# Tree rings from centuries past may help reveal a warming planet's future

Armed with the world's largest collection of tree rings, scientists are looking for clues to climate change

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TUCSON — Each specimen in a strangely beautiful "treehouse" laboratory here tells a story of resilience — from droughts and floods to catastrophic wildfires and bitter winters, some occurring thousands of years ago.

Nowadays, though, much of the work at the University of Arizona's Laboratory of Tree-Ring Research is about the future of a planet that's squaring off against global warming and its cascading disasters.

Armed with the largest collection of its kind in the world — 700,000 samples and counting — scientists are trying to better comprehend what's ahead by translating the autobiographies that trees record in their rings.

The basics are known: Rings reveal a tree's age, with thin rings indicating drier years and wide rings, wetter years. Pockmarks on rings identify years of extreme cold; blackened blotches are burn scars from fires a tree survived.

"Climate variability drives tree-ring variability," said fire ecologist Thomas W. Swetnam, the former director of the lab, who describes it as "a big library of climate and human history."

Tucson is the birthplace of this field of scientific study. Dendrochronology, which uses the annual growth patterns of trees to date events and environmental changes, was launched in the 1920s by astronomer Andrew Ellicott Douglass. He had the idea that tree rings could be used to understand how solar cycles affect Earth's climate, and though that theory didn't pan out, he was the first to confirm that trees record dry and wet years in their rings.

His procedure for the cross-identification of ring patterns for "absolute" dating then made him famous.

Douglass put his methodology to use in the Southwest by determining when construction began at Chaco Canyon, the spiritual and cultural center of the Ancestral Puebloans in what is now New Mexico. While trees are scant in the desert, the arid environment keeps them well preserved even after they die. Douglass examined tree rings found in the fragments of intact timbers and ancient charcoal on the site and concluded that the archaeological ruins dated to A.D. 919.

At its start in the 1930s — with Douglass as its first director — the lab was "temporarily" housed willy-nilly under the bleachers of the Wildcats' football stadium. And there it stayed for eight decades, even as the collection amassed by Douglass and other dendrochronologists grew exponentially.

Not until 2013 did the specimens get a permanent, true laboratory home, in a building designed with a round core, like a tree trunk, and a facade resembling the branches of a native paloverde tree.

The heart of the facility is the archive of 600,000 slices and cores of trees and 100,000 clumps of ring-readable charcoal, all properly wrapped, boxed, labeled, catalogued and stored in enclosed metal stacks. A room beyond the stacks contains larger cuts, some the size of a young child's play trampoline. The earthy smell and rich, dark colors there make for a splendid space.

The lab played a key role in a recent study on the 22-year drought that Western states are suffering. Researchers at the University of California at Los Angeles concluded that the crisis is a historic megadrought — the worst in 1,200 years, a time frame validated by the tree-ring data.

Only researchers can access the lab's collection now, but an electronic version will go online this year and allow public searches of the database, according to curator Peter Brewer. "We're getting it ready for the future," he said.

Dendrochronologists no longer take axes and chain saws to trees to find the best slices for their investigations. Instead, they use a slim metal increment borer that slides into a trunk and removes a drinking-straw-size sliver of wood. This approach poses no risk to their subject's well-being.

Valerie Trouet has tromped into remote forests in Tanzania and Siberia in search of ever more data. "People always ask if I love trees," said Trouet, a professor at the University of Arizona lab and a dendrochronologist with a degree in bioscience engineering. "I do, but I especially love wood."

She and a team with members from Germany, Switzerland, Bulgaria and Belgium have been studying tree-ring data spanning eight centuries to reconstruct changes in the movement of the jet stream, the fast-moving winds at a height of five to 10 miles in the atmosphere that blow west to east around the globe.

"The jet stream orchestrates what happens climate-wise on Earth's surface," Trouet said.

Their initial work, focusing on 300 years of data, showed that increased fluctuations in the jet stream have occurred over Europe since the 1960s. They're now hoping to determine whether those fluctuations and the extreme weather they triggered were historically anomalous or something more ominous.

"What's cool about Europe," Trouet noted, "is that it has a long history of documenting societal disruptions, famines, grain harvests, epidemics."

The question she hopes to answer: Is human-fueled climate change now implicated?

Of all the lab's research, the most intensely personal work is about protecting living trees from increasingly massive and destructive wildfires — the kind certain to put Western states even more at risk in coming years.

Beginning in the 1970s, Swetnam and lab colleague Chris Baisan began examining fire-scarred trees and their rings in forests throughout the West for answers to underlying conditions, long-term effects and possible remedies for these monstrous blazes.

Their work has resulted in an ever-expanding chronology of fire history culled from more than 1,000 sites in Western national forests and parks.

This record provides forest managers with a "fire regime," as Swetnam calls it, that details "evidence of the frequency, seasonal timing, severity and extent of past fires." Fire regimes help guide forest management and restoration — the before-and-after requirements of future forest health.

"At every level, down to the cell and up to the scale of a giant sequoia, trees are awesome creatures," Swetnam said, adding, "As gratifying as it is to see my science making such an impact, on the other hand it's like, oh my God, the message is so worrisome."