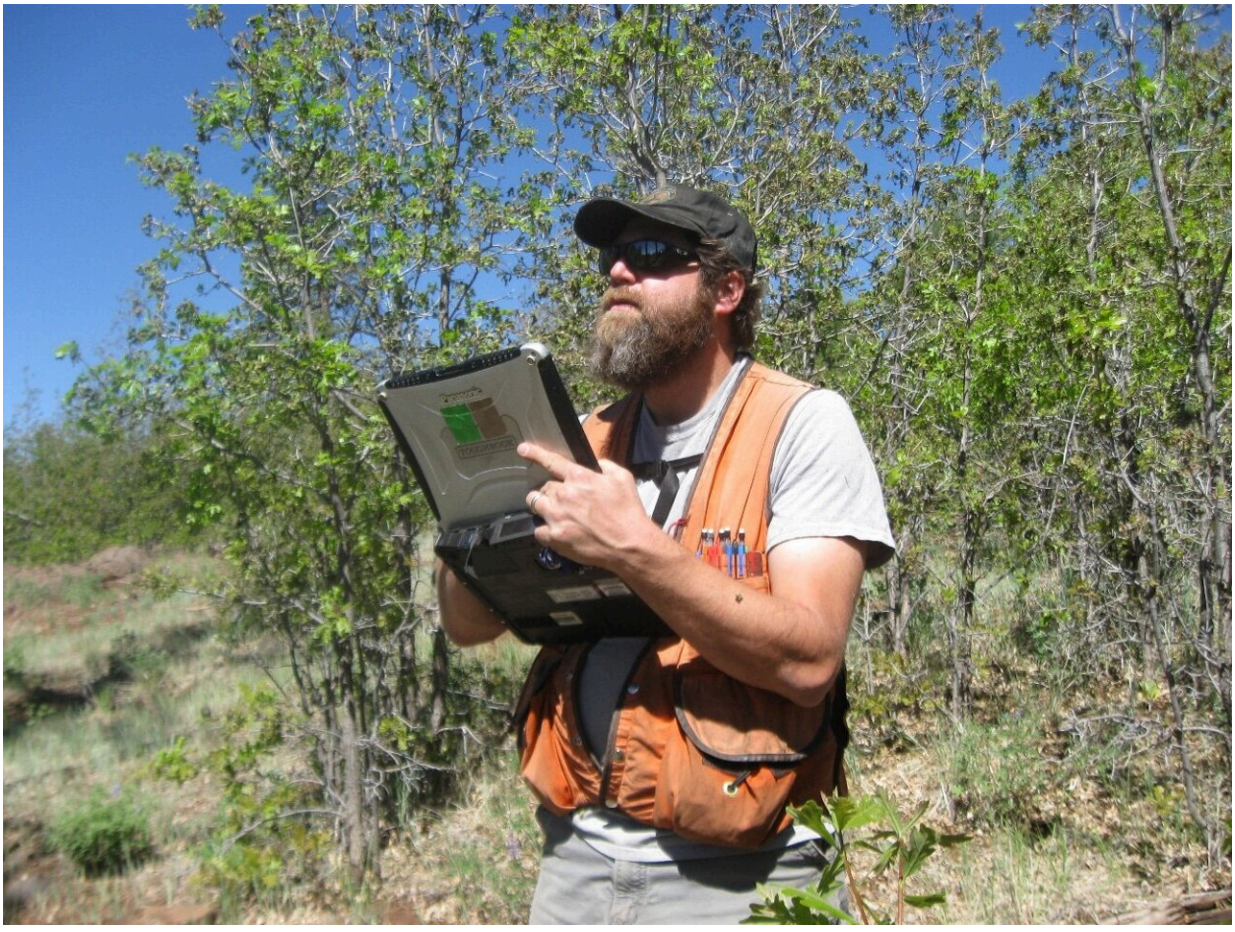
"Back in 1996, there were a couple of fires that were about 10,000 acres that were considered huge at the time," said John Paul Roccaforte, an ERI research associate and the study's lead author. "A few years after that, we're talking about a few million acres. Our approach was that we needed to have our studies scale up as well."

The opportunity to expand their research presented itself when the Bureau of Land Management (BLM) proposed a collaborative study: applying prescribed burns and mechanically thinning trees across a study site of ponderosa pine and Gambel oak forest in the Grand Canyon-Parashant National Monument.

Working with BLM crew members, NAU researchers installed 221 permanent plots in the area at the start of the experiment in 1996, setting

aside about 1,200 acres as an untreated control area. They then helped train additional fire units and machine operators to complete tree thinning and prescribed burns until 2005.

The ERI used a unique thinning technique designed to protect older trees and return the monument landscape to its historically open conditions. Instead of thinning a consistent number of trees per acre, the ERI identified pre-settlement ponderosa pines, identifiable based on their unique yellow color, and pines with breast height diameters greater than 70 centimeters. These trees were then protected during thinning and burning.



ERI research associate John Paul Roccaforte collects tree data using a field

computer at ERI's Mount Trumbull study site in northwestern Arizona on June 10, 2017. Credit: Northern Arizona University

Additionally, per ERI's restoration principles, teams retained an additional one-to-three replacement trees wherever they encountered evidence of a deceased historical tree.

"Something about fire is just really fun," Roccaforte said. "You can plan things on paper, but it's really exciting to get out on the ground from time to time and be really involved in the implementation part of it. Just being out there lighting stuff on fire and watching fuels get consumed, it's like helping restoration happen right before your eyes."

Until the study's conclusion in 2018, researchers routinely tracked forest structure, regeneration, old-tree mortality and tree growth in the area. Two crews of five researchers each would incrementally visit the site for eight days at a time, collecting measurements and comparing photographs to identify prominent changes in the terrain.

Researchers found the treatments decreased the forest's density by more than 50% while almost doubling the growth rates of individual trees, showcasing a newfound resilience against wildfire and variation in canopy coverage beneficial for wildlife. They also observed additional hardwood tree patches in place of pines after treatment, a phenomenon common in dry conifer forests with fewer resource competitors.

To ensure the long-term effectiveness of restoration strategies in similar dry climates, the study indicates forestry managers should routinely embrace fire as a tool to aid restoration instead of depending on other preventative measures. This way, patches of dense hardwood or vulnerable older oak trees responding to prescribed burns can be

identified and monitored depending on each forest's goals.

"Before fire exclusion in the late 1800s, fires burned very frequently through these areas," Roccaforte said. "Fires would maintain and keep tree regeneration at bay. If we don't keep up on frequent low-intensity burning, then we could be right back in the same place we were to begin with in terms of overly dense stands, whether that be ponderosa pine or hardwood."

While no plans for further site research have been confirmed, Roccaforte said the permanent plots established in this study could be used for additional investigation. ERI and BLM will conduct joint investigations in the future.

More information: John P. Roccaforte et al, Long-term ecological responses to landscape-scale restoration in a western United States dry forest, *Restoration Ecology* (2024). DOI: 10.1111/rec.14181

To learn more about ERI and ponderosa pine restoration, visit eri.nau.edu.

Provided by Northern Arizona University

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