'Great house' spruce and firs born on distant mountain tops

Professor Jeffrey Dean stands outside the Laboratory of Tree-Ring Research, housed under the football stadium on the UA campus.

Photo by Melanie Lenart

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Tree-ring analyses of the beams in ancient structures have been crucial in advancing understanding of the Chaco Canyon civilization that thrived around the turn of the last millennium in New Mexico. But sometimes researchers have to read between the lines to get the answers, as a team of scientists that included the LTRR's Jeffrey Dean found out this year.

The scientists used strontium isotopes in ground-up wood to pinpoint the source of some of the spruce and fir trees used to construct the multi-story structures built by the apparent ancestors of today's Puebloans, known as the Anasazi. Combining the information with earlier work using the trees' annual growth rings to date the beams provided additional insight into this ancient culture.

"What they were doing was actually thinning the forest rather than eradicating it," Dean said of the Anasazi people who inhabited New Mexico's Chaco Canyon from at least 900 to about 1150 A.D.

The team included Renewable Natural Resources research specialist Nathan English, Julio Betancourt of the U.S. Geological Survey and University of Arizona geologist Jay Quade as well as Dean. Their findings were published in the Sept. 25 issue of the Proceedings of the National Academy of Science.

The study builds upon research done in the 1980s by Betancourt and Dean, who used scanning electron microscopes to identify about a quarter of the dated beams in one of the structures as spruce and fir trees.

"Spruce and firs have not grown in the San Juan Basin for the last 10,000 years, since the Pleistocene," Dean noted. "Now they only grow on mountaintops."

The isotope study matched some of these beams with trees from the Chuska Mountains to the west and the San Mateos (popularly known as Mount Taylor) to the southeast. The researchers ruled out the San Pedro Mountains to the east as a source of the spruce and fir logs used in Chaco Canyon structures. All three mountains are 50 miles or more from the site.

"One of the reasons they probably didn't get logs from the San Pedro was they didn't go to the east. They simply weren't interested in it," Dean theorized. For instance, few of the roads in the widespread prehistoric system head east.

The study found that trees in the three mountaintops contained distinctively different ratios of a heavier strontium isotope compared to the more common strontium isotope, which is lighter by one neutron. English refined a laboratory technique to reveal the isotopic "signatures" in trees living now in the mountains, which allowed the team to match ancient wood samples with their source and create a "timber ledger."

"That gives us the ability to assess the cost to this society of harvesting and transporting these trees," English said.

English noted that the study indicates widespread cooperation among these ancient people. For one thing, trees from the same year and same source were placed into different "great houses;" for another, individual houses contain trees from the same year and different sources. The Chaco Canyon site has a dozen "great houses," with the largest containing about 600 rooms in five stories.

Betancourt and Dean had figured that the Anasazi carried the spruce and fir logs down from the distant mountaintops. In addition to offering proof of this, the latest study seems to dispute a theory that the long-distance trips for construction materials – which involved hoisting these logs on foot – evolved in response to a depletion of resources.

Chaco Canyon

Photo by Jeffrey Dean

Pueblo Bonito, above, was constructed more than 1,000 years ago in Chaco Canyon, New Mexico.

"It's much like we harvest timber today – we find the richest, most appropriate stands and log them rather than moving outward in distance from the lumber mill," English said.

In their paper, the researchers theorize that the Anasazi architects headed for the summits to seek saplings of specific dimensions, typically less than 9 inches in diameter. The easier-to-reach ponderosa forests on the mountainside probably lacked a suitable array of saplings, judging from dendroecology studies by LTRR Director Thomas Swetnam and others that indicate that prehistoric ponderosa forests were typically dominated by large trees.

A variety of other studies by LTRR faculty have contributed to the current understanding of Chacoan culture. In 1929, LTRR founder Andrew E. Douglass used charcoal from Arizona to "bridge the gap" between two southwestern chronologies, one based in the present and the other dangling in time, and thereby establish the general timing of occupation of Chaco Canyon.

Bryant Bannister, a longtime LTRR researcher who directed the lab from 1964 to 1982, based his 1959 dissertation on expanding Chaco Canyon crossdating efforts. He identified lower-elevation species, but the wood he labeled "species X" turned out to be the high-elevation spruce and fir later identified by Dean and Betancourt.

Dean, who has been a dendroarchaeologist with the Laboratory of Tree-Ring Research for 39 years, has been involved in other projects to date some of the 200,000 logs used in the construction of Chaco Canyon's monumental structures. The tree-ring crossdating of beams demonstrated construction occurred between 900 and about 1150 A.D., although recent evidence indicates the Pueblo Bonito structure dates back to the 800s, he noted.

The dendroarchaeologist continues to work with the others from the latest study to expand their provenance studies. Dean is particularly excited about their plans to apply strontium isotopes to determining the source of corn cobs and other food remains preserved for 1,000 years in Anasazi trash piles.

Evidence indicates that 3,000 to 4,000 people lived in this civilization center during its heyday, Dean said, so it's likely that food needs exceeded the canyon's agricultural capacity – even considering the Anasazi's irrigation system using side canyons to collect runoff from precipitation.

"One of the theories is people were importing food into Chaco Canyon," he explained. "They also imported pottery, probably because they ran out of fuelwood. They imported turquoise as well, and chert for making stone tools. Yet there is no evidence that much of anything went out. It's like a black hole."

Perhaps future provenance studies will shed some light on this question as well. In the meantime, efforts continue to learn more about this ancient culture.

"It's an ongoing project," Dean said. "We get new tree-ring samples every year from Chaco Canyon."

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