

# Warming Climate Means Trouble For Southwest Plantlife

June 27 2010, By Eric Betz

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This month, fires have charred tens of thousands of acres in New Mexico, Colorado and Arizona. After more than a decade of drought, these large seasonal fires are increasingly a part of life in the Southwest, and fire can be revitalizing in many conifer forests.

However, unlike other conifers -- including their larger cousins the Ponderosa pines -- fire hasn't played a fundamental role in many pinyon pine ecosystems. As a result, the trees are easily killed by it.

Between the surrounding high deserts of the Southwest and the ponderosa pine forests of the Colorado Plateau, a transition zone of pinyon pines and juniper trees dominates the landscape. Pinyons are a symbol of life on the plateau. These woodlands hold a wealth of biodiversity, providing homes for a vast array of plant and animal life. Their dry, open forest-floors allow for the growth of desert plants like yucca and prickly pear cactus. In rockier areas, small plants like lichens, Rockmat and vibrant-red wildflowers called Indian Paintbrush are prevalent. The small, often shrub-like trees can take hundreds of years to grow a six inch trunk and full-grown they can be little more than a bush, or if conditions are favorable they can grow as tall as a five story building.

This reluctant growth has allowed pinyons to thrive in the arid Southwest for millennia, but today the trees are vanishing from the landscape. A decade of drought, which scientists said is a direct result of climate change, has allowed bark beetles to feast on Southwest forests and left

them vulnerable to catastrophic wildfires.

"There is little doubt that our current drought has driven processes that resulted in mortality for some plants," said Ken Cole, a researcher with the U.S. Geological Survey in Flagstaff. Cole's research has shown that bark beetles, catastrophic fires and other unknown causes have resulted in the widespread death of pinyon pines.

Climate change is expected to increase the frequency and intensity of drought in the coming decades and ecologists think the changes may be too quick for species occupying the most vulnerable of ecosystems, such as the transition zones.

The history of fire in many pinyon forests is not yet well understood, but studies from many old growth forests and the lack of fire scars indicate that until recently large, stand replacing fires were rare, occurring only once every 400 years or so. So, the last century of fire suppression ethics has had less of an impact on pinyons than it has on many other species. Ecologists say that drought conditions may have shifted the environment in favor of non-native species, so when pinyons do burn, invasive shrubs and grasses often sprout up in their place as well as oak and mahogany trees.

These new invasive plants are much more flammable than natives and are literally adding fuel to the fire. Once an understory of these fire prone plants is in place, it would make it more difficult for pinyons to recover. Post-pinyon woodlands could resemble chaparral or savannah—something like the interior valleys of California.

Rainfall totals in the most recent drought have been comparable to those the Southwest has experienced in the past, but the droughts have been unusually hot. Researchers believe these temperature increases are a direct result of climate change and exactly the type of conditions models

have predicted will become more frequent in the Southwest in the coming century. Cole said these conditions will result in widespread reductions in pinyon pines, but scientists are reluctant to speculate on how bad it will be.

“The correlations between these model predictions and our climate trends of the last 20 years should concern everyone,” Cole said.

In a paper published in the Proceedings of the National Academy of Sciences, University of Arizona ecologist David Breshears and his colleagues described how pinyons respond to long-term drought.

"Lots of attention focuses on the bark beetle effects on pinyon pines, but the pinyon response is also tied tightly to their water response," Breshears said. And despite the recent wet winter, the Southwest is still firmly in the midst of a drought.

The group conducted an experiment at Biosphere 2—a research building containing an artificial, sealed ecosystem outside of Tucson—and found that drought stressed trees exposed to higher temperatures died thirty-percent more often than trees at normal temperatures with identical conditions. This indicates that die-offs could occur five-times more often.

"They are the trees that make it at the lowest, driest areas, below which shrubs and grassland and deserts dominate," said Lisa Floyd-Hanna, an ecologist at Prescott College studying pinyon-juniper woodlands. "Thus, they are tough."

In a drought, a pinyon tree will close off its pores to conserve water and try to ride it out. However, the pores are also necessary for it to breathe in carbon dioxide, and it starves itself waiting for rain. While the tree could last for long periods of time in an average drought, the increased

heat makes it die of exhaustion much quicker.

Also in response to drought, pinyons stop producing sap, which is the tree's first line of defense against bark beetle invasion. The insects are then free to move in and start their feeding frenzy on the unprotected trees, helping to create the conditions for catastrophic wildfires.

"Since there are only two dominant tree species, near complete loss of one species is indeed devastating," Floyd-Hanna said.

Already, hiking in these forests is like a walk through a graveyard where the dead lay unburied. In areas of Arizona, New Mexico and Colorado there are places where more than half the pinyons are already dead. In Sante Fe, as many as 90 percent are dead.

"Higher temperatures cause more evaporation and the result is less of the moisture being available for plants, animals and municipalities," Cole said. Despite the last season of wet weather, climate models predict the situation will only get worse in the Southwest in the coming decades.

Floyd-Hanna said there is hope that pinyon forests can recover. In other areas in the Southwest, such as the old-growth pinyons around Mesa Verde National Monument, young pinyons are growing up where [bark beetles](#) have recently killed off large numbers of trees. And the saplings are outcompeting the invasive species that have plagued similar sites.

Source: Inside Science News Service

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