Making Fire History

Paleofire database puts fire-scar and charcoal data on-line

• *By Melanie Lenart*

For the first time in history, records of prehistoric fires developed from tree rings and lake-sediment cores are freely available, even for those lacking connections to fire historians. All it takes is an internet connection.

The International Multiproxy Paleofire Database (IMPD) made its debut earlier this year on the website operated by the National Oceanic and Atmospheric Administration (NOAA). The "multiproxy" in the name captures the spirit of cooperation between those who reconstruct proxy records of past fire events from fire scars and other tree-ring evidence, and those who develop proxy records based on charcoal layers in the cores of lake sediments.

The paleofire database grew out of interactions during a weeklong workshop in Tucson during the spring of 2002, when 65 fire ecologists and climatologists gathered to consider how to merge the results of these two different ways of assessing pre-historic fire regimes. The workshop was co-organized by Laboratory of Tree-Ring Research Director Thomas Swetnam and Cathy Whitlock, a University of Oregon Professor and leader in charcoal-based fire history studies.

"I think the workshop really brought to everyone's attention how much data are available now," Dr. Whitlock said. "We're hoping the various labs will be willing and enthusiastic to contribute their data to this international effort," she added.

So far, 146 records based on tree rings and 4 records based on lake sediments have been submitted, according to database organizer Michael Hartman of NOAA. Hartman said he hopes to add another 25 charcoal-based records soon, once he gets permission from the principal investigators involved.

Although the database effort has made remarkable progress in the year and a half since it was first proposed, it still has a long way to go. More than 450 tree-ring based and at least 50 sediment-based fire records have been cited in the North American literature, according to a 2002 proposal put together by the database organizers.

"Actually the biggest part of the task is to get people to submit," Professor Swetnam said. "There are some barriers that I think need to be broken down. I think 99.9% of fire research is funded with public money. People need to have the ethic that once they have published they should submit their data so they are really available to the public."

The effort might be assisted by a recently developed policy of some prominent scientific journals. *Science* and *Nature*, for example, both now require their authors to make their raw data publicly available, either on the journals' own websites or by posting them on another site, such as the IMPD.

Connie Woodhouse, an LTRR alumnus who now works for NOAA's Paleoclimatology Program and is the principal investigator for the database work, agreed that it's a challenge for researchers to find the time to submit data.

"We're trying to tackle that in as many ways as we can," Dr. Woodhouse said.

For example, NOAA recently sent Hartman to the lab of one researcher to assist in the organization of many fire-history files for submission to the database. Also, some funds will be available in April that potentially could be used to provide graduate student support to organize data and metadata.

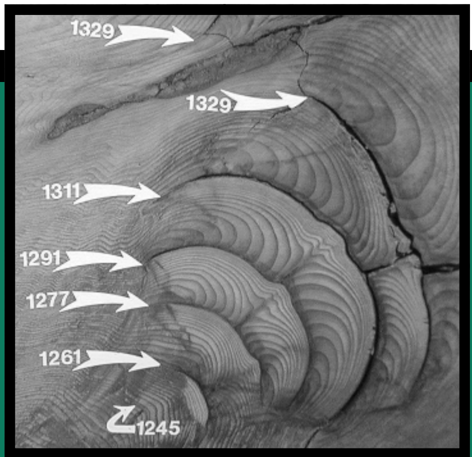
Efforts to make the database more "usable" may receive additional NOAA support in the future, Woodhouse indicated.

"NOAA is interested in finding ways that climate data can be useful, and since there's a fire/climate relationship, this includes information about fire and climate," she explained. "The intent is to try to connect the paleodata to our modern data, and also to make our data more useful to forest managers and other land managers like those at the BLM (Bureau of Land Management)."

With the cooperation of the U.S. Forest Service, the database organizers plan to make the database more "manager-friendly" in the future by allowing web-users to zoom in and access maps of past fire occurrence based on fire history data as well as modern fire records.

The interactions between fire and climate are complex, and influenced by other factors as well, as previous research by Dr. Swetnam and his students and colleagues has highlighted.

Like the charcoal-layer researchers, they have related increased fire frequency to independent records indicating drought. But they also found a relationship between area burned and wetter-than-usual conditions a couple of years before big fire years, which they attributed to a build-up of fuel from unsustainable lush growth. Fire suppression in U.S. forests during the last century also has limited the surface fires that clear out the small trees and logs that are considered "fuels" in firefighter parlance.



Arrows point to dated fire scars in the sampled stump of a giant sequoia that died in the 1950s. The information helped reconstruct the fire history of the Giant Forest, Sequoia National Park. The scars were created by low intensity surface fires that burned near the base of this tree during the indicated dates.

"We may be seeing the fuel dam bursting," Swetnam said. "We've had dry years before in the 20th Century, but we haven't had fires this big. The 2002 fire season broke all records."

Swetnam and others are eager to have as

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Photo courtesy of Wally Woolfenden

Further Tales of the Bristlecone Pine

By Linah Ababneh
Graduate student

It is surprising what trees can reveal about their growth conditions. The science of tree-ring analysis, called dendrochronology, provides a unique tool for better understanding environmental changes that affect the growth patterns of trees.

A number of Laboratory of Tree-Ring Research scientists have explored the growth patterns of very old bristlecone pines (BCP), a conifer found at higher elevations in the Great Basin and Rocky Mountains.

In a 1984 paper, Valmore LaMarche, Donald Graybill, Harold Fritts and Martin Rose described an increase in tree-ring widths of BCPs since 1850. Because their study involved older trees, they encountered BCPs that had lost portions of their bark, leaving the wood underneath (sapwood) exposed and dead, a condition known as "strip-bark." Although a part of the tree is dead it still lives and maintains growth every year.

LaMarche, *et al.*, however, did not address the strip-bark phenomenon, but focused on the increase in tree-ring widths in these strip-bark trees, attributing it to increased atmospheric carbon dioxide, which has doubled since 1850, and called it the "carbon fertilization theory."

A subsequent paper written in 1995 by Donald Graybill and Sherwood Idso proposed a different theory. After conducting similar studies of the same BCPs, Graybill's and Idso's findings suggested a possible correlation between the observed increase in tree-ring width and the existence of strip bark in older trees.

My research follows from the previous two studies but includes a significantly higher number of old BCPs. Furthermore, I am analyzing variability in tree-ring widths of BCPs, specifically the observed increase in tree-ring widths and the physiological condition of the tree (strip-bark vs. full bark) in relation to soil type (dolomite and sandstone) and difference in elevation over a defined period of time.

The study of the effect of one factor at a time, i.e. bark condition, soil type, and elevation, allows me to better assess Graybill's and Idso's theory of a relationship between tree-ring widths and strip bark in older trees. Assessment of LaMarche and colleagues' proposed carbon fertilization theory would require further research.

The preliminary results of my research indicate that elevation and soil type have different effects on the BCPs' growth. In addition, it seems that moisture levels in different soils may have an impact on the growth pattern. For example, dolomite and sandstone, the soil types in my research, have different moisture levels. I am also finding differences in tree-ring widths that relate to differences in elevation. More conclusions are still to be drawn, as the final stages of research are progressing.

This work is being accomplished by the generous support of the University of California, San Diego and Davis, Sigma Xi, and Mary DeDecker Grants, as well as the Laboratory of Tree-Ring Research's Agnese N. Haury Fellowship Fund and the Bristlecone Pine Student Endowment.

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much data as possible to work with as they tease out the effects of climate—and climate change—from that of fuel build-up. Other research at the LTRR and elsewhere has documented an increase in Northern Hemisphere temperature since about the mid-1970s. (*See related story on page 4*.)

"There may be increasing signs that what we're seeing is really climate-driven. That debate is really warming up," Swetnam said. "But it's too early to say whether the warming is causing regional fire changes."

The director likened the development of the paleofire database to that of the International Tree-Ring Data Base. The ITRDB was set up, also on a NOAA website, following a 1974 meeting in Tucson that set the tone for tree-ring research on climate for decades to come.

"That's been extremely successful. Different scientists working at different institutions around the world could link arms," he said. "The same thing could be done for fire history through the IMPD."