TREE-RING TIMES

Newsletter of the Laboratory of Tree-Ring Research Summer 2002

Global outreach inspires LTRR success

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Fire!

Tracking ancient blazes back in time using tree rings and charcoal

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A sequoia explodes into flames, page 2

Photo by Ellis Margolis

LTRR

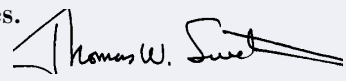
Director's Note

We are pleased to bring to you this issue of Tree-Ring Times with a colorful mix of photographs, personalities, and projects. In addition to our usual updates on activities of the Laboratory of Tree-Ring Research (LTRR), and a profile of one of our newest faculty members (Dr. Paul Sheppard), we focus on the importance of visiting scholars in our outreach program. The Agnese N. Haury Fellowship Program, endowed by a generous gift from Mrs. Haury, has enabled the LTRR to host numerous scholars from around the world to visit and study at the Lab.

This kind of outreach has greatly aided the expansion of dendrochronology to different parts of the world and increased collaborative opportunities for our students and faculty. The brief notes by former Haury Fellows on page 6 provide examples of the success of this program. This success is a tribute to the foresightedness of Mrs. Haury and Drs. Bryant Bannister and Malcolm Hughes, former Directors of the LTRR, in supporting and setting up this program.

We continue to seek ways to enhance our teaching, outreach, and research missions in this time of Arizona state budget cutting. This search leads us to ask our friends and alumni to consider contributing to one or more of our existing scholarship or fellowship funds, or for other uses (for example, see Rex Adams and equipment on page 12). And of course, we continue to seek additional support for our new building (see page 7, and attached gift–giving envelope).

Beyond our needs for financial support, our main purpose in this newsletter is to share with you the excitement that we all feel for the work and study that we are engaged in. The fantastic cover photograph of a flaming giant sequoia by graduate student Ellis Margolis captures one of the wonders of our tree-ring world. It is a pleasure for us to share some of these wonders with you in these pages.



Recognition & awards

Linah Ababneh, Graduate Associate in Research, received a Mary DeDecker Grant from the California Native Plant Society, Bristlecone Chapter, and a White Mountains Research Center grant from the University of California-San Diego.

Rex Adams, Senior Research Specialist, received a College of Science Career Staff Recognition Award.

Dr. Jeffrey S. Dean, Professor, was elected an Arizona-Nevada Academy of Science Fellow.

Donald Falk, Graduate Associate, received a Marshall Foundation Graduate Fellowship.

Dr. Katherine Hirschboeck, Associate Professor, received a General Education Assessment Team grant.

Dr. Steven W. Leavitt, Professor, was elected Editor of Tree-Ring Research, the flagship journal of the Tree-Ring Society. He was also elected a member of the American Quaternary Association Council.

Melanie Lenart, Graduate Student, received a travel grant from Women in Science and Engineering.

Dr. David W. Meko, Principal Research Specialist, received the Outstanding Staff Award for his long and meritorious service to the LTRR.

Dr. James H. Speer, a former LTRR graduate student, and **Dr. Thomas W. Swetnam**, Professor and LTRR Director, received the 2002 Henry Cowles Excellence in Publication Award from the Association of American Geographers.

Dr. Ramzi Touchan, Senior Research Specialist, received a Foreign Travel Grant Committee Award.

TREE-RING TIMES

Volume 3, Summer 2002

Editor: Melanie Lenart

LTRR Director: Dr. Thomas W. Swetnam

Computer Support: Dr. Martin Munro

Flaming Sequoia

The cover photograph by Graduate Research Assistant Ellis Margolis won a recent LTRR photo contest. The tree in Sequoia National Park, California, was more than 200 feet tall and 20 feet in diameter at the base when it turned into a Roman candle during a prescribed fire in 2001. Margolis had been sampling trees in a nearby sequoia grove that day.

Paleofire researchers gather for Tucson meeting

By Melanie Lenart

Fire makes its mark when it blazes through a forest stand. Fire scars in trees record damage from hundreds of years in the past. Charcoal layers in lake sediments reveal the presence of fire thousands of years ago—even back into the last Ice Age.

Charcoal and tree rings

Finding a way to merge these two natural archives of fire history is a challenge practitioners agreed to begin tackling when about 65 fire ecologists and climatologists met this spring in Tucson for a weeklong workshop. The workshop was co-organized by Dr. Thomas Swetnam, a fire ecologist and director of the Laboratory of Tree-Ring Research, and Dr. Cathy Whitlock, a University of Oregon professor and a leader in charcoal-based fire history studies.

Records of fire reconstructed from charcoal layers in lake and bog sediments often stretch back 10,000 to 20,000 years, back to the time when ice sheets reached as far south as Chicago. When coupled with pollen analysis, the same sediments used for charcoal can reveal information on past vegetation. However, researchers can rarely pinpoint the exact year of a fire because worms churn the sediments and typical dating methods only provide an estimate to within a decade or two.

Tree rings can identify the exact year of a fire's occurrence, as long as at least a few scorched trees remain on the landscape. Dead wood still tells tales via its tree rings, even when it has been thoroughly charred. And by reading between the lines, researchers can glean information on past climate. Still, fire ecologists who use dendrochronology feel lucky when they can stretch a fire record beyond 500 years into the past.

Workshop participants, who included fire historians from Argentina, Chile, Australia and several European countries as well as researchers from across the United States, agreed to several tactics to help reconcile these two different but complementary records.

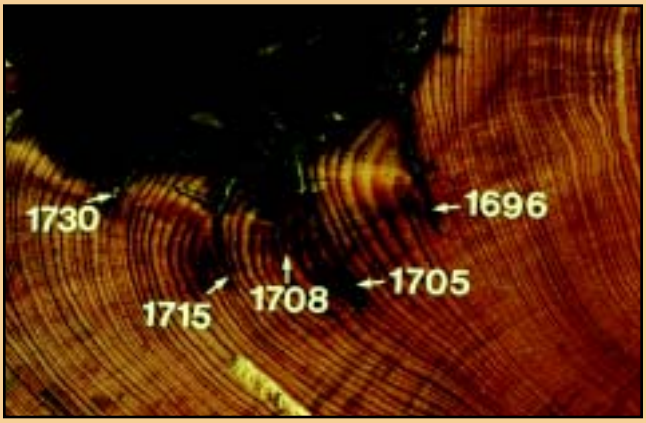


Photo by Christopher Baisan

This ponderosa pine cross-section has been crossdated, thereby yielding dates (shown in white) for the fires that caused the scars above.

First, participants hatched plans to calibrate these two approaches by sharing research sites more often. Two researchers who had already done this for an Idaho site reported good agreement between their records, for instance.

Building a better database

Participants also decided to set up an international database that would facilitate the sharing of results from individual sites and the development of networking. It will be modeled after the International Tree-Ring Data Bank.

"The way dendroclimatologists have been able to become global is to work with other scientists and to access data sets from all around the world in a common data base," Swetnam explained. "This really has been the paradigm of the last decade or two."

Swetnam and his colleagues and students have managed to coax forth a picture of regional fire patterns for the Southwest, revealing a complex link to El Niño's climatic fluctuations. But to do so took more than two decades of painstaking work reconstructing fire patterns from thousands of fire-scarred trees at dozens of sites.

Similarly, reconstructing fire history based on the charcoal record for one site around a small lake typically shows a link between hot and/or dry climate and increased fire frequency. But working on one site can consume a graduate student's attention for several years, as Dr. Whitlock's protégés have found.

Improving fire prediction

These two paleofire pioneers and others in their field have high hopes that they will be able to reconstruct fire patterns on a much grander scale within the next decade. They expect the results to reveal further connections between fire and climate.

One use of this new understanding will be the refinement of long-range forecasting of fire season severity.

International visitors enrich LTRR environment

By Melanie Lenart

It's one thing to discover something, such as how to turn an interest in tree rings into the science of dendrochronology, as Laboratory of Tree-Ring Research Founder Andrew E. Douglass did starting in the 1900s. It's another thing to maintain the edge since then, as his academic descendants continue to do.

How does the LTRR stay at the forefront of dendrochronology? It's partly thanks to the continuous influx of visiting scholars from around the country and the world, explained some of the faculty members who have played key roles in promoting a high international profile. Every decade, hundreds of visiting scholars spend days to months at the laboratory.

"We wouldn't be making a big impact in any of the sciences we work in if it weren't for this outreach," explained Professor Malcolm Hughes, who directed the LTRR from 1986 to 1999. "Meeting and working on a routine basis with people from different cultures is a very effective way to open people's minds."

"Much of our active outreach, as opposed to routine scientific collaboration, has been funded by private donations," Hughes added. One of these donors is LTRR supporter Agnese N. Haury, who in 1998 created a Fellowship Fund to bring scientists in a variety of disciplines from around the world to study dendrochronology at the Laboratory, typically for a two-month stint. *(For more, see page 6.)*

Other funding for visiting scholars has come from scientific agencies. For instance, the National Science Foundation supported the first international workshop on dendroclimatology, held in Tucson in 1974.

"It's where I first met my British colleagues from Belfast, even though they were only 120 miles away," noted Hughes, who hails from Liverpool, England.

The conference, which launched a new phase of international cooperation among dendrochronologists, was organized by LTRR Professor Emeritus Harold C. Fritts.

Dr. Fritts described himself as an "evangelist" when it came to promoting the uses of dendrochronology around the world.

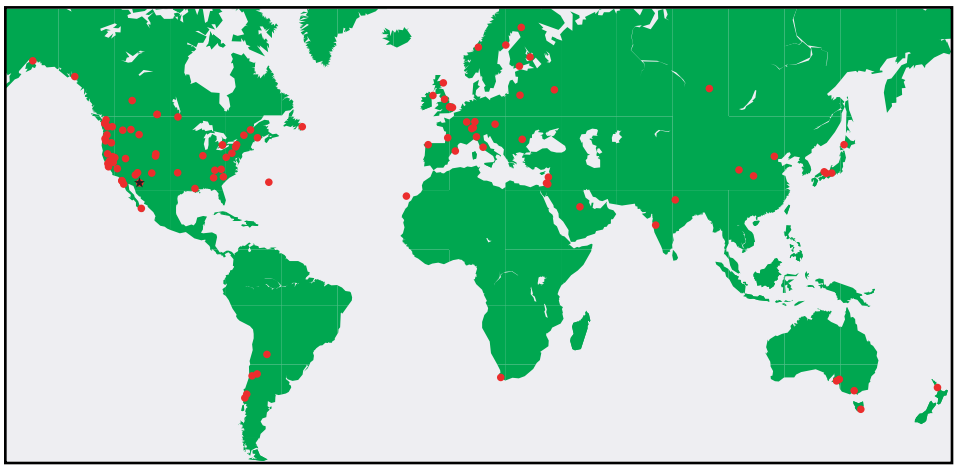
When he joined the LTRR faculty in 1961, with founder A.E. Douglass still maintaining a presence despite being 93 years old, Fritts had two objectives in mind. One was to study, understand and quantify the physiological basis for tree-ring growth under different environmental

Dendrochronology:

the science of dating events, intervals of time, and variations in environment in former periods by study of the sequence of and differences between rings of growth in trees and aged wood.

Webster's Third New International Dictionary

Dendrochronologists stress the importance of "crossdating," i.e., comparing ring patterns among trees at a site to detect missing rings or false rings, before reaching any conclusions.



Map created by Martin Munro with data-gathering assistance from Hugh Mulligan

The red dots in the map above show the origin of some of the visiting scholars who have come to the LTRR since 1992. The list is incomplete, but gives an indication of the laboratory's outreach. The LTRR's location in Tucson, Arizona, is shown in black. The two dots in the Atlantic represent Bermuda and the Canary Islands, home to two recent visitors.

conditions. The other was to work on an outreach program "to spread the word."

He succeeded on both counts, with contributions from others. His ecophysiological studies, statistical analyses and models of tree growth helped dispel then-lingering doubts about the validity of using dendrochronology to interpret climate and environmental factors. And his travels—to 26 different countries over the years—and efforts to bring other researchers to Tucson helped the LTRR gain intellectual support.

Financial support recruited from government agencies and, later, private donors further allowed the science of dendrochronology to thrive and expand.

"I think it's largely responsible for the breadth it has today," said Fritts. Areas of expertise include dendroarchaeology, dendroecology and dendroclimatology, to name some local favorites. As Fritts sees it, "Word got to the specialists in all fields, and it created new specialists."

Another LTRR innovator credited with appreciating the importance of international connections is Professor Emeritus Bryant Bannister, LTRR Director from 1964 to 1982.

His many travels included a trip with Dr. Fritts to the People's Republic of China in 1976, soon after Nixon went behind the Great Wall. They and other LTRR faculty members also began to establish ongoing collaborations with Russian scientists well before *perestroika* could be found in an American dictionary. And they wouldn't want to overlook Scandanavia, with its well-trained foresters and contribution of the best increment borer in the business, the standard tool for coring samples from trees.

This outreach, along with the Lab's world renown for its research, has long attracted distinguished visitors for brief tours or extended stays.

"We've had thousands of visitors," Dr. Bannister said. Probably tens of thousands of people have come through the LTRR's outreach program for schoolchildren and local residents. (*See back page.*) "People come from all over the world."

Some of the Lab's visitors included scholars who founded their own major laboratories devoted to dendrochronology, such as Dr. Gordon Jacoby of Columbia University's Lamont-Doherty Earth Observatory and Dr. Bruno Huber of Munich, Germany, one of Europe's more prominent tree-ring laboratories. Some of the recent Haury Fellows have founded or plan to establish their own tree-ring programs, too. (*See page 6.*)

Dr. Thomas Swetnam, who has headed the LTRR since 1999, considers the outreach program crucial.

"If you look at all of our strengths, the outreach program has to be near the top of the list," Dr. Swetnam said. "A living and thriving laboratory needs to foster the development and extension of its sciences by serving as a midwife in the birth of other labs."

Dr. Bannister offers a similar metaphor for the LTRR's role. "This is the grand-daddy of them all."

Fulbright scholar focusing on pests

After working visits to the Tucson facility in 1990 and 1994, Dr. Irina Sviderskaya of Russia won a Fulbright Visiting Scholarship to support her work this year at the Laboratory of Tree-Ring Research. A researcher at the Institute of Forest in Krasnoyarsk, Russia, Sviderskaya is here refining techniques to detect insect outbreaks with tree-ring analysis.

With huge tracts of forest, Siberia all-too-often plays host to devastating insect outbreaks. For instance, the Siberian moth deforested more than 7 million acres in the mid-1950s. Sviderskaya focuses on the pine looper, which attacks only Scots pine but still manages to defoliate hundreds of thousands of acres during an outbreak. Recorded observations of insect outbreaks were rare before modern times in some of these wilderness areas.

Sviderskaya moved into the study of insect outbreaks at the urging of some friends, entomologists who had been unable to read the story in the tree rings because they were only counting rings, not crossdating to account for missing and false annual rings. (*For more on crossdating, see page 8*).

"Really, I agreed to help them because I knew it was possible. I knew that Tom Swetnam and others had done it," she explained. She is currently working on a journal article with Swetnam about Siberian tree growth responses to insect outbreaks.

Haury Fellows take lessons back home

Since the 1998 Agnese N. Haury Fellowship Fund was established in 1998, recipients have been coming to the Laboratory of Tree-Ring Research from around the world to hone their tree-ring skills. The accounts below explain what some Fellows have done with the knowledge they gained.

Dr. Edmund February of South Africa

There were no tree ring laboratories in all of Africa at the time I received an Agnese Haury fellowship in March, 1999. The primary purpose of my visit to the LTRR was to learn as much as possible about tree-ring research so that I could establish a laboratory. To this end, I have now been successful in that I have established a fully functional tree ring laboratory in the Department of Botany at the University of Cape Town, South Africa. With Zewdu Eshetu, I am using tree rings to establish a long rainfall record from European oak around Cape Town, among other projects.

Dr. Zewdu Eshetu of Ethiopia

Following my stay in Tucson as a Haury Fellow in 2000, I was awarded a postdoctoral research fellowship from the South African National Research Foundation to study climate changes in South Africa from tree rings, with Drs. E. February and W.D. Stock. So far, we have developed a 120-year chronology for an introduced oak species. I am also working on radiocarbon dating of a juniper species from Ethiopia to resolve problems with numerous missing and false rings. My vision is to establish an Ethiopian stable isotope and tree-ring research laboratory.

Dr. Marco Carrer of Italy

I work at the University of Padova in Italy, where I received my Ph.D. in Forest Ecology in1997. I have been trying to apply tree-ring analysis to better understand the ecology of tree species in the Alps, especially in the higher elevations where climate may play an important role in tree growth. As a Haury Fellow in early 1999, I learned cellular analysis, which gave me deeper insight. I've brought this knowledge back to my lab, where a couple of Ph.D. students now work on this technique.

Dr. Paula Gardiner of England

I came to LTRR in April, 2000, on a Haury Fellowship while I was writing up my Ph.D. Since returning to Bristol University, where I am now a Lecturer in Archeology, I regularly teach tree-ring concepts to undergraduate and graduate students. At present I am collecting and dating samples from the submerged forests in the Severn Estuary. Last year I sampled and dated Medieval barns in southwestern France with a student I am mentoring. Eventually I hope to set up a dendrochronology laboratory at Bristol University.

Linah Ababneh of Jordan

I am a Ph.D. candidate at the University of Arizona, studying geochemistry and global change. The Haury Fellowship helped me to widen my knowledge of the applications of tree-ring analysis in Near Eastern archaeology and ecological studies. For my Ph.D., I am seeking to detect the effect of increased carbon dioxide and available nitrogen on subalpine forest ecosystems.

Other Haury Fellows and their interests are listed below.

Osamu Kobayashi from Japan studied climate reconstruction for application in Asia, with plans to consider the influence of pollution on tree growth.

Olga Solamina of Russia came to the LTRR to work on interdisciplinary studies of high mountain glaciers and climate history.

Juan Carlos Aravena of Chile worked on interpreting climate and forest dynamics from tree rings.

Hemant Borgaonkar of India came to learn how to reconstruct long-term climate variability for the western Himalayan Mountains.

Michael Friedrich of Germany sought to learn how to apply information in tree rings for a variety of applications, including climate, ecology and botany.

Carlos Santana Jubells of Spain visited to learn how to use Canary Island pines to interpret climate and cultural phenomenon.

Paul Sneed from nearby Prescott, Arizona, came here to focus on historical ecology, including fire patterns.

Nora Martijena of Mexico worked on studies in population ecology and dendroecology.

Iain Robertson of the United Kingdom sought to learn more about stable carbon isotopes in tree rings to reconstruct environmental conditions.

Christelle Bellingard of France came to work on techniques for dating archaeological structures.

A primer on how you can help support the LTRR

Challenge Gift to LTRR

A very generous anonymous donor has offered to provide up to $50,000 in matching funds to the LTRR for purchase of needed equipment, to fund pilot research projects by faculty, or for other uses by LTRR to meet its research, teaching and outreach missions. This is a "challenge" gift requiring that other gifts be received by LTRR, and the anonymous donor will match these gifts up to an amount of $50,000.

Clearly, this is a wonderful opportunity for the LTRR to obtain very needed financial support in this time of Arizona state budget-cutting. Gifts to any of the following existing funds will qualify as a "match" for this challenge gift, as will gifts for unrestricted use by the LTRR.

LTRR Capital Building Fund

The University of Arizona has the goal of raising $6 million for the planned Environment and Natural Resources building (ENR Phase II). A challenge-match gift of $1 million from Mrs. Agnese N. Haury has been offered to the LTRR, and additional gifts would qualify toward this match. Currently the Laboratory is located in the Football Stadium.

Architects have designed the ENR II building as an addition to the existing ENR building (ENRB), located on Park Avenue just north of Sixth Street. The ENR Phase II building is sited along Park Avenue just north of Sixth Street. Views from the south (top) and east are depicted below.

Bristlecone Pine Student Endowment

Funds from this endowment, recently established with the support of an anonymous donor, will be awarded to deserving undergraduate or graduate students who are involved in research on bristlecone pines at the LTRR. The Laboratory recognizes a need to support promising students in this field of research, which has a long history at the LTRR.

Agnese N. Haury Fellowship Fund

Gifts to this program would be added to the existing Fellowship endowment. The two programs funded by this endowment are designed to attract individuals, foreign or domestic, who demonstrate significant potential to contribute to the enhancement of the field of dendrochronology. A **Short-Term Training Fellowship Program** is available for graduate students, postdoctoral fellows and established scientists, who typically receive travel and cost-of-living support to stay for one to three months in Tucson while training at the LTRR. **The Graduate Fellowship Program** is designed to provide supervised training in tree-ring analysis for two to three years to a University of Arizona graduate student. In both cases, special attention will be given to well-qualified candidates with archaeological interests.

Douglass Tree-Ring Fund

The Andrew Ellicott Douglass Memorial Scholarship is designated for upper division or graduate students with outstanding academic achievement. The LTRR has a supplementary account for its students. This scholarship is indicative of the excellence of the recipient's work and of the hope for future valuable contributions to dendrochronology.

Schulman Tree-Ring Fund

The Alsie French and Edmund Schulman Memorial Scholarship award is for deserving upper-division undergraduate or graduate students. The LTRR has a supplementary account for its students. The scholarship goes to outstanding students of dendrochronology with the potential for making valuable contributions to the field.

To access Dr. Sheppard's skeleton-plotting program from the web, go to:
http://tree.ltrr.arizona.edu/skeletonplot/introcrossdate.htm

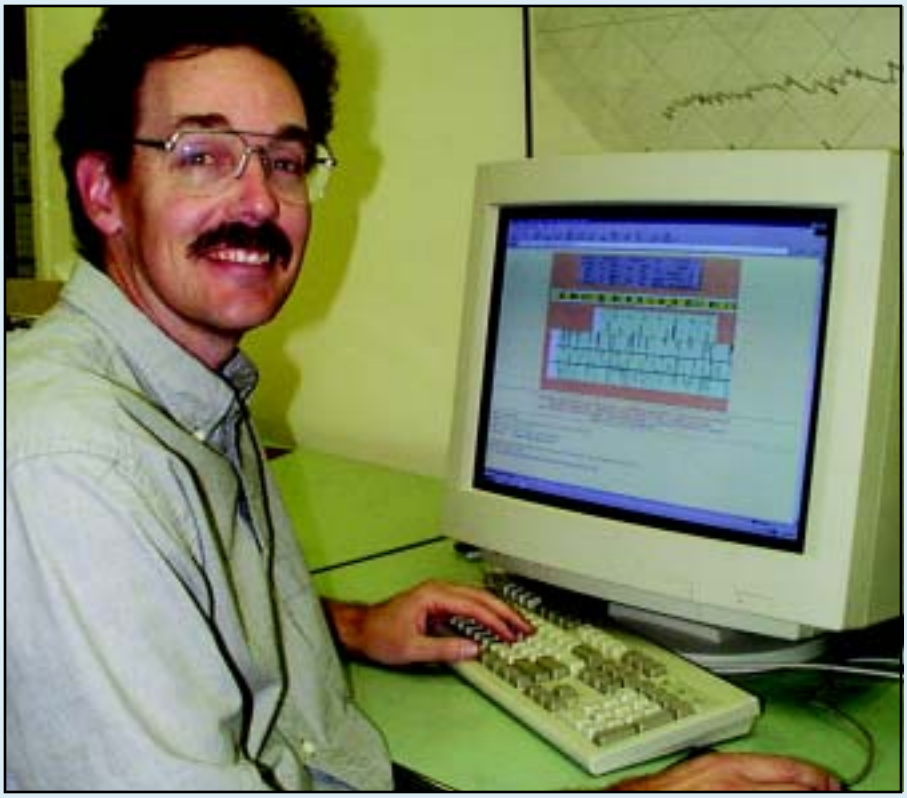


Photo by Melanie Lenart

Dr. Paul Sheppard prepares to demonstrate his web-based skeleton-plotting program.

Try skeleton plotting on the web

LTRR Assistant Professor Paul Sheppard has developed a web-based skeleton-plotting application that effectively introduces people to the most important concept in dendrochronology – crossdating. This teaching tool has been a huge hit with visitors, beginning dendrochronologists and teachers.

Using the Java application, students make marks on the virtual graph paper, with the longest marks representing the narrowest rings (relative to their neighbors) on the simulated tree-ring core.

The result can be pattern-matched to other trees or to an existing tree-ring chronology. This technique of crossdating a sample with other samples allows students – and practicing dendrochronologists – to detect missing rings or false rings or plain old mistakes.

Although many sophisticated statistical tools have been developed to aid in crossdating, skeleton plots remain one of the primary tools for dendrochronologists at the LTRR and many other laboratories because they use the innate human ability to visually identify graphical pattern matches.

By enabling students to practice skeleton plotting via the web, Dr. Sheppard has extended LTRR's outreach and teaching of a fundamental principle of dendrochronology to hundreds of new students.

Paul Sheppard hired for LTRR faculty position

By Melanie Lenart

Dr. Paul R. Sheppard, hired in August of 2001 as an Assistant Professor at the Laboratory of Tree-Ring Research, believes tree rings could be a key to assessing how a global increase in "fixed" nitrogen in modern air affects forests.

Although the atmosphere is composed largely of nitrogen, almost all of it comes in an inert form that plants ignore. Only a tiny percentage of the nitrogen in the air comes already "fixed," i.e., in a form plants can use. Yet this portion has doubled in a mere 50 years, thanks to contributions from cars, industry and fertilizer manufacturers.

"That's the stuff that floats around in the air as gas, vapors and particles. It is deposited unevenly, mostly downwind of major urban centers," Sheppard said.

Nature's fertilizer

Sheppard, like many other scientists, suspects that airborne fixed nitrogen might help trees grow bigger. After all, fixed nitrogen, such as ammonium, is a main ingredient in plant fertilizers.

Most scientific research on this essential plant nutrient has involved short-term experiments, with large amounts of nitrogen applied directly to the soil. But nature works in other ways. With increasing amounts of fixed nitrogen blowing in the wind, forests far removed from any agricultural runoff are receiving daily inputs of nitrogen, albeit in small doses.

Contact Dr. Sheppard at Sheppard@LTRR.arizona.edu or (520) 621-6474.

Background at a glance

- LTRR Assistant Professor Paul Sheppard has a master's in forest sciences from Cornell University (1984) and a bachelor's in forestry from Humboldt State University (1982).
- From 1984 through 1988, he worked as a Senior Research Assistant for Columbia University's Tree-Ring Lab at Lamont-Doherty Geological Observatory.
- Sheppard started 1989 as a University of Arizona graduate student in Geosciences and Dendrochronology. He received his Ph.D. in 1995
- In 1996-97, Sheppard was an NSF-NATO Fellow in dendrochronology at Spain's University of Barcelona's Department of Ecology.

Dr. Sheppard stands on a peak of the San Gorgonios.

"There's an obvious need for knowing more about nitrogen cycling and its effects on ecosystems, especially tree growth," Sheppard noted. "Many traditional ecology studies on this topic are going on now. I think we as dendrochronologists need to be more involved in this research to add a longer temporal perspective."

Dendrochronologists, or tree-ring researchers, routinely measure the size of annual tree rings to assess relative growth rate for a particular year. The ups and downs of typical tree growth on a site have been used in many creative applications over the years, with the almost universal advantage that tree-ring records go back further than instrumental records of the enviroment.

Sheppard plans to pair the traditional approach of comparing growth patterns with direct measurements of nitrogen in the tree rings themselves. The results could reveal how growth fluctuates in relation to nitrogen availability, after considering climate.

Unfortunately, it's no simple matter to measure the quantity of nitrogen in tree rings. Plants depend on nitrogen to create essential amino acids, so they often raid their own storehouses from previous years when building new tissues. Trees even move nitrogen backward into earlier rings.

In the past couple of years, Sheppard has been refining techniques to remove these mobile forms of nitrogen from rings. He is getting close to his goal of measuring only the nitrogen used to construct the cell walls of the annual tree rings.

"Using an isotopic tracer, we actually have direct evidence of whether a pre-treatment works or doesn't work," he noted.

At home in the mountains

Assuming future funding, Sheppard plans to focus his field research on the San Gorgonio and San Jacinto Mountains, two California ranges with high-altitude forests that receive a daily dose of nitrogen along with pollutants from nearby Los Angeles. He knows the mountains well, having hiked them first as a Boy Scout growing up in southern California and later as a California State Parks ranger.

"They are definitely receiving pollution deposition," he said. "As proof of that, all you need to do is stand on the peaks, especially in summer, and watch these brown clouds of pollution climb up the mountain."

Sheppard's research interests also include considering the influence of nitrogen inputs from volcanoes on tree growth. In addition, Sheppard plans to continue using tree rings to consider the effect of earthquakes on trees, work he participated in with Dr. Gordon Jacoby during his four-year stint at the Lamont-Doherty Geological Observatory Tree-Ring Lab. Sheppard and a colleague found local tree growth responses to a 1978 earthquake in California.

Core coursework

Along with working on his research, Sheppard will be spending considerable time teaching in his role as an LTRR faculty member. In the fall semester, he will again teach *Environmental History of the Southwest*, designed for undergraduate non-science majors.

He has also taught the *Introduction to Dendrochronology* course that attracts undergraduates and graduate students from a variety of departments, and a graduate course on building tree-ring chronologies using computer programs. Sheppard enjoys his role in introducing students to the world of tree rings.

"I consider dendrochronology to be one of those 'oo-ah' sciences that will be interesting to a lot of students," he said, adding, "It's just cool stuff."

For more on LTRR courses, go the Lab's home page: http://www.ltrr.arizona.edu/

For details, contact Li Cheng at lcheng@LTRR.arizona.edu or 520-621-3846.

Soil carbon storage in a high carbon dioxide world

By Li Cheng,
LTRR Graduate Associate

The considerable increase in atmospheric carbon dioxide (CO_2) concentration has caused great concern because of its potential for increasing global temperatures.

Tree-ring researchers have been considering this issue from different angles. In 1984, the late Valmore LaMarche, then a Professor at the Laboratory of Tree-Ring Research, and some colleagues noted that bristlecone pines samples showed wider rings since about the 1850s. They suggested this could represent an increase in growth from carbon dioxide fertilization. In 1998, LTRR Professor Malcolm Hughes, working with colleagues, published results in Nature showing the 20th Century in general and the 1990s in particular have been warmer than the preceding 600 years, using tree rings and other natural archives of climate.

The effects of carbon dioxide on natural systems continues to be a focus for many researchers here at the Lab. My own dissertation work focuses on using stable isotopes of carbon, originally derived from atmospheric CO_2, to determine responses of soil organic carbon storage to elevated CO_2. Soil is the biggest carbon pool at the Earth's surface, containing three to four times the carbon in atmosphere. It is not hard to imagine that a slight change in the size of such a large soil carbon pool will strongly influence atmospheric CO_2 concentration. However, whether soil overall is a sink or source of elevated atmospheric CO_2 remains unknown.

In order to help answer this question, I am working with Professor Steven Leavitt on the Free-Air CO_2 Enrichment (FACE) experiments conducted by the U.S. Department of Agriculture and the University of Arizona at the UA's Maricopa Agricultural Center.

Photo by Steve Leavitt

LTRR Graduate Student Li Cheng, right, and Research Specialist James Burns pause during their work in the Free-Air CO_2 Enrichment (FACE) experiments in Maricopa, Arizona. The pipes that blow in the extra carbon dioxide are visible in the background.

The FACE experiments take place in an open-field sorghum agroecosystem in which four plots are exposed to elevated CO_2 levels (about 550 parts per million) and four plots are exposed to existing atmospheric CO_2 levels (about 360 parts per million). Because the sorghum plants grown during the experiment produce a different isotopic signature in the soil than the wheat and other plants that had been cultivated there previously, this experiment can be used to address a number of questions.

My current research focuses on examining whether the plants and soil organic carbon in the plots with elevated CO_2 levels differ in quality and quantity from those in the control plots. Preliminary results from my research show that sorghum growing in the elevated CO_2 plots contains a higher proportion of celluloses and lignin, but fewer soluble sugars than in the low CO_2 plots. Cellulose and lignin are complex compounds not readily degraded under normal environmental conditions, while soluble sugars are relatively easily degraded.

This means that soil microorganisms will be more likely to eat plant residues derived from the sorghum growing at current CO_2 levels than those grown under elevated CO_2 levels. This finding agrees with another preliminary result, that soil organic carbon inputs in the elevated CO_2 plots are higher than inputs in plots grown at CO_2 levels of our current atmosphere. These results indicate that soils may serve as a sink for enhanced atmospheric carbon dioxide.

Come on in, pull up a bleacher

By Steve Leavitt

There are hidden treasures in this world—wonderful places about which the public may know very little. Although our building under the stands of the University of Arizona Football Stadium is not one of them, it clearly has its own charm and glamour.

Of course there are the standard amenities that anyone would expect in such a building: the long and storied history, spacious hallowed hallways, hot dogs and nachos available six days a year just a few feet from our doorways, tall ceilings, the ultimate Stairmaster just a few feet above our heads, a well-maintained grass field for departmental picnics, one of the world's largest carports, and the breathtaking vistas from the skyboxes to which we have no access.

But there are other advantages of which only the occupants of this building are commonly aware.

The level of sound magnification under the Tora Bora-like cavernous west side of the stadium beneath the stands is truly remarkable.

Rap music broadcast from passing faculty vehicles is amplified to heavenly levels, well beyond the mortal limitations of their expensive car stereos and massive bass canon speakers. This is a fortuitous side effect of their hefty salaries and disposable money, allowing the less fortunate in the campus community to enjoy the music systems about which they can only dream. This is accentuated by the wide assortment of mellifluous hair-trigger car alarms that can only be described in terms of the shrieking one has come to expect from a New Age, no-anesthesia, flea-market dentistry kiosk.

We are now additionally fortunate to be home to the garbage compaction device for this sector of campus, located right under the north end of our enclave. The periodic loud banging of the heavy metal refuse transport carts being mechanically unloaded is fascinating in its own right, but there is added value when it also occasionally sets off a trio of car alarms.

The collateral cacophony of thundering bass-enhanced music, clanging trash carts, and car alarms, with the occasional screaming jet take-off thrown in for good measure, is especially conducive to concentrating on university affairs, and can only be likened to running the needle-threading concession next to the flea-market foghorn booth.

The stadium also offers a confidence skills course as we navigate to and from offices on our upper floors whose access gates are locked after 5 p.m. Negotiating those gates after-hours demands Olympian skills, requiring one to balance a cup of coffee in one hand, with books, bags, puppies, compressed gas tanks and fine china in another hand, all while gingerly manipulating the key with the other hand to open or relock the gate locks.

We have used this Houdini magic trick to weed out many a student who clearly showed no signs of mastering these necessary academic and survival skills.

Finally, our hallways are open to outside air, and spawned the expression many generations ago, "If you don't like the weather in your office, just step outside your door." Some current LTRR faculty members gamely endeavor to maintain a literal "open-door" policy throughout the year, but this seems almost as incompatible as beluga caviar on a flea-market snack bar menu. Such policies are inevitably challenged to the limit in the summer when the hallway is greater than 100 degrees Fahrenheit or in the winter when it is less than 40 degrees Fahrenheit.

At the risk of looking a gift horse in the mouth, it just couldn't get any better … unless, of course, the University were to site a flea-market tire-burning franchise under the West Stadium.

Photo by Melanie Lenart

Behind the Woodshed

By Professor Steve Leavitt

An irreverent, microanatomical view of life at the LTRR

Spotlight on Rex Adams

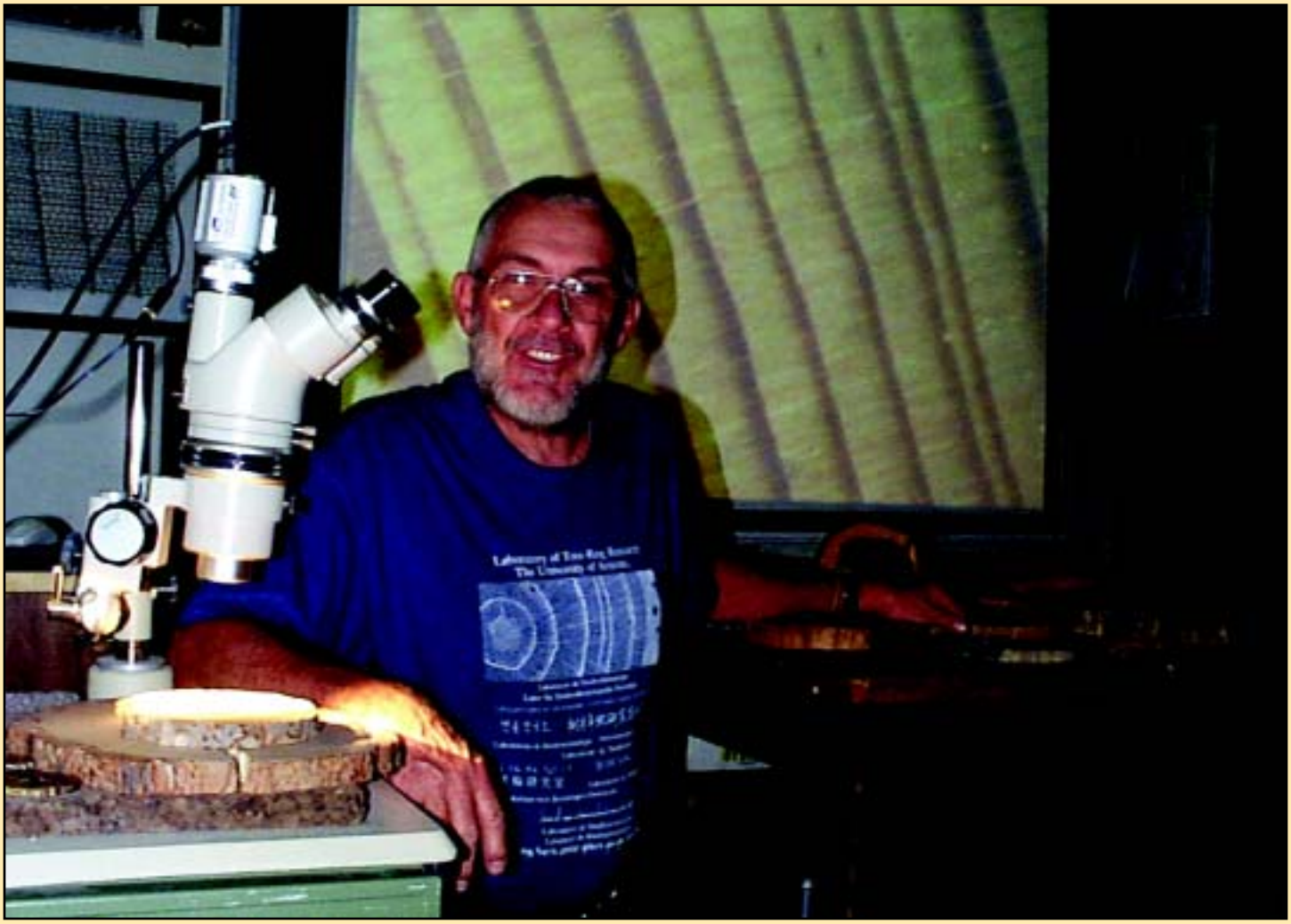


Photo by Melanie Lenart

LTRR Outreach Coordinator Rex Adams has introduced thousands of schoolchildren and adults to the wonder of tree rings over the years. Now, thanks to a generous gift from an anonymous donor, he can show visitors exactly what tree rings look like close-up using a special microscope, color camera and video projector system. The screen behind him has a projected color image of the cross-section under the microscope in the foreground. The same anonymous donor will match gifts contributed for a variety of LTRR funds. **(See page 7.)**

THE UNIVERSITY OF ARIZONA
TUCSON ARIZONA

Laboratory of Tree-Ring Research

P.O. Box 210058

Tucson, AZ 85721-0058

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