



North Central Research Station

News.....

April/May/June 2001

Fire in the Hills: Landmark Study of Fuel Loading in the Ozarks

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Centuries ago, in what we now call the Ozarks, Native Americans used fire as a land management tool. Their blazes raced through the understory every 3 to 7 years, leaving open, parklike forests with few flammable materials on the forest floor.

Today's Ozark forests bear little resemblance to their forebearers. Limbs and tree-tops from 100 years of timber harvesting—have piled up beneath a forest canopy that has grown denser in the last 50 years of fire suppression.

The question is: How much fuel has built up? Does decay balance the addition of new fuels? And how do these fuels affect fire behavior? The problem is, no one knows for sure.

“Unlike the West, where fuel loading is carefully documented, there’s not much information about fuels in the oak-hickory forests of the Eastern U.S.,” said Edward Loewenstein, an NC research silviculturist in the Central Hardwoods unit in Columbia, Missouri. “This comes at a time when prescribed burning is commonly used to restore native species in our area. In Missouri, 69,000 acres were burned in 1999, yet we don’t know how these fires, or other management techniques for that matter, are affecting fuel loads.”



Ed Loewenstein

▲ *Knowing how much flammable material is present in a forest is vital for safe, effective prescribed burns.*

Without a fuels inventory, it’s difficult to predict how wildfires will behave, or how to use controlled fires to reduce the risk of wild ones. To shrink these information gaps, Loewenstein teamed up with George Hartman, a fire ecologist with the Missouri Department of Conservation, and Keith Grabner, a fire

(Fire continued on page 2)

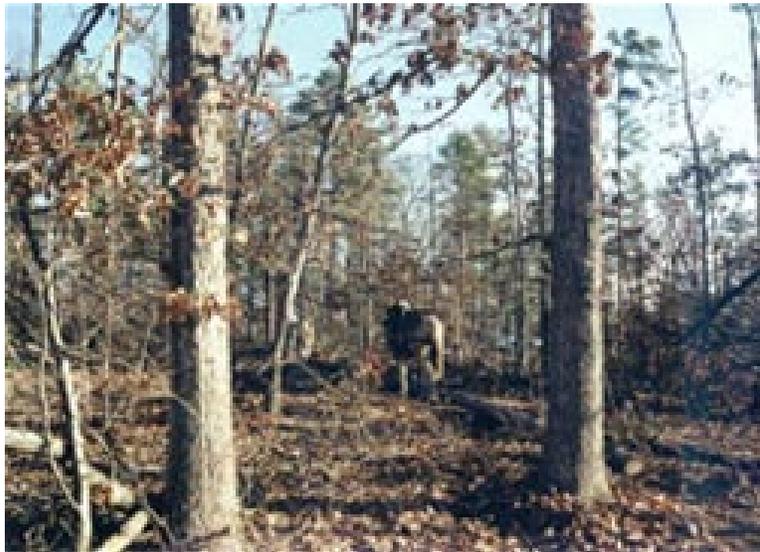


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Ed Loewenstein

◀ *Horse logging is a "light-on-the-land" way to thin Ozark forests.*

ecologist with the U.S. Geological Survey's Northern Prairie Wildlife Research Center. The three applied for a grant administered by the Joint Fire Sciences Program of the U.S. Departments of Agriculture and the Interior. Their innovative proposal outlined a 3-year study to evaluate the effects of prescribed fire, with and without thinning, on fuel reduction and fire behavior. It won them \$264,000.

All Bases Covered

"We're beginning to create baseline data that are long overdue," said Loewenstein. This information will be important in the modeling (computer simulation) work that the Columbia unit is known for. The LANDIS model, for example, predicts cumulative, landscape-scale effects of local management actions, wind, and fire. "If we can improve the model's ability to predict fuels and fire behavior, we can give managers a sense of how their actions might affect fire probabilities on a mosaic landscape, how future fuel loads will change over time, or how to conduct 'restoration burning' in ways that will also reduce fuel loads," he said.

"This study is among the first to evaluate response to a *mixture* of thinning and prescribed fire. We may find that a combination of techniques enables managers to reduce fuel

loads AND restore historic vegetative conditions," Loewenstein said.

Spying on Fire Behavior

The study will be conducted on three 45-plus-acre sites owned by the Missouri Department of Conservation. Each site contains three topographic land types—north slope, ridge top, and south slope. These topographic types will be divided into 3-acre plots, each receiving a different fuel reduction treatment: prescribed fire alone, prescribed fire with overstory thinning, thinning alone, and a no burn and no thinning control. The team will study effects on fuel loading, fire behavior, cost effectiveness, and effect on herbaceous and woody species composition and structure. If followup funds become available, they'll monitor the sites to see how fuel buildup changes 5, 10, even 15 years after a treatment.

Some of the techniques for spying on fire behavior are curious. To clock rate of fire spread, for instance, modified watches are buried in the soil and activated when the flaming front passes. Cotton strings are soaked in fire retardant and then suspended throughout the plots. The extent of singe marks shows fire height.

Missouri Department of Conservation's George Hartman thinks

managers throughout the State will put the study to good use. "Until now, we've been getting by with best estimates," he said. "This data will help managers decide where to focus their efforts, what's the best match of treatment to landscape, and what the tradeoffs will be."

Who Wants to Know?

What really impressed the grantors was the team's plans to reach these managers through technology transfer. In addition to papers tailored for various management audiences, the team will create a demonstration site at one of the study areas. "We want managers, researchers, students, and rural fire departments to come and see for themselves what kind of legacies these treatments leave: what kinds of vegetation, what kinds of fuels," Loewenstein said.

The team is also issuing an invitation for managers to come and watch the fires as they burn. "Getting managers involved from the very beginning is one way to make sure the results will be useful, and therefore, actually used." With a plan like that, the knowledge should spread like wildfire.

For more information, contact Ed Loewenstein at eloenstein@fs.fed.us, 573-875-5341 x229.



Buried Treasure Reveals an Active Afterlife for Riparian Trees

"The banks themselves, along with perhaps millions of trees, are ever tumbling, falling, and washing away from the spots where they may have stood and grown for centuries past. ... We saw several trees falling in, and beautiful, though painful, was the sight. As they fell, the spray which rose along their whole length was exquisite; but alas! these magnificent trees had reached the day of oblivion." John James Audubon 1843 Missouri River Journal.

Audubon's "day of oblivion" is actually the start of a long and fruitful second career for fallen trees in midwestern waterways. Dan Dey, a research forester with NC's central hardwoods unit in Columbia, has found that dead wood can last 9,500 years or more in meandering rivers with erodible banks. Depending on the year, the log may either be entombed in oxygen-starved sediments, or exposed by a raging flood.



Richard Guyette

▲ *These ancient logs in Medicine Creek date between 1,440 and 8,400 years B.P. (Before Present).*

"The same forces that bury a log in sediments can scour a bank and expose it," Dey said. "Once excavated, this 'coarse woody debris' returns to active duty, providing a substrate for aquatic insects, quiet pools for fish spawning, or waterfalls for aeration. Given enough time,

the log begins to contribute its nutrients to the stream—nutrients captured several millennia ago! Just as quickly, another flood can bury it for several more millennia."

The implications of such a life span are huge, says Dey. "It makes you wonder, for instance, how much carbon is actually sequestered in fallen, buried logs. And how unearthed logs contribute to the geomorphology and ecology of the stream. Given the lack of information about this important contributor to carbon cycling and stream ecology, we decided to do a study."

Postcards from an Ancient Forest

It all began in 1999, when a northern Missouri farmer named Steve Peterson noticed some logs protruding from the cutbank of his farm creek. Intrigued by the thought of a buried forest beneath his soybeans, he called the University of Missouri-Columbia Forestry Department. The secretary put him through to Richard Guyette, a dendrochronologist (dendrochronology is the dating of past events through the study of tree-ring growth) who often collaborates with Dey on fire history work.

When Guyette waded into Medicine Creek, he was delighted to find logs as old as those found in the famous peat bogs of Europe. "The logs were in good shape thanks to the oxygen-free conditions, and some of them still had their bark on," Guyette said. "When I carbon dated them, I found them to be 2,000 to 8,000 years old." The site became the first of five streams that Dey and Guyette would sample. To reconstruct the dynamics of large wood in stream systems, they recorded length, diameter, volume, mass, density, age, and species. They were interested in finding out when the tree had died, how long it had been in the system, how fast it had decayed or moved around, and what ecological functions it was providing.

"At first Rich had nightmares about people removing the ancient logs before we could study them," Dey remembered. "His worries subsided as we found more ancient logs, and finally realized that alluvial burial and excavation of logs is a characteristic component of rapidly eroding streams. It was a dream come true for a dendrochronologist."

One of the most interesting discoveries was the presence of several well-preserved forest litter layers containing leaves, twigs, tree boles, bark, hickory nuts, seeds, acorns, tubers, etc. "By studying these layers, an investigator could reconstruct what the forest looked like at various points over 10,000 years," Dey noted.

(Buried Treasure continued on page 6)

When Land Use Leads to Land Loss: Preventing Sedimentation in the Nemadji River Basin

Researchers at the Grand Rapids lab still talk about the day when Carlton County Highway 6 dropped 11 feet. The stretch of road, which crosses the Black Hoof River in northern Minnesota, went into a slump—not the kind of slump that might be shaken off by a little extra batting practice, but the kind in which a chunk of streambank slides downward and outward, pouring massive amounts of sediment into the stream.

Besides the gee-whiz quality of a fallen road, what makes slumping here so important is that the area is part of the Nemadji River Basin, which has the dubious distinction of contributing the highest amount of sediment to Lake Superior of any stream entering the big lake. Straddling the Minnesota/Wisconsin border just south of Duluth, the 433-square mile basin is especially prone to sedimentation because of its steep topography and its high content of very erodible clay. To work on minimizing sediment discharge here, the Nemadji River Basin Project was formed, a basinwide partnership made up of the State of Minnesota, Carlton County, the Natural Resource Conservation Service, the North Central Station, and other agencies.

Sandy Verry, from NC's riparian unit at the Grand Rapids lab, serves on the forestry subcommittee of the project. Armed with the many lessons learned from long-term hydrologic, atmospheric, and ecological research on the Station's Marcell Experimental Forest, he provides the science-based advice needed by the subcommittee in making wise decisions about managing the basin.

Grand Rapids researchers have been studying the impact of land use changes on the shape of streams in the basin. They've found,



Art Eiling

▲ To keep sedimentation from entering Spring Creek (a tributary to Black Hoof River, Carlton, MN) a second culvert will be placed about 2 feet higher than the first. In the foreground is Deacon Kyllander, hydrological technician with the riparian unit in Grand Rapids, MN.

for example, that changes in land use can lead to changes in bank full flow rate, which is—just like it sounds—the speed at which a stream flows when it's full to the top of its banks. As the water flows faster, the stream begins to straighten itself out and pick up even more speed. "Some of these fast-flowing streams lost 45 percent of their length," Sandy Verry said. Faster water and straighter streams can lead to more slumps and, in turn, more sediment discharge.

"After reviewing our Marcell studies and others in the region, we found that removing trees from a subbasin would increase bank full flow rate and slump rate by two to three times," Verry said, "and that planting the land completely in agricultural crops would increase the rates by three to five times."

The effect of open land on water velocity has led the Nemadji River Basin Project to stick to a rule of

thumb in managing the basin's land: keep 60 percent of the area in forest. Using GIS mapping systems, the subcommittee plans where timber sales should occur, where trees should be planted, where banks need to be stabilized, and where in-stream grade control structures should be placed to reduce downstream undercutting.

And, now, the latest on county road 6 and the Black Hoof River. Sandy Verry and the Grand Rapids team, at the request of the Minnesota Department of Natural Resources, studied the area and recommended changing the drainage patterns on the highway, increasing the size of the culverts—the drains crossing under the road—and rerouting the stream away from the road. DNR Fisheries, Carlton County, and the Minnesota Pollution Control Agency are now in the middle of putting those recommendations to work.



Contributed by Lucy Burde

Sustaining Traditional Eco-Knowledge

Peggy Castillo, NC's American Indian Program Manager, was recently awarded a \$15,000 grant from the Conservation Education program.

Conservation Education is a national Forest Service program that helps people of all ages better understand and appreciate natural resources through structured educational experiences and activities. Through the program, both children and adults can develop the critical thinking they need to understand the complexities of ecological problems, and they can learn how to act on their own to conserve natural resources and use them responsibly.

John Zasada, project leader of NC's Northern Forest Silviculture unit in Grand Rapids, Minnesota, originally told Castillo about the Conservation Education program and encouraged her to apply for the grant.

"John and I had worked on a couple of Black Ash workshops before this," Castillo said, "and we both felt this would be another good opportunity to work together." [In June 1998, basketweavers from four tribal affiliations, research scientists, and foresters from the NC Station came together in Rhinelander, Wisconsin, to talk about black ash health, survival, and traditional use. The group held a second workshop in Grand Rapids, Minnesota, in July 1999.]

Zasada did the rough draft of the grant application, and Castillo and Karen Danielsen of the Great Lakes Indian Fish & Wildlife Commission (GLIFWC) put the finishing touches on it to suit the Boys and Girls Clubs of America, whom they were targeting.

The grant application described the way in which, for many generations, Native Americans had derived their life essentials from North American forest ecosystems. Beginning with the time of European settlement, however, Native Americans became much less dependent on these forest products. But the forest and its wise use remain a very important part of Native American culture so Castillo and Danielsen proposed a project to teach

Native American youth about northern forest ecosystems and their connection to traditional ecological knowledge. Their proposal included giving Native American youth hands-on experience in the traditional methods of collection, use, and management of forest products. With the assistance of tribal elders and others, the project would be an ongoing program promoting a model of traditional knowledge and sustainability used by tribal youth and non-Native youth programs.



Peggy Castillo

▲ At a workshop sponsored by the Conservation Education program, a Lac Courte Oreilles youth learns to tap maple trees for sap used to make syrup.

Tim Swedberg, NC's Conservation Education program coordinator, gave Castillo the good news in September 2000. "I was so surprised when Tim came to me and said that we had the grant," she said.

Immediately afterward, Castillo and Danielsen, together with Boys and Girls Club staff members, visited with tribal representatives in Wisconsin to talk about the workshops. To date, several workshops have been held, including two storytelling sessions, a maple sugar bush camp, and a cedar rice stick (for harvesting wild rice) workshop. Two more workshops—on paper birch and black ash—are planned for June. The pair are hoping that over the course of the summer and fall NC scientists can work with some of the Native American youth.

Castillo feels the Conservation Education grant is a real plus for North Central. "Over the years, the Station has been very supportive of the American Indian Program," said Castillo, "and has really progressed in partnering with surrounding Native communities. We have had many success stories, like hiring summer students, sponsoring tours of the labs, teaching classes at Tribal Community Colleges, and working on joint scientific studies. This grant is just one more great example of our partnership."

Castillo emphasizes that the American Indian Program is what it is because of the people who have helped make it so: "Without the support of Station Management, my supervisor, fellow employees, friends in the Native community, and my husband Paul, the American Indian Program wouldn't be here."



Contributed by Laura Hutchinson

(Buried Treasure continued from page 3)

A Long-View Look at Today's Forests

For Dan Dey, knowing how ancient forests looked and functioned is a clue to best management practices for today's riparian forests. "There are plenty of debates about what kind of forest we should be aiming for in our restoration efforts. Our vision of pre-European conditions will definitely be improved by having thousands of years of quantifiable data," said Dey.

At this point, Guyette and Dey are building their database of samples. By comparing ring-width sequences of oaks and looking for overlapping patterns, they hope to compile what's called a master chronology, an index that will allow scientists to pinpoint log age with more accuracy than carbon dating allows. "Knowing the

exact age of a log, in addition to its wood chemistry, tells us something about soil and atmospheric condition over time. The size and pattern of tree rings may give us insight into our own changing climate. In one of the world's richest agricultural regions, long-term information like this has real value," Guyette said.

Data from the preserved litter studies will be used to complement existing charcoal and pollen studies to arrive at a picture of how the forest flora changed over the long march of time. Dey hopes to use this information to create management guidelines that provide a sustainable supply of wood of the right size and species—not just for human harvest, but for recruitment into streams as well.

"For me, studying ancient logs and litter is one more way to investigate the interplay between riparian forests and aquatic systems—how the health and productivity of one affects the other," Dey said. "We may find that riparian systems, because of the burial of coarse woody debris, are the most important systems in our landscape in terms of carbon sequestration. Knowing this might encourage people to invest in programs to reforest bottomlands and to reconnect the flood plain with the forest—to let natural forces, such as meandering and scouring, continue their important work."

For more information, contact Dan Dey at ddey@fs.fed.us, 573-875-5341 x225.



People on the Move . . .

Congratulations!

Matthew Logghe and **Eric Schuette**, *Gaylord*; **Julie Rollins**, *Grand Rapids*; **Toby Petrice**, *East Lansing*; **William Carothers**, **Karlis Lazsda**, **David Oaks**, *Mt. Pleasant*; **Richard Murray**, **Travis Rymal**, *St. Paul*, were promoted.

Moving on...

Patrick Hartless, *Grand Rapids*, transferred to the Bitterroot National Forest.

Greggory Jennings, *Mt. Pleasant*, transferred to Eldorado National Forest.



Paul Mancuso, *St. Paul*, transferred to U.S. Fish and Wildlife Service.

James Williams, *Springfield*, transferred to the Salmon-Challis National Forest.

Jerry Ostrom, *St. Paul*, retired.

Jessica Howland, *Columbia*; **Deborah Carr**, *East Lansing*; **Daniel Schwartz**, *Gaylord*; **Trevor Balzer**, *Mt. Pleasant*; **Sara Smith** and **Mike Wehr**, *Rhineland*; **Molly Beland**, **Elizabeth Collins**, **Rachel Gibling**, and **Dawn Hallman**, *St. Paul*; **Ronald Burns**, *West Lafayette*, resigned.

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