Tree-Ring Times

Newsletter of the University of Arizona Laboratory of Tree-Ring Research

Fall 2001

Bristlecone work raises chances of bridging gap

By Christina Jarvis

Photo by Tom Harlan

Dating of some bristlecone remnants can pinpoint the time frame when treeline used to be higher than it is now in the White Mountains of California.

In an otherworldly landscape, scientists and students from the University of Arizona's Laboratory of Tree-Ring Research in Tucson are advancing knowledge of timescales and climate on Planet Earth.

For the past two years, a renewed Bristlecone Pine Project, directed by Thomas P. Harlan, has consolidated previous research and successfully extended the Campito Mountain chronology by 1,800 years, to about 7,200 years in length. In the future, Harlan hopes to bridge a gap between the 8,700-year Methuselah chronology rooted in the present to a 3,000-year "floating" chronology based on older wood samples. This could extend the longest tree-ring chronology for North America back into the last Ice Age.

This effort was made possible by an anonymous donor wishing to contribute to a project unique to LTRR for which success was possible but not guaranteed. Harlan had been working on the bristlecone project unofficially for many years but said the funding allowed him to expand his efforts. He was able to purchase a Global Positioning System (GPS) and laptop computer, equipment he uses to identify the location of sampled trees and stumps in the field and then plot them on a computerized topographic map. The funding also covers field expenses for Harlan and some trained assistants for several summers.

"I would have done this research anyway, but not at this scale," Harlan said. "Because of the new funding, 20 other people, most of them volunteers, were able to contribute their time, labor and money. Much, much more was accomplished than would have been possible otherwise. I deeply appreciate all their hard work and the financial assistance that made this synergy possible."

The Bristlecone Pine Project at LTRR has a multi-generational history. Edmund Schulman began bristlecone work in the White Mountains of California in the 1950s. He died at age 49 in 1958, two weeks before Thomas Harlan arrived at LTRR. C. Wesley Ferguson carried on, working primarily with specimens from the area dubbed "Methuselah Walk" because of the many ancient bristlecone pines lining the path.

Whereas Schulman sampled living trees, Ferguson and others sampled dead wood also, and reported long chronologies exceeding any in North America – an 8,701-year record going all the way back to 6700 B.C. Some were skeptical and doubted that such old wood could remain on the ground surface without rotting away. Because the tree-ring data was pieced together from many samples, one bit of wood plugged into the wrong place could affect the whole chronology. The results had to be crosschecked.

In 1970, geologist Valmore LaMarche obtained a grant to investigate bristlecones on Campito Mountain, also in the Whites. Interested in geological time changes, he had noted that in mountain ranges across the United States where bristlecone pines were present, dead wood lay 500 feet above the present tree line.

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Dendrochronology

Director's note

We wish you Happy Holidays with this second issue of LTRR's Tree-Ring Times! Our continued efforts to carry out world-class teaching, research, and service continue, and in this issue you will see that our work is greatly aided by generous help from our friends. The oldest living trees in the world - bristlecone pines - were discovered by LTRR's Edmund Schulman, and his legacy of work on bristlecone pine (and that of many other LTRR scientists) is continued today with the help of an anonymous gift to LTRR. Our lead story in Tree-Ring Times highlights the work of Tom Harlan and associates on bristlecone pine, which has been made possible by this generous gift. The help of our friends and alumni are all the more important these days, as state-wide cuts in the budget reduce our ability to support "seed" research, such as examples of potential projects in the tropics and in northern Mexico described on the back page of this issue. In future issues of Tree-Ring Times we will describe other examples of how gifts and endowments have assisted us in the past, and how help from you could aid us in the future.

Happy New Year! (and New Ring!)

Thomas W. Swetnam

Photo by Ron Towner

A 35-room cliff dwelling in Cueva Bringas, shown above, remains undated, as do dozens of others in this region of eastern Sonora, Mexico. LTRR adjunct assistant professor Ron Towner would like to change that. See more details on the back page of this issue.

Tree-Ring Times Production Team *Fall 2001*

Editor	**Thomas W. Swetnam**
Managing Editor	**Melanie Lenart**
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Volume 1, Issue 2

Recognition and awards

Katherine K Hirschboeck, Associate Professor, first recipient of the Editor's Award from the Journal of Hydrometeorology for "exceptionally thorough review of papers submitted during the journal's inaugural year," 2001.

Thomas W. Swetnam, Director and Professor, 2001 W.S. Cooper Award from the Ecological Society of America for an outstanding paper in geobotany and physiographic ecology, with Julio L. Betancourt in the Journal of Climate 11:3128-3147, 1998.

Donald Falk, Graduate Associate. Recipient of 2001 Robert Hoshaw Award from the Department of Ecology and Evolutionary Biology for outstanding graduate student, and of a National Science Foundation dissertation improvement grant.

Ana S. Martinez, Administrative Assistant, 2001 CoS Staff Recognition Award.

Kurt F. Kipfmueller, Graduate Associate, UA Foundation award for "Meritorious Performance as a Graduate Teaching Assistant," Spring 2001.

Theodore Turley, Student Assistant, graduated, (Dean's list), December 2001, Eller College of Business and Public Administration, B.S. in business administration.

William "Ed" Wright, Graduate Associate, graduated May 2001, Ph.D., UA Department of Geosciences.

Christine Hallman, Graduate Associate. Graduated December 2001, M.S., UA Department of Geosciences.

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His investigation on Campito had two goals: to discover when the tree line moved down and to create an independent bristlecone pine chronology to validate the one for Methuselah Walk.

He asked Thomas Harlan to oversee a crew based at the Crooked Creek Research Station. Within an area laid out by LaMarche, they made a topographical map of Campito, surveying, sampling and tagging most of the bristlecone pine wood they could find—chunks large and small, dead trees, logs, and uppermost living trees.

Harlan took the Campito Mountain samples back to LTRR and, without looking at any other chronologies, crossdated the dead wood with living trees. He produced a 5,300-year chronology that verified that of the Methuselah Walk. Although the Methuselah Walk set remains the longest North American tree-ring chronology, Campito is the second longest record.

"The Campito chronology is the longest in the world for altitudes above 11,000 feet," Harlan noted.

The 1970s effort on Campito Mountain was successful, but there was more work to be done. Some pieces of wood were even older than the existing Campito chronology, so collection was required to fill in the gaps. LaMarche apparently suggested to his colleagues that he had devised a method for high quality reconstruction of temperature over a long time scale. He wanted to return to Campito to collect more samples, but he died in 1988 at age 50 without having shared his temperature reconstruction method with colleagues. Wes Ferguson had died two years before, at age 64.

Photo courtesy of Tom Harlan

Thomas Harlan enters GPS information -- gathered via satellite -- about the location of wood samples in the field. This way he and others can retrace their steps to track down samples that upon analysis turn out to cover pertinent time frames.

Donald A. Graybill then obtained a grant for bristlecone pine research in the western U.S. to develop new areas and chronologies for the reconstruction of temperature and precipitation. He soon became ill and, unable to do the fieldwork himself, sent Harlan in his stead. Graybill died in his early fifties in 1993.

The irony of the short lives of scientists who study the world's oldest trees is not lost on Harlan, but this has not slowed his drive to continue building on the work of his predecessors. He and associate Greg Lazear compiled a computer program to keep track of and date samples. Their first task was to consolidate all data collected in previous projects and boxed separately upon the deaths of Schulman, LaMarche, Ferguson and Graybill. Harlan is entering this information into a computer database. So far he has incorporated 1,000 pages of field notes, not including data from work this past summer.

After preliminary sorting, it was time for fieldwork. Teams of students, volunteers from as far away as England and paid assistants have spent up to six weeks per summer working on this project. They have been taking new samples, locating samples using GPS and plotting them on the computerized map, relocating tagged specimens and looking for new sites with promise.

Many tags were gone, carted away by birds or pried off by the incessant wind that rattled aluminum tags until the nails pulled out. On some Campito wood above timberline, the surface that had been protected by the tag was about 3 mm higher than the unprotected surface, showing the effects of erosion by weathering.

The group experienced the usual hardships of fieldwork – softened by assistance from the U.S. Forest Service, which provided a trailer with office space and the use of another for cooking and bathroom facilities. The assembled company was soaked by rain for the first two weeks. Increment borers got stuck in trees. On steep mountain roads, their wheel edges came within inches of open mine shafts and steep drop-offs. And they worked hard.

There were some fringe benefits. They enjoyed camaraderie around campfires. And they saw wild horses, blue grouse, hares, and elk.

In addition to Campito Mountain, teams obtained further information from Wheeler Peak, Indian Garden, and Ward Mountain in Nevada and Pine Peak, Swazey Mountain, and the

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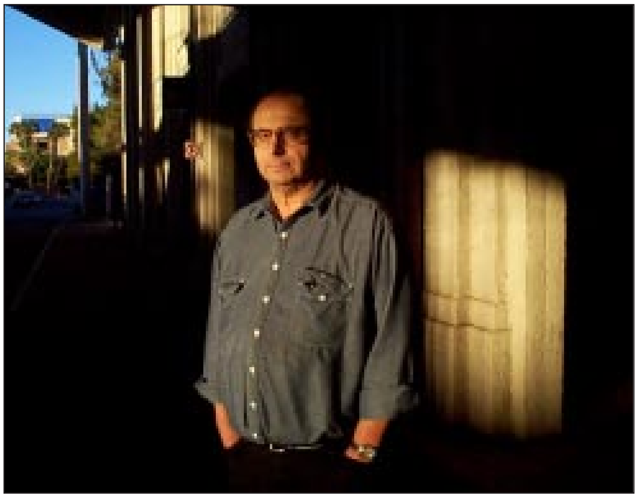
'Great house' spruce and firs born on distant mountain tops



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

Photo by Melanie Lenart

By Melanie Lenart

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."

For more information, contact Dr. Dean at 520-621-2320 or jdean@LTRR.arizona.edu.

Tree rings tell of climate in Turkey, Jordan

By Melanie Lenart

After putting the finishing touches on a 660-year climatic reconstruction for Turkey, LTRR research specialist Ramzi Touchan moved one step closer to his dream of creating a long-term climate chronology for the Middle East region.

Touchan, a researcher with the lab since 1991, previously completed a 396-year climatic reconstruction for southern Jordan with LTRR colleagues, research specialist David Meko and professor Malcolm Hughes. Now he will turn his attention to the samples collected in Turkey, Syria and Lebanon this past summer.

The results from Turkey showed spring droughts tend to be short-lived, at least relative to North American dry spells that tree rings indicate can last decades. It's rare for a drought to last more than five years in southwest Turkey, judging from Touchan's preliminary results.

Drought durations appear similar to results for Jordan, which show winter-spring droughts rarely last more than five years. These proxy records of drought, revealed through the pattern of small annual growth rings in trees, can prove especially important in the Middle East because continuous instrumental climate records for these desert ecosystems generally go back only about 50 years.

"Water is the main issue for all of the countries in the Middle East," Touchan noted. "For the local people, the issue is one of understanding drought patterns."

The project to expand knowledge of regional drought regimes and fit the Middle East into long-term regional climate patterns has taken Touchan to the Middle East for the past two summers. He hopes to continue the research for at least another five years, working to train local foresters and educators in the science of dendrochronology.

Touchan's vision also calls for developing a university-based tree-ring laboratory that will be affiliated with the University of Arizona, at least to start. Already officials in Turkey, Jordan, Lebanon and Syria are vying for the opportunity to provide buildings and faculty support for this purpose, he said.

Touchan hopes U.S. funding agencies and private philanthropists will recognize the value of furthering the ongoing collaboration he has initiated with support from the National Science Foundation's Earth Systems History section.

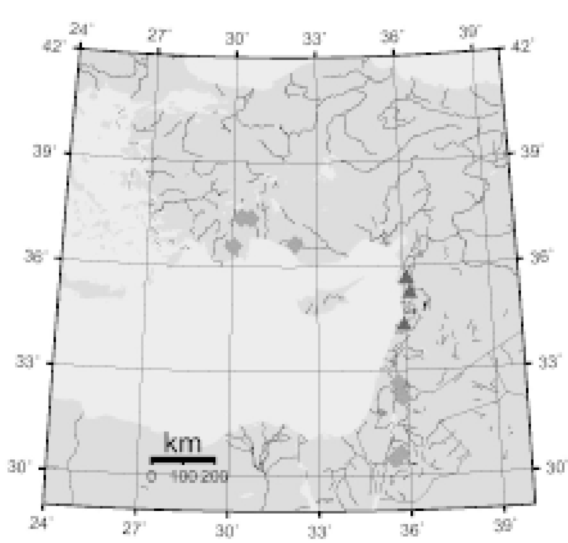
The education effort is already paying off. Touchan was assisted in the field this past summer by two overseas colleagues – Adib Rahme, College of Agriculture dean at the University of Aleppo in Syria, and Nesat Erkan of the Southwest Anatolia Forest Research Institute in Turkey – who learned about tree-ring techniques during a one-month visit to the LTRR earlier this year. In the coming year, Touchan plans to train a scientist from Lebanon's Ministry of Agriculture.

"My strategy is to depend more on local people once we train them," he said. "We're trying to get a mixture of collaborators of scientists in those regions."

UA geosciences undergraduate Brian Wallin also joined Touchan on both sample-gathering trips. Wallin took the field work in stride and found people from the different cultures fascinating and friendly.

"It was my first time out of the country, except for Mexico. I have to admit I was a bit nervous. But everyone was very friendly," Wallin said. "This year, going back to Turkey was like going back to see old friends."

Touchan and Wallin were in Damascus, Syria, when they heard the news of the Sept. 11 tragedy.



Researchers led by the LTRR's Ramzi Touchan have collected tree-ring samples from the Middle East sites shown on the map at left. Diamonds indicate analyses are already underway, while triangles show sites of collections that have not yet been analyzed.

Map created by Ramzi Touchan

Photo by Jean Estephan of Lebanon

Ramzi Touchan, center, prepares to sample trees in a cedar forest in Lebanon with help from UA geosciences major Brian Wallin, right, and Abedllah Khatib, a graduate student with the University of Aleppo in Syria. A sculpture, in back, adorns the visitor's area.

Although saddened, they were also touched by the sympathy expressed by colleagues and even people they had never met.

"People over there were shocked and saddened by the tragedy and the loss of innocent American civilians," Touchan reported. "When they knew we were from the U.S., they came up to us and offered their condolences. On the way to my sister's house in Syria, the cab driver expressed sorrow and didn't want to charge me for the ride."

The two returned without incident. Since then, they've been hard at work crossdating tree cores by matching the patterns of narrow and wide rings in a variety of trees to the actual year.

Although Touchan plans to analyze the tree-ring data from many other sites before reaching any conclusions, he has high hopes that a regional signal will emerge from the collections. Previous research by others using instrumental records (1930-1991) indicates that Turkey's winter rainfall is influenced by the North Atlantic Oscillation (NAO), a pattern of global air circulation known to affect winter temperatures in western Greenland and northwestern Europe.

In addition to helping to refine understanding of how the NAO affects the Middle East, Touchan plans to apply the research to learn more about the Siberian High and other atmospheric circulation patterns. The Jordan results indicate a strong correlation between dry winters and the western extension of the Siberian High, for instance.

As part of a future five-year plan, Touchan and dendroclimatologist Mary Glueck would like to extend the collection efforts and analysis to countries in North Africa, such as Tunisia and Algeria. They also want to update and expand the tree-ring chronology developed for Morocco by Charles Stockton, a retired LTRR professor. Eventually he plans to apply the analytical techniques to defining long-term streamflow of the Euphrates. The underlying goal for all this research was described succinctly in the summary of purpose written by Touchan:

"The Mediterranean is a water-deficit region and in parts of the region there is a history of conflict over natural resources. This information will aid in anticipating and, it is hoped, lessening the likelihood of conflict over scarce water resources."

Dr. Touchan can be contacted at 520-621-2992 or rtouchan@LTRR.arizona.edu.

Fire, climate interactions in Rocky Mountain wilderness area

By Kurt F. Kipfmueller

Photo courtesy of Kurt F. Kipfmueller

Kurt F. Kipfmueller, right, takes a wedge from a tree in the Selway-Bitterroot Wilderness Area on the border between Idaho and Montana. He has developed 1,200-year chronologies for two species to look at long-term interactions between fire and climate.

Forest fires have long been recognized as an important component shaping forest composition and structure over long periods of time. In upper elevation forests near timberline, fires are relatively infrequent, occurring at intervals of perhaps 100 years or more at any given place on the landscape.

While infrequent (temporally), these fires often reach large proportions and often completely kill most overstory trees. While the results of these fires are often dramatic, leaving behind charred trees over thousands of hectares, they are an integral part of a natural system where vegetation has uniquely adapted to the fire regime over long periods of time. Climate has long been recognized as an important agent controlling the occurrence of large fires in many forest landscapes.

In southwestern forests and lower elevation forests, there exist important interactions between oscillating wet and dry conditions leading to large fire events. Wet years are responsible for abundant vegetation that (once dead) provides an important fuel source during subsequent dry periods.

The role of climate in influencing large fire events in upper elevations, however, is not well understood. Dry conditions during the summer clearly play some role in large fire event initiation and propagation. However, little quantitative evidence has accumulated to identify interannual relationships that may also be important, such as protracted drought periods.

I am conducting research that investigates the interactions between fire and climate at long timescales. This research involves a three-pronged approach whereby tree-rings are used to date fire events and reconstruct climate.

This research also investigates the patterns of forest recovery following fire events by using tree-rings to estimate establishment dates for forest species. This research is being undertaken in the Selway-Bitterroot Wilderness Area located on the border between Idaho and Montana.

The Selway-Bitterroot Wilderness Area is the third largest wilderness area in the coterminous United States and shares a border with the Frank Church River of No Return Wilderness area, the largest wilderness area in the lower 48 states.

As part of the project, fire history and age structure relationships are being reconstructed in four subalpine watersheds within the wilderness area. I am determining the temporal patterns of fire occurrence as well as the patterns of forest recovery following large, destructive, fire events.

The occurrence of large fire events is being compared with reconstructed summer temperature to identify the relationship between climate and fire occurrence in the region.

Climate is being reconstructed using tree-rings collected from subalpine larch and whitebark pine collected near the upper treeline. These tree-ring chronologies currently span more than 1,200 years, from 721 to 1998 A.D. They are among the longest records of tree growth in the region.

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Frost rings in bristlecone and foxtail pines

By Christine Hallman

Photo by Melanie Lenart

Christine Hallman inspects a tree-ring core under the microscope.

It is difficult to imagine a volcanic eruption in Indonesia affecting trees on the other side of the Pacific Ocean. Yet large volcanic eruptions around the globe sometimes leave their mark on trees in the western United States in the form of frost rings. My thesis work involves locating these tell-tale frost rings and thus helping to pinpoint dates of potential previous volcanic eruptions or locations of anomalous circulation patterns.

Through a systematic identification of frost rings, climatic variations and spatial patterns in high-elevation pines located in the western U.S. can be identified. Previous research suggests that climatically effective volcanic eruptions can disturb atmospheric circulation patterns and cool temperatures globally. This sudden cooling can lead to frost formation in temperature sensitive tree species. My research includes 14 bristlecone pine and two foxtail pine sites located in the Great Basin, Front Range of the Colorado Rockies, Arizona, and the Sierra Nevadas.

Since bristlecone and foxtail pines are long-lived, they provide potential for the documentation and/or discovery of unusually low temperatures that may be linked to explosive volcanic eruptions through notable frost events. My tree-ring samples date from 1692 BC to AD 2000 with the majority of them dating after AD 800. The oldest living bristlecone is about 4800 years old. As you can imagine, some of their rings are very narrow. For example, a bristlecone may have over 3000 rings in the space of 2 feet.

My thesis research involves a regional frost-ring investigation of high-elevation pines in the western U.S. This work builds on previous studies and collections from a variety of researchers from LTRR as well as recently collected data. Specifically, my research is based on the 1984 *Nature* article by the late Dr. Valmore LaMarche, Jr. and Dr. Katie Hirschboeck. I'm working with Dr. Hirschboeck to extend temporally and spatially the findings in the 1984 paper.

After identifying and categorizing frost rings from over 900 tree-ring samples, I compiled the frequency of frost-ring years for each sample from each site was compiled. The most frequent and widespread frost rings or "notable frost events" were determined. seventeen notable frost events were identified with 9 of them covering large portions of the western US. For example, a widespread frost event occurs in AD 1453. This frost event is associated with a 1452 eruption in the Southwest Pacific and a 1451 eruption in Java. The "notable frost event" suggests subfreezing temperatures covered large portions of the western U.S. during the 1453 growing season. Some of the 17 notable frost events are restricted to a given region (e.g., Front Range of the Colorado Rockies) thus, implying that regional climatic variations do exist.

Eleven of my 17 notable frost events match LaMarche and Hirschboeck's 1984 results. They define a "notable frost event" as an event that occurs in at least 50% of trees in a site or in two sites. My criteria for a "notable frost event" is that the frost ring occur in at least 25% of the trees in a site and occur in two or more sites.

Trees at higher latitudes and higher elevations tend to have a higher frequency of frost events. Recently collected tree-ring samples do not show a widespread frost event in years following the 1982 eruption of El Chichon, Mexico, or the 1991 eruption of Pinatubo, Philippines, but more samples need to be collected. Although not widespread, I have found frost rings in 1982 and 1992 in younger trees.

Christine Hallman can be contacted at 520-621-9731 or challman@geo.arizona.edu.

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Wah Wah Mountains in Utah, the latter two being entirely new sites. An "i-button" temperature recorder was attached to a timberline tree on Campito, where it collects temperature data several times a day throughout the year.

"Once someone figures out what Val LaMarche had in mind, they'll have temperature readings from right on-site, rather than from the airport in Bishop, California," Harlan said.

The funding will allow similar expeditions for the next two summers. The project also furthers the research of UA students. Linah Ababneh, an Emil Haury Scholar from Jordan who is working on her Ph.D., is seeking to detect the effect of increased carbon dioxide and nitrogen on subalpine forest ecosystems, comparing bristlecone pine in the White Mountains with foxtail pine in the Sierra Nevadas in California.

Ababneh is testing a LaMarche hypothesis that greater atmospheric carbon dioxide levels can have an effect on growth that goes beyond temperature and precipitation. The bristlecone pine samples show wider rings since about the mid-1970s, which a ground-breaking and still-controversial 1984 paper by LaMarche and colleagues attributed to carbon dioxide fertilization. Ababneh plans to use stable isotopes of carbon and nitrogen to consider the respective influence of their atmospheric counterparts. She is excited about her work.

"I am building upon Dr. Haury's legacy. He said that the science of dendroarchaeology might have contributed the most significant advances in the archaeology of the Southwest," she said. "I follow in his footsteps, and suggest that tree rings and dendrochronology will provide the most significant advances in understanding greenhouses gases in forest ecosystems."

Extension of the bristlecone pine chronology will be an important contribution to current efforts at calibrating the carbon-14 dating technique in the period immediately after the last Ice Age.

Greg Lazear's tree-ring computer dating program, refined and field-tested, may prove to be another one of the project's contributions to the tree-ring science community, Harlan believes.

The program automates crossdating of "skeleton plots" – the graphical representation of the pattern of narrow rings found in a piece of wood – thus allowing computerized matching with existing chronologies.

This will help dendro-chronologists to more efficiently develop skeleton plots and to date exceptionally long chronologies like those from bristlecone.

Thanks to a generous donor, Harlan and others will have more opportunity to expand a grand scientific endeavor.

"The White Mountains are extremely large and we have worked in only a small part of them," Harlan noted. "There's always the next ridge over."

For more information, contact Tom Harlan at 520-885-4194 or strider@throneworld.com.

Photo courtesy of Tom Harlan

LTRR researchers Rex Adams, second from left, Thomas Harlan, fourth from left, and Linah Ababneh, third from right, take a lunch break with some of the volunteers and USFS rangers who worked on the bristlecone project this past summer.

NOVA features bristlecone pines

A NOVA program on the Methuselah Tree bristlecone is showing nationally in December. Schulman's discovery is highlighted and Tom Harlan is interviewed in the program. Tucson's KUAT (Channel 6) will air this program at 9 p.m. on Feb. 26.

For more information on the program and on bristlecone pines in general, go to the following web site: http://www.pbs.org/wgbh/nova/methuselah/textindex.html

An irreverent microanatomical view of life at the LTRR

By Steve Leavitt

With a department that prominently displays the word "Research" in its title, one might think the role of teaching is secondary. However, even from its inception, the laboratory has maintained a prominent pedagogic profile through course offerings related to dendrochronology and through mentoring graduate students and guiding their tree-ring-related thesis projects.

The decade of the 1990s ushered in a new era of expanded teaching by Laboratory of Tree-Ring Research faculty in the university's lower division general education program and first-year colloquium courses.

One of the most interesting and fulfilling aspects of teaching is that we learn as well from our students. Amazingly, in the freshman-sophomore classes largely comprised of non-science majors, these lessons are sometimes contrary to what we have been led to believe are current scientific facts and paradigms.

Sometimes our lessons in "new science" (maybe akin to "new math," but without the grounding in reality) are administered with a healthy dose of "new writing," which makes the experience even more holistic and exciting.

How could I forget such essay classics as "the higher amounts of

Photo by Melanie Lenart

Steve W. Leavitt, professor of dendrochronology, scouts lofty timber that needs to be taken down a peg (provided he doesn't have to go to PC re-education camp as a result of what he writes).

carbon dioxide found in the future will be circulated through volcanic activity which could have its own harmful effects on those areas," or the riveting "(photosynthesis is) the process in which plants turn their 'energy' into oxygen in which we use to breathe," or the scintillating "millions of years ago the Earth was not nearly as hot as it is now. That is because of high fertility birth rate in woman. The more people you have on Earth, the hotter it will become."?

Now, let's suspend disbelief even further and imagine that A.E. Douglass had been enlisted into teaching general education classes (of which I expect he would do a fine job). He had dutifully taken along the final exam papers to read between field activities of the Second Beam Expedition near the Whipple ruin.

Through four days he had read the first 38 essays about "how tree rings could be a research tool in understanding wide-scale (read 'global') change." In the evening of that fateful 5th day of excavations on June 22, 1929, with his head already beginning to throb from the cumulative effects of grading, he pulled out an unassuming exam, no. 39.

Under the flickering kerosene lamp he read the following prophetic passage from a student identified 70 years later only by the initials "**SWL**"

"There are vegetarions called trees that grow in many places such as forests and Canada. Inside the trees are circles like the hard water deposits in a flea market sink. These are called tree rings and according to old wives' tales say they show how old the tree is when they are counted. They form from bark, and they expand and contract to different sizes like the 'one-size-fits-all' second-hand cummerbunds at a flea market tuxedo stand. As they shrink and swell, the volume of the atmosphere changes and more ozone layer reaches the surface and changes temperatures."

Of course, there is a remote possibility this student was not in class the day that subject was covered, or perhaps was distracted in class (read "sleeping").

Either way, dare I say Douglass' headache may have become chronic, he may have been unable to look at the Whipple tree-ring samples *du jour* (perhaps even changing profession on June 23rd to selling maps to the stars' [homes] in Hollywood), and the tree-ring universe as we know it might never have evolved.

To coin a phrase for the brave new lexicon, this would have been "tragidipitous," a descriptor unintelligible but oddly familiar ... well, like the interminable banter of a flea market time-share salesman.

Wish List

Mexico cliff dwellings

The little-known cliff dwellings of northern Mexico have tremendous potential for the development of dendrochronology in Mexico. Quite similar to the famous cliff dwellings of Mesa Verde, these structures are located in remote areas of the Sierra Madre Occidental and have received very little archaeological or dendrochronological attention, yet they contain relatively undisturbed roof timbers amenable to dendroarchaeological research. These sites can contribute important data for developing centuries-long tree-ring chronologies in the area and region.

LTRR adjunct assistant professor **Ron Towner** hopes to expand archaeological tree-ring dating into northern Mexico via projects focused on these cliff dwellings. The amount needed for a small pilot project ($10,000 to 15,000) would facilitate sample collection and analysis for some of the more accessible sites in the area and would help attract additional funds for future large-scale projects.

Dr. Towner can be contacted at 520-621-6465 or rtowner@LTRR.arizonza.edu.

Tree rings in the tropics

Tree-ring work in the tropics is very difficult because many tropical tree species do not develop clearly visible annual rings. Nevertheless large, old tropical trees do exist and they may be a valuable resource for paleoclimatology – especially the study of El Niño behavior before and after the Industrial Revolution, when atmospheric greenhouse gas concentrations began their current and rapid rise.

Our recent pilot project shows that the seasonal cycle can be resolved using measurements of stable isotopes in tropical trees – even those that completely lack rings. Hence a group led by the LTRR's new assistant professor, **Michael N. Evans**, is seeking funding (~$5,000) for an expedition to collect samples from the lowland forests of western equatorial South America – a region where rainfall varies almost solely with El Niño activity.

Data developed may provide important evidence for whether recent El Niño behavior is part of the norm, or instead is another component of the increasingly clear fingerprint of global warming.

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