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**FIRE HISTORY**

—Fumiko Shirakura

On 8 May 2003, a tornado struck part of Tallgrass Prairie Preserve and severely damaged the Cross Timbers forest located on its western boundary. A permanent plot of approximately thirty-six acres was established there.

The Cross Timbers are a mosaic of grasslands, savannas, and upland forests dominated by *Quercus marilandica* (blackjack oak) and *Q. stellata* (post oak). Cross Timbers exist from southeastern Kansas through Oklahoma and into central Texas; in this region there are large contiguous undisturbed areas.

It is the largest ecosystem in Oklahoma where windstorm and fire are major disturbances that affect composition of species as well as the temporal and spatial dynamics of the Cross Timbers forests. However, we know little about its dynamics; for example: Why long-lived *Q. stellata* do not become dominant species by eliminating

short-lived *Q. marilandica*? In addition, there is less formal documentation of the history of the frequency of fire in the Cross Timbers, although fire has been used in the hunting of bison and as a management tool in the area.



*Fumiko Shirakura Analyzing Tree-ring Data.*

One of my objectives is to reconstruct the history of fire prior to 1993 when the study site was purchased by The Nature Conservancy. Another goal is to understand the role of fire and windstorm disturbances in the Cross Timbers dynamics that promote co-dominance of *Q. marilandica* and *Q. stellata*.

So far, I have found that fire occurred almost every year after the 1950's and that the frequency of fire and its intensity responded to human activities, such as the total area of ranches and the number of cattle. Sometimes fire occurred both early and late in the year. Tree disks showed *Q.*

*marilandica* had more fire-scarred disks than *Q. stellata*, however, *Q. stellata* had a larger number of fire scars per year per disk than *Q. marilandica*. A question that I am keen to answer is: Which species is more sensitive to fire? I also found that *Q. marilandica* is more vulnerable to wind damage than *Q. stellata*. The tornado killed or damaged a greater proportion of *Q. marilandica* than *Q. stellata*. I am examining whether *Q. marilandica* is less sensitive to fire and recovered or re-sprouted more rapidly than *Q. stellata* does from the tornado damage.



Tree-ring data from 1958 to 2003  
by Fumiko Shirakura

**FUMIKO SHIRAKURA**

—Andrew Donovan-Shead

Fumiko Shirakura is from Fukuoka, on the northern shore of the island of Kyushu, at the southwestern end of Japan. It is fitting that a botanist should come to us from a city that has an administration with policy goals to cherish “greenery and the environment,” and to nurture lifestyles “with the aim of achieving harmony with the environment.”



Fumiko Shirakura, Botanist.

Fumiko will soon complete her M.S. degree in botany, after which she plans to work as a field researcher for a while before enrolling in the PhD program in the Botany Department at Oklahoma State University. Her research interests include: forest dynamics, fire history, dendroecology, and the distribution of exotic and native plants. Fumiko is one of the leading students at the University, having been named to the honor rolls of the Dean and President on several occasions.

**SCIENCE IN ACTION**

—Andrew Donovan-Shead

Long-term readers of *The Docent News* will remember the Science in Action article from the September 2003 edition, in which we looked at the research being conducted by Dr. Michael Palmer in the southwestern part of the preserve ravaged by a tornado early that year. We met Mike’s colleague Dr. Jose Ramon Arevalo from Universidad de la Laguna, in the Canary Islands, and Mike’s research students Fumiko Shirakura and Kiyoshi Sasaki. That research project continues; we will get news of it for another edition in future.

Meanwhile, another opportunity for science has developed elsewhere on the border of the Tallgrass Prairie Preserve. Look up the November 2003 edition of the newsletter for an article on the Cross Timbers, and the May 2004 edition for an article on the Keystone Ancient Forest Preserve.

On 4 August 2005, Dr. Palmer learned that management activities had opened approximately fifteen kilometers of old growth cross-timbers to researchers on the border of the preserve. Now remember from our other looks at cross-timbers that many of these old growth trees are upwards of three to six hundred years old. Dr. David Stahle, a dendroclimatologist at the University of Arkansas, dated one tree in the Keystone Ancient Forest Preserve at six hundred years. These gnarled old trees have been watching over the world here since long before the coming of European settlers and have witnessed the ebb and flow of life during the time when Native Americans ranged far and wide in complete freedom. These trees are extremely important to science because they contain a continuous record of life through multiple past centuries.



*Recently fallen Q. Stellata by Dr. Michael Palmer*

On 10 August 2005, Dr. Palmer performed a reconnaissance of about four miles of the perimeter and estimates that he saw many fallen trees. A large number of trees “had the stereotypic

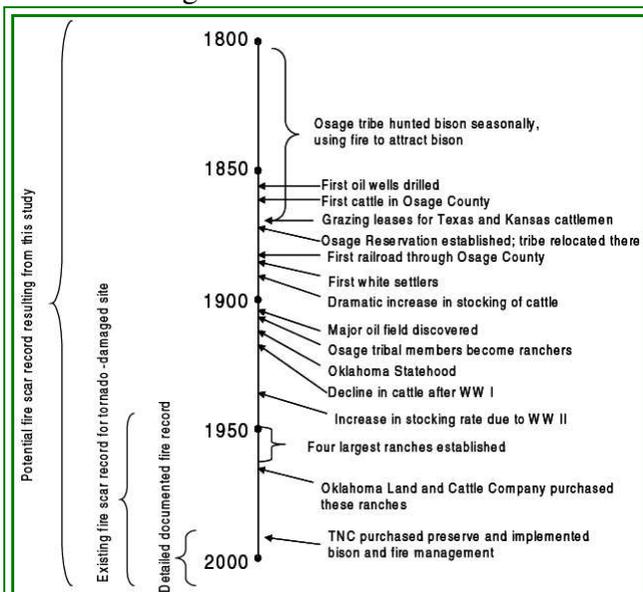
appearance of being one hundred and fifty to three hundred and fifty years old”; that is trees with twisted bark, flat topped, and with large upper branches. Also, “external symptoms of old fire scars were apparent on many trees.”

Dr. Palmer is excited by this opportunity because “the vegetation of much of the south-central U.S. consists of a mosaic of cross-timbers forest (co-dominated by *Quercus stellata* and *Quercus marilandica*) and tallgrass prairie. An analysis of fire scars from the bases of old trees at the interface between forest and grassland would reveal much about the dynamics of both systems, with implications for coexistence theory and conservation. There are two classes of problems that can be addressed using such fire scars: fire history and the nature of co-dominance.

1. “Fire history: Although fire is indisputably a major determinant of biodiversity in both prairies and cross-timbers, we know little about the historic frequency of fire. The circumstantial evidence yields a paradox: there is a strong positive response of native plants to fire, implying that fire has been quite frequent over the past few centuries. Some anecdotal and historic evidence from the 19<sup>th</sup> century supports this view. In contrast, limited data from tree rings in the interior of cross-timbers forests imply that fire was virtually absent in the 19<sup>th</sup> century. It is possible that fires did not extend into forest interiors, despite high flammability of oak litter. A fire scar record for trees at the interface between prairie and forest would resolve the paradox.

“A number of historical developments over the past two centuries

have [had potential effect] on the fire regime of the tallgrass prairie in Osage County [see below for the time-line]. These include changes in the oil industry, railroad construction, and the conversion from bison grazing to commercial livestock and back again.



*Historical Time-line  
 by Fumiko Shirakura with Dr. Michael Palmer*

The most pivotal date is 1870, when the Osage tribe was moved to the county from Kansas, and the traditional use of the landscape for seasonal hunting abruptly gave way to a more European lifestyle. It is worth stressing here that the settlement and commercial development of Osage County is very late compared with the rest of the grassland biome in North America. Thus, understanding the 19<sup>th</sup> century fire regime of Osage County may be our best opportunity for understanding the pre-settlement fire regime of the entire biome.

2. “Co-dominance: Co-dominance of tree species is common in temperate woodlands (e.g. Piñon-juniper woodlands, maple-beech forests, cross-timbers). Throughout their geographic ranges, *Q. stellata* and *Q. marilandica* are almost invariably found together. Their coexistence implies a trade-off, yet much of the evidence shows that *Q. stellata* lives longer, survives drought and windstorm better, re-sprouts better, and produces more acorns than *Q. marilandica*. Thus, why doesn’t *Q. marilandica* lose out? An analysis of fire scars would tell us whether *Q. marilandica* is superior at recovering from fire. If so, we would demonstrate ‘disturbance partitioning’ in a landscape with both frequent windstorm and fire. This would be a novel explanation for co-dominance. Furthermore, a detailed comparison of ring widths will tell us whether the two species respond differentially to climate.”



*A 2005 example of fire damage extending ~50 metres into the interior of a cross-timbers forest, by Dr. Michael Palmer.*

On 2 September 2005, Dr. Palmer accompanied by Dr. Stahle, did a second reconnaissance during which they “sampled basal tree disks of fifteen of the downed trees, and confirmed that the trees were old-growth” above

two-hundred years of age, containing fire-scar records.

Dr. Palmer says that as far as he knows, “the study site is... unique: I believe it is the only old-growth forest east of the Rocky Mountains [that] has a natural edge with an unplowed grassland. Most of the forest has no signs of anthropogenic disturbance” except for the fire and fence clearing described above; he goes on to say that “the features visible in an 1871 land survey... are still visible in modern aerial photography and satellite imagery. Despite signs of frequent fire..., trees of great age... are present very close to the edge.



*Six Times Scarred by Fire, by Dr. Michael Palmer.*

Outside of the study area, most of the forest has been cleared or sprayed with herbicides, grasslands have been plowed, and edges have been

straightened. Thus, the trees in the study area are sentinels, recording the fires in the grasslands.”

A byproduct of Dr. Palmer’s research “will be a large number of attractive, highly polished tree disks. These disks will be of immense educational value.” He plans to donate some of the more striking disks, accompanied by interpretations written for the general public, to the Tallgrass Prairie Preserve gift shop display and to other interested institutions. Dr. Palmer is also interested in learning about traditional views of the use of fire in the landscape.

Overall, this is an exciting project with good potential for cooperation among scientific disciplines, both national and international, as well as with the general public and, significantly, with Native Americans. Under normal circumstances it would be highly unethical to destroy trees in order to sample them for experimental purposes. Thus the necessary management work on the perimeter of the preserve presents a serendipitous scientific opportunity because tree disks are all inclusive of the record whereas core samples don’t take enough of the wood to reveal the true record.

This article used substantial portions of Dr. Michael W. Palmer’s proposal to investigate *Fire Regimes in the Tallgrass Prairie / Crosstimbers Interface: Towards a Fuller Understanding of Grassland and Forest Dynamics*.

#### ERRATA

In our issue last month the list of coordinators was corrupted when I picked up an out-of-date template after doing computer maintenance. Luckily, the problem was noticed by a couple of readers who were kind enough to draw my attention to the errors. This month the coordinator lists should be correct, but let me know of any

changes needed if they continue in error.

**NEWSLETTER PUBLICATION**

Deadline for submission of articles for inclusion in the newsletter is the 10<sup>th</sup> of each month. Publication date is on the 15<sup>th</sup>. All docents, Nature Conservancy staff, and university scientists are welcome to submit articles and pictures about the various preserves in Oklahoma, but of course

the Tallgrass Prairie Preserve in particular.

**BACK ISSUES**

You can find back issues of the Docent Newsletter in the green zip-binders in the Visitors' Center; they are stored in the Perspex rack next to the filing cabinet under the name-tag board. All issues that were published in color are printed in color. The pictures look good.

***Tallgrass Prairie Docent Coordinators***

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