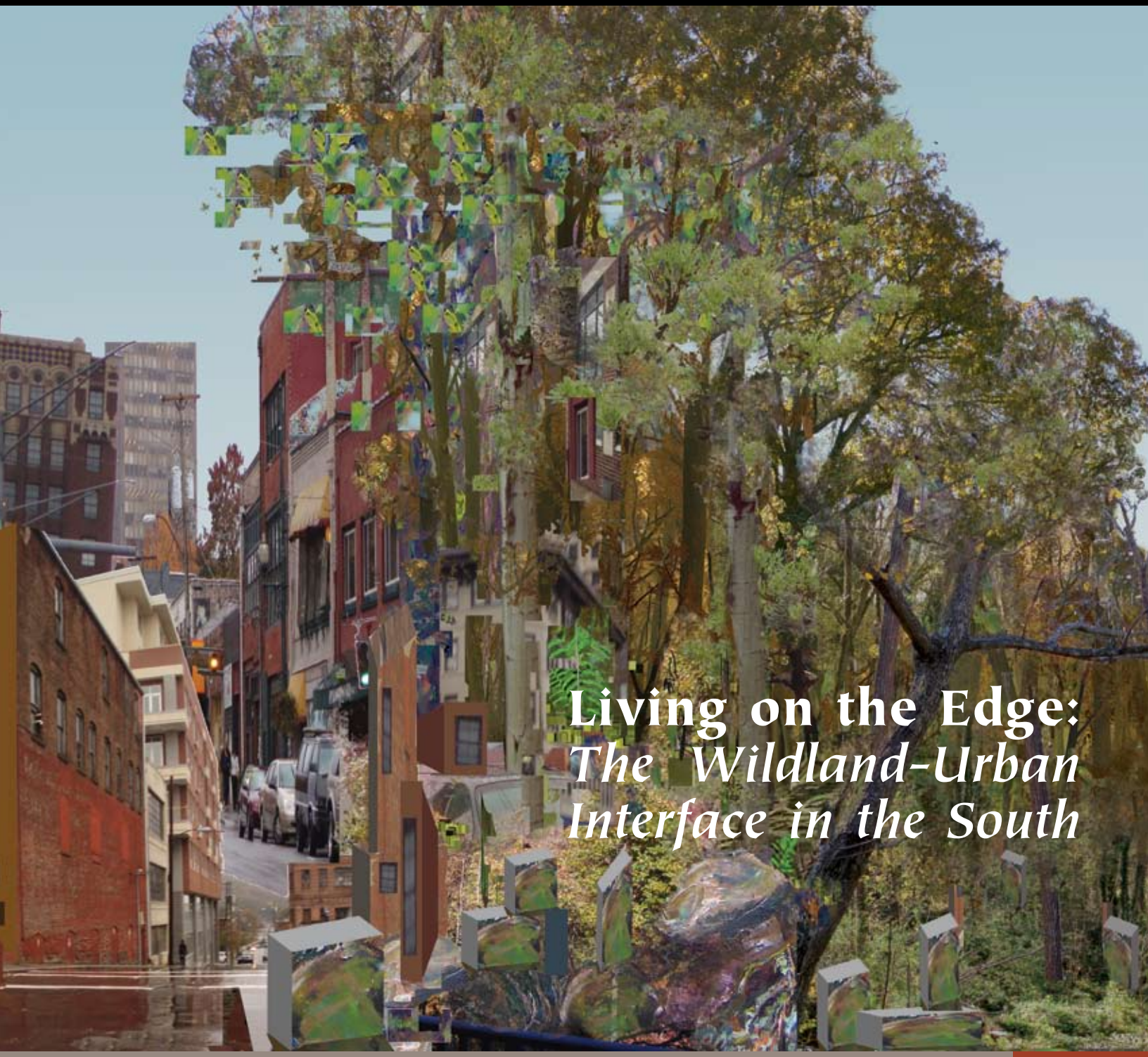
# COMPASS

perspectives & tools to benefit southern forest resources

issue 7



# Living on the Edge: *The Wildland-Urban Interface in the South*



**Southern Research Station**

USDA Forest Service

# inside...
## the science

*Cover photo: The wildland-urban interface is not a finite edge, but rather one that meanders between the natural and manmade habitats of the South, as depicted in this painting by Asheville, NC artist Paul Olszewski.*


# COMPASS

*Science You Can Use!*

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perspectives and tools to benefit southern forest resources

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The mission of the Southern Research Station is to create the science and technology needed to sustain and enhance southern forest ecosystems and the benefits they provide.





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## What *is* the Wildland-Urban Interface?

From a spatial or geographical perspective, many different types of wildland-urban interface (WUI) have been defined. One type is the ***classic interface***, where urban sprawl presses up against public and private natural areas, bringing to mind a distinct line between urban and rural areas. The ***intermix*** refers to areas undergoing a transition from agricultural and forest uses to urban land uses. The ***isolated interface*** is made up of structures interspersed in remote areas, such as summer and recreation homes, ranches, and farms that are surrounded by large areas of vegetation. And there are ***interface islands*** within predominantly urban areas, islands of undeveloped land that are left as cities grow together and create remnant forests.

***Wildland fire*** attracts the public's attention, perhaps more than any other WUI issue, and images of communities in flames on the outskirts of cities are often used to depict the interface. On an individual homeowner scale, the WUI can be thought of as an area where human-made infrastructure is in or adjacent to areas prone to wildfire. On a community scale, the interface can be thought of as an area where conditions can make a community vulnerable to a wildland fire disaster.

From a ***sociopolitical*** perspective, the interface can be thought of as a place of interaction between different political forces and potentially competing interests. It is particularly in the interface—where people are in closer than usual contact with natural resource management—that public attitudes, values, and perceptions affect the way that those resources can be managed and conserved. This perspective also includes the way the diverse cultural, ethnic, and age groups that comprise the South's population—and their often very different values and attitudes regarding forests and other natural areas—affect how resources can be managed and used in the interface.

**One type of wildland-urban interface is the isolated interface, where second homes are scattered across remote areas.** *(photo by Larry Korhnak, University of Florida)*

# Seeing the Houses through the Trees: *The Wildland-Urban Interface in the South*

*by Annie Hermansen-Báez*

Forests literally cover the southern landscape. My first impression of the southern landscape came from a descent into the Gainesville, FL, airport back in 1995. "Where are the houses?" I wondered. There were so many trees that I only caught a glimpse of rooftops scattered here and there. Growing up on the central coast of California, the concept of living in a forest within city limits seemed foreign. I was familiar with cities that had houses with trees scattered here and there, not an entire city within a forest!

Not surprisingly, forests cover more than 60 percent of most Southern States. These areas where homes and forests or other natural areas intermingle are often referred to as the wildland-urban interface (WUI). In these WUI areas, there are a host of issues and challenges for natural resource professionals, policymakers, and homeowners alike.

## The Changing Wildland-Urban Interface

The wildland-urban interface makes up a large part of the South. A team of scientists from the Forest Service and the University of Wisconsin, Madison discovered this when they mapped the WUI using 2000 U.S. census data, landcover maps, and a definition of the WUI based on fire risk assessments. They found that while overall, just 9 percent of the land area of the continental United States is classified as WUI, States in the South ranged from 5 up to 41 percent, with an average of 21 percent classified as WUI. "In the South we have much more intermixing of land uses and a higher degree of parcelization and fragmentation of forests than other regions of the country," says **Ed Macie**, team leader for the **SRS Southern Center for Wildland-Urban Interface Research and Information**.

The wildland-urban interface will continue to grow as the South's population grows: population increased by 14 percent between 1990 and 2000, and is expected to increase another 24 percent between 2000 and 2020. According to the 2000 U.S. census, of the 100 fastest growing counties between 2003 and 2004, 60 were located in the South.

The demographics of the South are also changing. Hispanic, African American, and other minority populations are growing rapidly and by 2020, are projected to make up close to 40 percent of the South's population. The population is also aging. According to the 2000 census, the number of people aged 65 and over will more than double between 2000 and 2030. Different ethnic, cultural, and age groups have different preferences for how natural resources are managed and what kinds of recreational opportunities are provided. "A lot of research shows that blacks and Hispanics prefer more developed recreation sites and recreational opportunities involving larger groups—extended family and friends—compared to whites," says **Cassandra Johnson**, SRS social scientist.

Undoubtedly the South is undergoing tremendous change—land use and demographic shifts—with no end in sight. These changes are having and will continue to have dramatic effects on the sustainability of forests and other natural areas. Forecasts show the southern region losing 12 million forest acres (8 percent) to developed uses between 1992 and 2020, with an additional 19 million forest acres forecast to be converted between 2020 and 2040.

This loss of forest area and the fragmentation of remaining forests are the most obvious effects of urbanization and other human activities on forests. We are indirectly affecting forests through activities such as introducing nonnative invasive species, polluting the air, reducing biodiversity, and increasing soil erosion. "Both direct and indirect effects on forests reduce our ability to use the forest for ecosystem goods and services such as purifying water, providing recreational opportunities, and aesthetics," says **Wayne Zipperer**, SRS research ecologist.

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## Seeing the Houses Through the Trees

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Land use policy and planning decisions have an immense influence on natural resource issues in the WUI. Lack of vision and little or no planning and regional coordination for comprehensive growth management are major factors contributing to interface problems across the South. Current land use policies are difficult to implement across Federal, State, and local jurisdictions, which often overlap. As a result, various levels of government make land use decisions independently of and often in conflict with each other. Additionally, in many Southern States the local governments have limited authority to plan and control development. Zoning and land use plans are often not enforced and waivers are routinely granted. "We need to understand more about how land use policy affects natural resources and the role of natural resources in mitigating the unintended consequences of urbanization," says Macie. "This understanding will enable local policymakers to make decisions that will support nature's role in providing clear air and water, and in creating more livable environments."

### With Benefits Come Challenges and Risks

Hurricanes are another major risk affecting the South. Most notably, Hurricane Katrina hit the Gulf Coast in 2005 with maximum sustained winds up to 125 miles per hour, becoming the costliest and one of the deadliest natural disasters in U.S. history. Besides causing great risk to humans and property, hurricanes can have devastating affects on forests in urban and urbanizing areas. Urban forest losses from hurricanes ranged from 11 to 38 percent between 1992 and 2004. Although falling trees are thought to be a big safety concern for residents in areas affected by hurricanes, only about 10 percent of the damage to homes comes from fallen trees; trees, especially those in clusters, may actually shelter homes from the wind if they are healthy and wind resistant. Large amounts of downed woody debris from hurricanes can pose a fire risk. We still have much to learn about the effects of hurricanes and other natural disturbances on natural resources and the ecological services they provide, as well as the value of lost ecological services.

Managing for wildlife is also far more complex in the interface than in rural areas. Many of us enjoy viewing wildlife and go to great lengths to attract wildlife near our homes. Until, that is, they munch on those flowers we just planted in our backyard or dig up the newly planted tomato plants in those planters on our deck. Managing wildlife in these interface areas brings many challenges and opportunities. Resolving nuisance wildlife conflicts, providing opportunities for both hunting and viewing of wildlife, and conserving, managing, and restoring wildlife habitat in the face of mounting development pressures are but a few.

Recreation planners face the challenge of providing high-quality experiences while sustaining the quality of natural resources on an ever-shrinking land base. They must also be able to communicate with the wide range of recreation users who have different cultural backgrounds and value systems from what has been

**Although a large part of the South is still forested, much of this forest land is now fragmented by development.** *(photo by Rodney Kindlund, USDA Forest Service)*

the norm. As forest recreation demand increases, there is more potential for conflict between different recreation user groups using the same areas. All-terrain vehicle riders, for example, are likely to clash with hikers over how backcountry areas should be used.

Urbanization is the most pressing land use issue affecting water quality and quantity. The growing population of the South is demanding ever-larger water supplies. With this growing demand comes the challenge of assuring fair allocation of water supplies for both human populations and for wildlife and aquatic species habitat. Nonpoint-source pollution is also a major concern; sources are widely dispersed across the landscape and are difficult to pinpoint or regulate.

## A New Way of Doing Business

In the South, over 90 percent of forested land is held by nonindustrial private land owners. The majority of these owners (94 percent) own less than 100 acres. Many are new owners who bring with them diverse perceptions of forestlands and how they should be managed. We can no longer assume that forest landowners see timber as the primary reason for owning forests; owners of small forests tend to emphasize amenity, identity, lifestyle, and ecological reasons for forest ownership. "Income from forest products is important, but way down the list," says **Bruce Hull**, professor at Virginia Polytechnic Institute and State University and SRS collaborator. "Interface landowners depend on forest products for less than 5 percent of their income."

Additionally many of these landowners are politically connected and represent a powerful force affecting funding and institutional policies. As natural resource professionals, we need to adapt to this changing clientele. "Many new opportunities exist for forestry and foresters," says Hull, "but we need to think differently because our clients and our economy are now different."

To do this, we need to apply new skills and tools. Techniques for managing forests on smaller scales and for multiple objectives are important in the fragmented interface. Many threats to forest health, such as southern pine beetle infestations, can only be properly controlled with coordinated management among multiple owners. Information about how to protect trees during construction and land development and how to work as a team with the various professions involved is also important for foresters working in areas undergoing land use change.

Foresters can no longer expect to just work alone in the woods. The ability to communicate effectively is an increasingly important part of a natural resource professionals' job. The ability to translate forestry and other natural resource information into terms the public is familiar with is important for building understanding and acceptance of natural resource practices and environmental processes. "People working in the interface need people skills: patience, problem solving, listening, and a process of doing business that is transparent and empowering," says **Martha Monroe**, professor at the University of Florida and SRS collaborator.

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## *Human Influences on Forest Ecosystems: The Southern Wildland-Urban Interface Assessment*

In 1998, Florida wildfires demonstrated the complexities of natural resource management in the wildland-urban interface (WUI). Shortly after these fires, the Chief of the Forest Service conducted a review of the South and identified the WUI as one of the main challenges for the Forest Service.

In response, the Southern Research Station and the Forest Service's Southern Region, in cooperation with the Southern Group of State Foresters, conducted an assessment to identify and better understand factors driving social and ecological changes within the WUI, as well as the consequences of such changes. The resulting assessment, *Human Influences on Forest Ecosystems: The Southern Wildland-Urban Interface Assessment,* was completed in 2002. The purpose of the assessment was to provide the foundation for establishing an interdisciplinary program of research and technology transfer within the Forest Service.

The assessment can be ordered from the InterfaceSouth Web site at: www.interfacesouth.org/products/publications.html?results=10.

**Growing population in the South means that wildland-urban interface issues will only grow more pressing.** *(photo by Larry Korhnak, University of Florida)*

## Seeing the Houses Through the Trees

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Land will continue to be developed, so we must be aware of the changes brought about by urbanization and understand the diverse issues, challenges, and opportunities in the changing environment of the wildland-urban interface. In the South, the area of the country where population is growing most rapidly, trying to understand—let alone manage—the future of forests can seem overwhelming. The good news is that people across the South—from agencies, nonprofits, industry, individual volunteers—are coming up with ways to overcome interface challenges with unique solutions.

In the following pages, we will look at what SRS researchers and their collaborators are doing to predict and reduce the risks of wildfire, help resource managers chart where the smoke from prescribed burning goes and where arsonists are likely to strike, determine the relationship between land use policies and forest canopy, and understand the effects of urbanization and natural disturbances such as hurricanes on natural resources. You will also learn about training and outreach programs that are helping natural resource professionals and others to be better prepared to work in the interface.

On a recent flight out of Gainesville, I peered out of the window at the forests interspersed with homes and businesses and thought to myself, "THERE are the houses!"

# Life on the Edge

*by Joe Kays*

**Annie Hermansen-Baéz in her office on the University of Florida campus.** *(photo by Joe Kays)*

Growing up on California's central coast, the world was a laboratory for **Annie Hermansen-Báez**, thanks in large part to her father, an elementary school teacher.

"Whenever we went anywhere he was always pointing out things about the natural world to me and my two brothers, whether we wanted to hear about it or not!" Hermansen-Báez says. "We camped all over California and lived out in the country for many years. My brothers and I always had snakes and lizards as pets, along with many dogs, cats, chickens, and geese."

After earning a degree in biology from the University of California, Santa Cruz in 1991, Hermansen-Báez joined the Peace Corps and spent 3 years in Paraguay teaching subsistence farmers about agroforestry systems, crop diversification, and soil conservation techniques; helping them construct soil erosion barriers and utilize green manures; and sharing tree nursery and organic vegetable gardening practices.

Based on her Peace Corps experience, Hermansen-Báez decided to go back to school in forestry at the University of Florida (UF). In 1998, the year she completed her master's, Florida wildfires scorched 500,000 acres and caused more than $600 million in damage, prompting the Chief of the Forest Service and the Director of the Southern Research Station to commission an assessment of the wildland-urban interface in the South.

Hermansen-Báez spent the next 3 years collaborating on that assessment with **Ed Macie**, the Forest Service's regional urban forester, then in early 2002 helped establish the **Southern Center for Wildland-Urban Interface Research and Information** in Gainesville, FL. Hermansen-Báez has two titles these days—center manager and technology transfer coordinator—but she describes herself as a facilitator between the scientists and the center's clients, who include natural resource professionals, private forest landowners, planning departments, local policymakers, and others.

We caught up with Hermansen-Báez at the center's offices on the shore of UF's Lake Alice, itself a natural oasis in the middle of one of the Nation's largest universities. Looking around her office, we see evidence of many travels to South America, among them photos of her husband and two sons.

***You are a strong promoter of multiculturalism, aren't you?***

We are a multicultural family, so I think it's very important that my children learn about the world around them. I met my husband while I was in the Peace Corps. He is from the area where I worked in Paraguay. We moved to Gainesville in 1995, got married, and now we have two children. We speak Spanish and even Guarani, the native language of Paraguay, in our home and we try to go back to Paraguay at least every couple of years.

***How do think your background prepared you for the work you're doing today?***

Both as a volunteer in the Peace Corps in Paraguay and as a student in a tropical biology course in Costa Rica, I came to realize that you couldn't separate natural resource issues from people issues. I really wanted to work in a career in which I could combine those two issues. That continued when I was working on my master's degree. For my thesis I studied the seed germination of a tree species from the Brazilian savannah. Brazilian farmers sell the seed pods to a pharmaceutical company who then extract a medicinal compound. I also looked at how income from selling the seed pods fits into the whole socioeconomic structure of the area.

***How has the center's mission evolved since its inception?***

In the fire arena, the concept of the wildland-urban interface has been around for awhile, but only in the last 5 years has it really taken off as a term

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**Interface challenges mean new training methods for foresters.** *(photo by Larry Korhnak, University of Florida)*

## Life on the Edge

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used outside of fire. We're trying to make people think about the interface as much broader than just fire and to include a range of issues related to the effects of urbanization on natural resources. You can't think about fire without thinking about land use planning, for example. They're all connected.

***What has been your greatest challenge?***

The demographics of people living in and close to our forests have changed dramatically in recent years. The average land tract size is going down and the number of landowners is going up. A lot of these people have a negative image of forestry because they don't know much about forest management. So we in the forestry community have had to spend time working on our image with the general public. We try to help them understand that forests are a renewable resource and that everyone will benefit if we maintain land in forests—be it plantations or natural forest stands.

We've also had to adapt our training methods for foresters. In the past, foresters weren't trained to work with the diverse group of people that you find in the interface now, so we're spending a lot of time on professional development, retraining our forestry professionals to work with different types of forest users and different management objectives. We're also working with the forestry school here at UF to teach future foresters about working in this new environment, incorporating more interface concepts into the curriculum.

Another challenge is communication. Historically, forestry has not marketed itself very well. If you look at the old Forest Service publications,

they're often lacking color and illustrations and tend to reach a limited audience. We're trying to make our products look more interesting and we're making them available in multiple formats so we can reach a wider audience.

***What are some of the center's most promising areas of research?***

We're doing a lot of research right now on plant and mulch flammability. Fire professionals want guidance so they can advise people who live in the interface what they can plant around their homes. We've developed a series of fact sheets about fire in the wildland-urban interface to help people make their homes and surrounding landscapes more firewise.

We recently started a study on how urbanization will affect the forest ecosystems and human communities of the Florida Panhandle, an area that is beginning to see rapid land use change. We try to give people information they can use to make sound decisions. People need to know what the consequences might be so that they can make informed decisions.

We're also getting into the whole biomass area. Because of energy concerns, biomass as a potential fuel is popular right now, and there are a lot of woody biomass sources in the interface, everything from urban wood waste to hurricane debris. The UF is really taking a lead in developing alternative fuels, so there is a lot of opportunity for collaboration.

***In the best-case scenario, what would the wildland-urban interface look like in a place like Florida?***

It's tough to say exactly what it would look like, but our philosophy is that since land use change is going to happen, it can happen best with

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## The Southern Center for Wildland-Urban Interface Research and Information

The SRS Southern Center for Wildland-Urban Interface Research and Information (WUI Center) was opened in Gainesville, FL, in January 2002. Activities of the WUI Center represent an immediate Forest Service response to critical findings of the ***Southern Wildland-Urban Interface Assessment*** and the ***Southern Forest Resource Assessment***, which both identified urbanization as the biggest threat to southern forests.

Though initially focused on research and technology transfer needed to address fire in the wildland-urban interface (WUI) in the South, the WUI Center has expanded its focus to include a range of issues related to the urbanization of southern forests, such as how ecosystems and disturbance regimes are altered by human influences; subsequent risks to human and natural communities; and the relationship of land use policies to ecological processes and disturbances in the interface.

The mission of the center is to develop and communicate guidelines, models, and tools needed by natural resource managers, policymakers, planners, and citizens to reduce risks to ecosystems and human communities in urban and urbanizing landscapes. The center's technology transfer program focuses on disseminating new and existing information, serving as a clearinghouse of WUI information, building partnerships and collaborative efforts and approaches, and facilitating and creating linkages.

The Southern Wildland-Urban Interface Council (SWUIC), a chartered council of the Southern Group of State Foresters, is the advisory council for the WUI Center. SWUIC helps guide the technology transfer activities of the WUI Center and assists in identifying research needs. This guidance helps ensure that the research and technology transfer products of the WUI Center meet the needs of their stakeholders.

The WUI Center's Web site, InterfaceSouth (www.interfacesouth.usda.gov or www.interfacesouth.org), has publications, training and outreach programs, decision support systems, a literature database, a photo gallery, current WUI news and events, and much more. You can also sign up for the Southern Wildland Urban Interface Network listserv from the Web site and receive the *InterfaceSouth Update*, an electronic, monthly bulletin about critical WUI issues, and the *InterfaceSouth Post*, which contains current interface information, such as upcoming conferences or news articles, sent out on a weekly basis.

**For more information**:
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# The Southern Center For Urban Forestry Research & Information

In 1997, the **SRS Southern Center for Urban Forestry Research & Information (UF Center)** was formed to direct urban forestry research and provide technology transfer within the Southern Region to address pressing issues including changing land use patterns, increased urbanization, loss of forest canopy, and changing demographics. The UF Center and the **SRS Southern Center for Wildland-Urban Interface Research and Information** work closely together and are now both part of the same SRS research work unit.

The focus of the UF Center is to help communities and landowners address a broad spectrum of southern urban natural resource issues—from the city center to the national forests—with a focus on the human dimension. The UF Center is a cooperative effort that integrates Forest Service Research, State and Private Forestry, and the National Forest System. The UF Center also works closely with universities, State forestry agencies (urban and community forestry programs), cooperative extension services, nonprofit organizations, and others.

UF Center research focuses on topics such as urban expansion and demographic shifts and their effects; the role urban forests play in improving the livability, healthiness, and prosperity of urban neighborhoods; the economic value of trees and urban forests in southern cities; the effectiveness of urban forest management and design options for improving urban neighborhoods and commercial areas; and the role urban forests may play in carbon sequestration.

The UF Center's technology transfer program focuses on:

- identifying research and information needs of customers;
- communicating research results and other information with customers through publications, conferences, workshops, and other resources;
- facilitating the exchange of information among and between researchers, practitioners, and others involved with urban forestry;
- providing technical assistance to State urban and community forestry programs; and
- assisting with the development of storm damage assessment and poststorm urban forest assessments.

The UF Center's Web site, Urban Forestry South (www.urbanforestrysouth.org), was developed collaboratively with the southern regional extension forester and the University of Georgia, School of Forestry & Natural Resources. The Web site has a variety of urban forestry resources, such as a document library, tree ordinances, classroom activities, presentations, and much more. You will also find a section on grant announcements and other funding opportunities, job announcements, and an urban forestry manual.

**For more information:**
Dudley Hartel at 706–559–4236 or dhartel@fs.fed.us.

## Life on the Edge

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planning that takes into consideration the suitability of sites for the development proposed for them. We also need to think about reducing risks to humans and forest ecosystems from events such as fires, floods, and hurricanes.

***There's a certain irony in the fact that your offices are adjacent to a wildland island, isn't there?***

It is interesting to have our office right next to an interface between people and wildlife. In the spring we had a sandhill crane couple with two young chicks wandering around our building, knocking on the doors with their beaks. We often find turtles on our front doorstep, which we promptly return to Lake Alice. We've even seen bald eagles and hawks in the vicinity. And we are right on the UF campus in the heart of Gainesville.

It goes to show that you can have a wildland-urban interface just about anywhere! People often think of the wildland-urban interface as being on the edges of cities or towns. But the interface is more of a condition than an exact place—it's where there are a mix of elements coming together in one location, such as the wildlife and human interactions we have here, or housing set in a landscape managed for both fire resistance and aesthetics. I love working in a place where I can walk out the door and step into that wildland-urban interface. I think most of us would prefer to work and live in a place like this—the challenge is making it safe and sustainable for both the humans and wildlife.

*Joe Kays is a freelance science writer and editor of* Explore, *the research magazine for the University of Florida.*

# Blazing Landscapes

*by Judy Bolyard Purdy*

A home in the country, near the city. Americans in record numbers are coming home to forest and mountain retreats to barbecue on their decks, putter in their gardens, and relax in natural surroundings.

Many newcomers to rural southern retreats have forgotten—or may have never known—that wildfires are as much a part of their new neighborhood landscapes as nature's symphony at sunset. Idyllic hideaways perched atop a mountain or nestled in a pine forest may one day be in the path of a destructive wildfire caused by lightning or carelessness.

"The entire South is becoming one big wildland-urban interface. Increasingly, people are building homes and recreating in the interface with no regard for the risks," says **John Stanturf**, project leader at the **SRS Center for Forest Disturbance Science** based in Athens, GA. Stanturf oversees a team of foresters, ecologists, meteorologists, soil scientists, chemists, and computer modelers who study the ecology, management, and restoration of southern forest ecosystems. He estimates that wildland-urban interfaces, or "exurban" areas, encompass three to five times more land than urban areas.

"Land use may change from forests to home sites but that doesn't change the surrounding tree cover," Stanturf says. "The fire risks haven't gone away."

## Fire in the Landscape

With few exceptions, North American plant communities—whether forests, prairies, or savannas—have evolved with and rely upon periodic wildfires. For millennia, wildfires have swept across fire-adapted southern landscapes, from the Coastal Plains with their longleaf pine forests to the foothills of the Appalachians. Fires reduce accumulated debris, recycle nutrients locked in dead vegetation, and release seeds packed in cones or other structures that open with fire's intense heat. Without fire, many plant communities become choked by vegetation and fail to regenerate.

"In certain ecosystems, fires are as important as sunshine and rain," says SRS plant ecologist **Joe O'Brien**. "Fire has critical impacts we don't even know about yet."

After particularly devastating forest conflagrations occurred in the Northeast and Midwest, Congress passed the Clarke-McNary Act in 1924 to ban fire as a management tool on Federal lands. In the 1930s, Federal agencies also began extinguishing all accidental fires. These fire exclusion and suppression policies, combined with Smokey Bear's highly effective fire-prevention campaign, created a legacy of wildlands that are now vulnerable to catastrophic wildfires. Private citizens and Federal and private agencies are once again beginning to embrace fire as an important management tool.

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**As houses move closer to wildlands, it becomes more difficult to use prescribed burning to manage forests.**
*(photo by Joe O'Brien, USDA Forest Service)*

## Blazing Landscapes

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The timing couldn't be better. During the 20th century, the South's population grew 319 percent, compared with 270 percent for the entire United States. Southern land use has changed and forests are now more fragmented. Forest Service research shows that prescribed fires are a sound and responsible way to protect people and their homes and to ensure the ecological health of fire-affected landscapes. For example, SRS studies show that the populations of many animal species, including bobwhite quail and turkey, increase following a prescribed burn because of improved habitat. But it's getting more difficult for private and government landowners to use prescribed fire because of changing patterns of land use, public concern, and lack of knowledge about forest management.

The 13 Southern States that comprise Forest Service's Southern Region receive the most lightning strikes in the contiguous 48 States, with Florida leading the way. The South averages approximately 45,000 wildfires a year, often burning more acreage than all other regions combined. The region also leads the Nation in number of prescribed fires, says forester **Dale Wade**, who retired from the Forest Service and now trains and advises landowners to use fire as a management tool. "A prescribed burn every few years may be the most effective tool for reducing the risk of damaging, often catastrophic fires," he says.

Wildland fires often stop only when the fuel runs out or the weather changes. They are more expensive to control and mop up, costing up to 10 times more than prescribed burns, Wade says. The cost to homeowners is also staggering. The United States experienced an especially large number of wildland fires in 1998. In Florida alone the price tag for damages during an 8-week period was estimated at more than $600 million, Wade said. That same year, Congress created the Joint Fire Science Program to inventory fuels and evaluate treatment strategies, setting up a partnership among the Forest Service and the U.S. Department of the Interior Bureaus of Indian Affairs and Land Management, National Park Service, U.S. Fish and Wildlife Service, and U.S. Geological Survey.

### Fight Fire with Fire?

The essential role of fire in southern plant communities presents dilemmas for both public and private resource managers. Tensions sometimes arise between resource managers and the people who live in or near the forest because prescribed burns can mean temporary inconvenience. Recurrent fire is mandatory to perpetuate most native southern ecosystems, but should homeowners living adjacent to a wildland be subjected to smoke and the threat of an escaped fire? Should landowners be forced to reduce the buildup of fuels on their property or should they be allowed to let fuels accumulate and accept the increased risk of damaging wildfire? Land managers and homeowners must work together to forge long-term solutions that maintain fire-adapted ecosystems while protecting adjoining landowners and the public from the threat of catastrophic fire.

"The past century has vividly demonstrated that fire exclusion cannot be attained over the long term," Wade says. "But altered forest conditions and fuel buildup that results from this failed policy make the reintroduction of fire difficult and complex, with a much greater risk of a bad outcome."

**Fire plays an essential role in southern forest ecosystems, but can quickly become a problem for landowners living nearby.** *(photo by W. Robert Maple, USDA Forest Service, www.forestryimages.org)*

Prescribed fires are often set in late winter or early spring, when temperature, moisture level, and wind direction are more predictable. Because many vegetative communities historically burned during the growing season, an increasing percentage of burns are now done during the warmer months. Approximately 6 million acres of public and private property in the Southeast are treated with prescribed fire each year.

"We need to be burning 30 million to 40 million acres annually in the South," Wade says. "And you can't burn just once and be safe. In many situations you're safe for only a year or two following a prescribed burn."

A carefully planned and executed prescribed fire poses a very small risk to people's lives, homes, and businesses. "We use prescribed fires in the wildland-urban interface because they are very effective," Stanturf says. "In Florida, for example, people can stand in their driveways and watch a prescribed fire burning nearby in a controlled manner."

To help southern resource managers and private citizens use prescribed fire appropriately, SRS researchers study everything from smoke behavior to fire alternatives. In the past, many fire-behavior prediction models were based on data from the Western States; what's true for the West isn't necessarily so for the South.

That includes how smoke behaves, which is ***the*** critical issue in prescribed fires, says Stanturf. SRS researchers are studying smoke production and movement to understand, predict, and minimize its effects. *(See related story on page 18.)* Among the reasons that understanding smoke behavior is so critical for the South is the high percentage of roads that penetrate southern forests, compared with many Western States. Predicting smoke behavior is difficult. It becomes even trickier when smoke combines with moisture to form dense shrouds that obscure visibility and endanger motorists, or when it is stirred by coastal breezes invisible on weather maps.

"Smoke will shut us down faster than any other issue because of air quality and safety issues, especially if it drifts over hospitals and schools or across roadways," Stanturf says.

Another reason the South needs ongoing research is that fragile, fragmented, and historically important forest communities, including "island remnants" in urban areas, are being lost or irreparably changed because of the lack of fire.

## Preserving Healthy Ecosystems

It's undisputed that certain plant communities need fire. Longleaf pine forests, for instance, need to be burned every 1 to 3 years. Yet some haven't been burned in 50 or even 90 years, says O'Brien, who studies ways to reintroduce fire without causing more harm than good. Forests sheltered from the effects of fire for decades accumulate dense layers of needles on the forest floor, fostering a rich growth of tree roots near the surface. When fire is finally reintroduced after several decades of exclusion, the heat destroys surface roots, and within the next year or two, up to 80 percent of the large longleaf pine trees may die, according to O'Brien's research.

But prescribed, low-intensity burns aren't always palatable in urban settings, such as Miami, FL, which is home to threatened rockland pine forests. These open, savanna-like, subtropical pine forests grow on thin-soiled limestone ridges and are dominated by slash pine in the canopy. "You have squares of rockland pine forest, often the size of postage stamps, that contain endangered and endemic flower species that evolved with fire," O'Brien says. "These forests are embedded in urban areas, have

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## Blazing Landscapes

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been reduced in size by 98 percent, and need fire to survive."

Like O'Brien, **Tom Waldrop** studies fire-dependent ecosystems. Team leader for **Disturbance Ecology in the Southern Appalachian Mountains and Piedmont**, Waldrop is part of a national effort to study fire and fire surrogates—such as herbicides, harvesting, and mechanical mulching—on forest structure and function. Fire surrogates can reduce fuel buildup, but little data exists about their ecological impact and economic effectiveness. In addition to relative costs, what are the effects on seedling germination, species richness, or nutrient cycling? And are essential processes lost when fire is excluded?

The National Fire and Fire Surrogate Study involves more than 130 scientists at 13 sites across the country looking at such issues as insects, diseases, and wildlife. Waldrop oversees research at one site in the Piedmont and another in the Southern Appalachian Mountains. Early results from the study, he says, show that "most ecosystem components are not adversely impacted by prescribed fire or mechanical fuel reduction. These treatments can be used to restore ecosystem structure, function, or both."

In a separate project Waldrop studies the fire-dependent Table Mountain pines that grow along Appalachian ridgetops. Little is known about fire as a tool for Appalachian and Piedmont forests, where intentional fire was restricted for 50 to 80 years. Waldrop experimented with two fire regimens—a single, high-intensity fire and a series of low-intensity fires—and demonstrated that prescribed fire can be reintroduced into Table Mountain pine forests with little adverse impact. "The goal is to learn to use fire as a more effective management tool in an ecologically sensitive manner," he says.

His team is also using a type of aerial imagery, called hyperspectral imagery, and topography to develop fuel models for remote, rugged areas of Southern Appalachian Mountains that are hard to traverse and contain a rich mix of plant communities. "Fuel load estimates aren't as accurate as they could be," he says, "and ground measurements are time consuming." The models will yield maps of specific ground fuels, such as mountain laurel, a native shrub which can be explosively flammable under certain conditions.

Waldrop is also investigating two methods for restoring Piedmont forests heavily damaged by southern pine beetles on two different types of sites. One forest is an historical site, while the other is being prepared for a commercial timber operation. Portions of each forest have undergone high-intensity fires—hot temperature fires that burn the tree crowns—and other sections are receiving extensive mulching of the dead trees followed by seedling plantings. Waldrop is comparing plant growth and diversity, soil properties, and the abundance of mycorrhizae (beneficial fungi that help roots absorb water and nutrients) under both treatments.

It's obvious that some important fire-deprived ecosystems are declining and others may disappear all together. And even though 22 States, including 11 in the South, now have laws to facilitate prescribed burns, the decision to burn landscapes near homes and cities can be a career-ending risk.

Meanwhile, forests continue to grow, fuels continue to accumulate, and landscapes continue to burn—whether from a lightning strike or a lawnmower spark.

"There will be big problems," Stanturf predicts, "if we fail to plan ahead."

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## Rare Rockland Pine Forests Rely on Fire

Native, savanna-like, subtropical pine forests, called rockland pine forests, are hotbeds of biodiversity and home to threatened and endangered plants and animals, such as the milkpea on the left, that need fire to survive. Little is known about the ecology of these forests, which occur in southern Florida near Miami and other places such as the Bahamas (where a native ground-nesting parrot lives among the pines) and Cuba. These pine forests provide winter habitat for many migratory birds, including the endangered Kirtland's warbler. *(photo by Joe O'Brien, USDA Forest Service)*

# Growing Population Increases Fire Risk at the Wildland-Urban Interface

*by Steve McNulty*

Years ago, large blocks of forest land were owned by a single individual. However, as these land parcels were sold and resold, they were divided among more and more owners. Where once a single person may have owned 200 acres, now 400 people may each own half an acre. This change in the wildland-urban interface has significantly impacted how this land area is managed. Even if the forest is left physicially intact, it is no longer practical to harvest the timber or control fuel build-up through controlled burns. Therefore, the risk of wildfires impacting residential areas has been increasing for several decades as people move out of the cities and into the country.

The SRS Forest Inventory and Analysis (FIA) program has monitored forest location, age, size, and species composition for the United States since the 1930s. In recent years, this program has expanded to include over 30,000 forest plots that are re-measured once every 5 years.

Data collected by the FIA program is very useful in determining how forests and forest fire risk are changing with changing demographics. In the eastern United States, the greatest risk of large wildfires occur in areas of highly fragmented forest with much urban encroachment, coupled with areas of high forest fuel loads. These two factors can be combined to produce a wildland-urban interface fire risk map such as shown below. In the southern United States, parts of Arkansas and Tennessee represent the areas with the best chance of large-scale wildfire occurrence. These areas are heavily forested, but also have a large number of people living out in the forest. In combination, these two factors make both fire fuel load and wildfire control challenging; continued population pressures are likely to further expand the area of high fire risk in the future.

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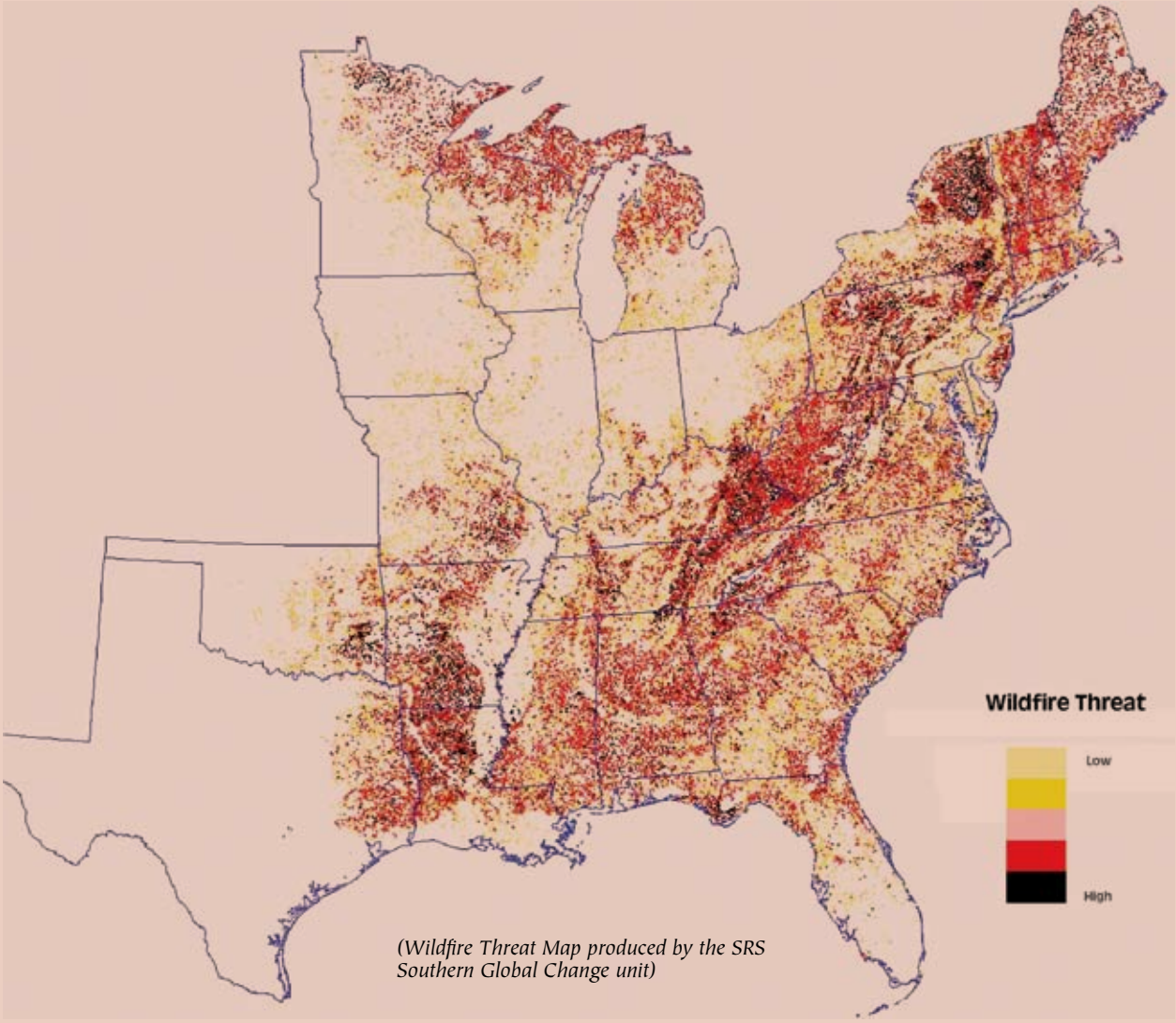


*(Wildfire Threat Map produced by the SRS Southern Global Change unit)*

# A Tale of Two Towns: Rural Communities Divided Over Growth

*by Cassandra Johnson*

A good deal of research has examined the ecological impacts of sprawl; other work has looked at the social inequities created when middle-income residents abandon central cities, leaving lower income residents to deal with problems that typically accompany urban life, such as decaying infrastructure, problem schools, and high crime rates. Far less scholarship compares acceptance of urban expansion in communities that are socioeconomically and racially separated.

In 2002, I worked with **Myron Floyd** from North Carolina State University on a study of two towns in rural upper Charleston County, SC, where perceptions about future development are in conflict. The contestation involves different visions of growth for the rural area. Exploratory research suggests these differences are highly correlated with socioeconomic status, which, in turn, is closely aligned with race.

Over the past half century, the pace of development on the Sea Islands off the South Carolina coast has intensified. From the end of the Civil War until the 1950s, descendants of African slaves (the Gullah or Geechee people) were the primary inhabitants on South Carolina's barrier islands. Now, these places have been developed into popular resorts with recreational amenities geared toward the affluent resident and vacationer—and the historical Gullah population has been largely displaced by high-income property owners.

Similar population and economic pressures are now impacting some of the coastal counties that are part of the Lowcountry near Charleston, SC. While South Carolina's population increased roughly 15 percent from 1990 to 2000, the increase was more than 28 percent in the State's eight coastal counties. Despite growth and development, substantial traditional African-American populations remain in South Carolina's coastal counties. Their socioeconomic status, however, differs greatly from that of migrant and long-time resident whites.

For instance, the percentage of the population living below the poverty level in rural upper Charleston County is 16.9 percent, which approximates the poverty rate for the county as a whole (16.7 percent), but the poverty rate for African Americans in the area is about five times higher than for whites (23.5 percent and 5 percent, respectively). Upper Charleston County contains approximately 1 percent of Charleston's population, with African Americans comprising about 64 percent of the 5,091 residents and whites 35 percent.

The preliminary study we conducted shows that socioeconomic differences between African Americans and whites contribute greatly to racial differences in perceptions of urban growth. Using interviews and content analysis of articles in the

**The pace of development in South Carolina's coastal counties has stepped up in the last decade.** *(photo by Larry Korhnak, University of Florida)*

local press, we compared municipal responses to urban growth for two rural municipalities "Newborn" and "Seaside Village" (pseudonyms) from 2002 to 2003. The town council in Newborn, where all the elected officials are African American, has been much more receptive to development initiatives than that of Seaside Village, where all the elected officials are white. Also, within Newborn, African Americans appear more willing than whites to accept development. Newborn's population of 1,195 is two-thirds African American and one-third white; Seaside Village's smaller population of 459 is roughly 93 percent white and 7 percent African American.

## Clean Water Becomes Controversial

Newborn was incorporated in 1992 in response to urban expansion from metropolitan Charleston. Residents in the then unincorporated rural area feared their community would be consumed by the upscale development that had transformed other nearby towns into suburban bedroom communities. Newborn is composed of three discontinuous residential and commercial segments, located within 11 square miles along a U.S. highway. The eastern edge of the Francis Marion National Forest is also included within the town's borders.

In 1997, Newborn passed a referendum to establish a municipal water system because many residents had contaminated wells. In 1999, a community-based environmental group conducted an assessment of the study area and reported that substandard housing, lack of potable water, and sanitation were critical threats for area residents. A number of residents reported that sewage from poorly constructed septic systems was contaminating well water. These problems were especially prevalent among African Americans. In the same year, the town also proposed a referendum on a sewer system, but cancelled it because of mounting criticism from a small, mostly white group opposed to growth.

After 7 years of debate and controversy surrounding public water, the town began construction of the water system in 2004, funded in part by a U.S. Department of Agriculture grant. Opponents of the system remain firm in their conviction that municipal water will attract developers; city officials maintain that the water system represents a form of environmental justice for low-income residents with poorly constructed wells.

Seaside Village is about 10 miles northeast of Newborn. The town was incorporated in the late 1850s and has a long, distinguished history dating back to Native American settlement. Residents have a deep history and strong sense of place for the town. Seaside Village proper is surrounded by predominantly rural, unincorporated African-American communities that have a Seaside Village mailing address but are not included within the town's political boundaries. In contrast to Newborn officials, Seaside Village's governing body is adamantly opposed to any type of development that would detract from the town's rural character. For the most part, residents here have properly functioning wells, and most are middle-to-upper income wage earners.

## A Clash of Perceptions

Our analysis suggested that African-American leaders in Newborn view urban expansion as one means of overcoming generational poverty. A public water system would not only provide an immediate remedy to the problem of contaminated water but also be a conduit for longer term economic stimulation. Newborn officials see improved infrastructure and the subsequent location of commercial establishments as bringing much needed jobs and opportunities for low-income residents.

The proposed infrastructure merely highlighted what many described as long-time race and class divisions in upper Charleston County. Middle-class residents (most of whom were white) feared that the type of growth that could result from the installation of public water and sewer would severely compromise the area's rural character and unique ecosystem, specifically the ecological diversity contained in the Francis Marion National Forest. These residents also warned that suburban development would displace poor black residents from their property because of rising rents and property taxes. Growth opponents pointed to the history of displaced African Americans from the Sea Islands and also to more recent cases of blacks being forced from long-time African-American communities closer to Charleston. Growth proponents countered that those opposing the infrastructure are a privileged class not constrained by persistent poverty or racial discrimination.

In late 2005, a regional growth management agreement to limit development near the Francis Marion

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**The disparity in economic status between African Americans and whites in the South Carolina Lowcountry has contributed to conflicting views on development in the area.** *(photo by Bill Lea, USDA Forest Service, retired)*

## A Tale of Two Towns

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National Forest was initiated by larger, urban municipalities to the south of Newborn. The proposal stipulated that 11 area municipalities, including Newborn, take steps toward restricting growth in the rural Lowcountry by limiting housing densities to one home for every 25 acres near the national forest and by prohibiting new water and sewer lines in north Charleston County. Newborn town council voted unanimously against the agreement, contending that growth is necessary for the town's survival. Newborn's vote effectively defeated the initiative for the time being because it had to be agreed upon by all municipalities in order to take effect.

### How to Cross the Racial Divide

It was apparent after analyzing both the interviews and press reports that the marginal status of African Americans, compared to whites in the area, is a significant contributor to racial stances on development. The responses of these two populations point to a more fundamental problem in rural America—that of persistent rural poverty. Remarks from two research respondents (M and B) indicate that the quality of people's lives is central when considering long-term sustainable development. Life quality must be addressed before any compromise on growth can be reached:

> **M:** We started out by … putting together several groups that looked at the quality of life resources—we looked at water, we looked at tourism. We wanted …

to change and develop and make it (development) meet our needs without this massive development of our area.

**B:** Which is one of the things I think is our primary purpose, that we have to raise the quality of life so … people aren't so anxious for development. If you can raise the quality of life and offer opportunity … then there's no need for massive development. People aren't so vulnerable to big developers coming in and saying we'll offer you $500,000 for your place.
In order for that to happen, we're going to have to break down the separation of the races. In order for that really to occur, for this area not to be overdeveloped, we're going to have to break down the racial divide.

As rural areas across the South continue to develop, we will see more examples of differences in responses to urbanization and development that run along racial and socioeconomic lines. Researchers in the South have hardly begun to explore factors underlying these differences to understand better how sociodemographic groups experience rural landscapes and draw on them for their personal and collective identities.

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***Socioeconomic data from:***
U.S. Department of Commerce, Bureau of the Census. 2002b. Basic facts: basic tables and maps for the U.S., States, counties, cities, towns, and American Indian Reservations. [Date accessed: February 22, 2003].
U.S. Department of Commerce, Bureau of the Census. 2002a. U.S. Census Bureau: State and county quick facts. [Date accessed: February 7, 2003].

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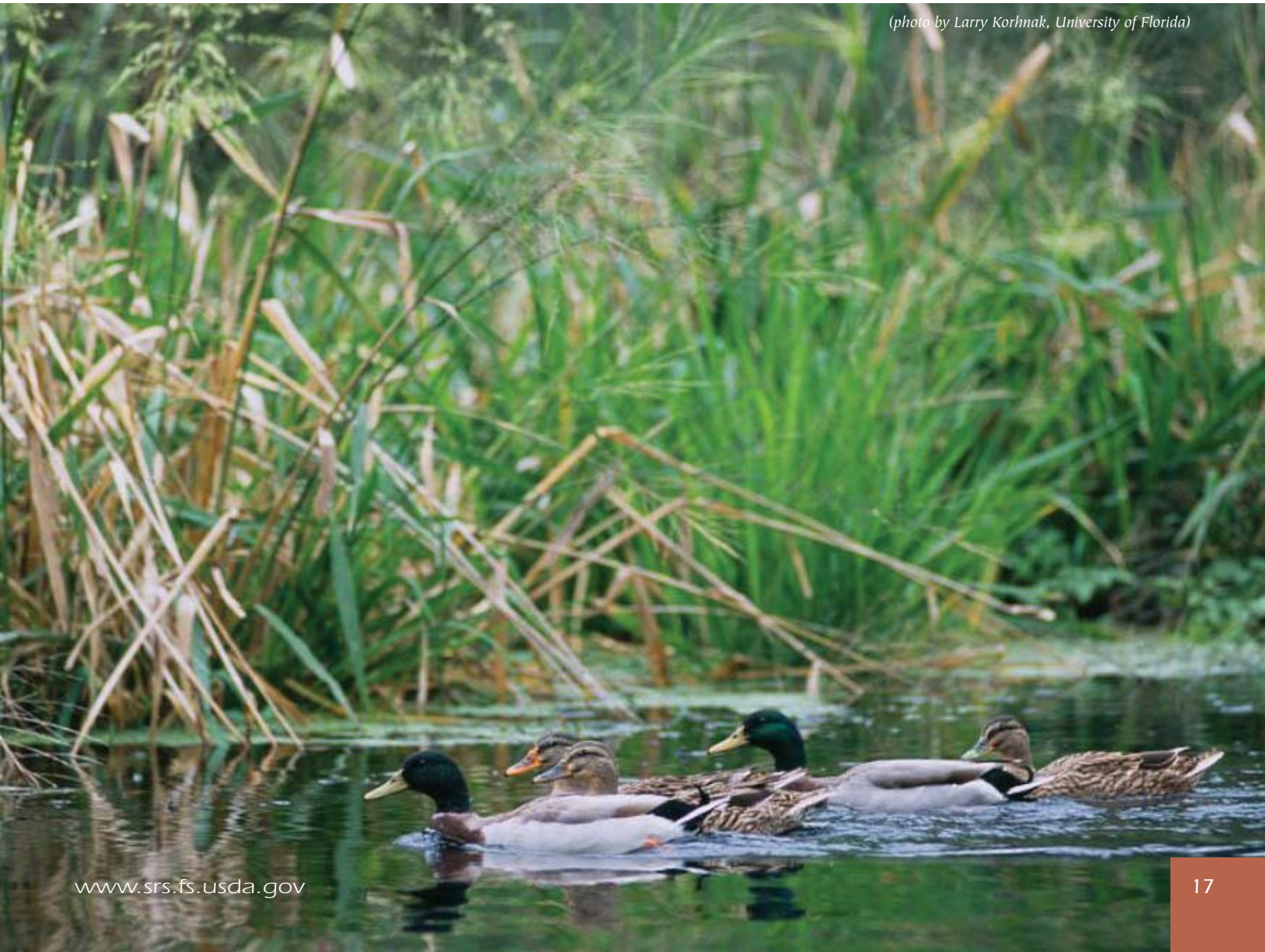

*(photo by Larry Korhnak, University of Florida)*

# Smoke Gets in Your Eyes

*by Zoë Hoyle*

You're driving before dawn on a winter day. It's bad enough to be up so early in the cold, trying to wake up. You smelled smoke when you started out; you know they've been burning in the national forest to reduce fuels. You start to notice some shreds of fog: before you know it, you're inside a thick dirty cloud and can't see a foot in front of you. The drivers of the cars ahead and behind you are equally blind, all of you driving on in a panicked faith that no one will stop too soon.

This may seem dramatic, but it happens fairly often in the South during the winter fire season, usually for only a few minutes, but sometimes for much longer. In southern Mississippi in 2000, fog and smoke from a small wildfire combined to form a "superfog" on Interstate 10 in the hours just before dawn. Visibility went down to almost zero; the inevitable pileup resulted in 5 fatalities and 24 injuries. Though the smoke in this case came from a wildfire, it could just as easily come from a fire set to improve forest health.

In the South, natural resource managers do most of their prescribed burning in the first 3 months of the year, a time when the needs of human populations and forest ecologies can come into visible—and sometimes deadly—conflict. To reduce the impact of prescribed burns on nearby human populations, SRS scientists have entered the realm of night smoke, haze—and superfog.

**The most critical threat to human populations from prescribed fire is smoke, which can cause health problems as well as highway hazards.** *(photo by USDA Forest Service, www.forestryimages.org)*

## Where There's Fire

Prescribed burning—the setting of fires under controlled conditions—is used to treat some 6 to 8 million acres in the South each year, more than in any other part of the United States. About half the acres are burned to improve forest health, the rest for agricultural and range purposes. Southern land managers have long accepted prescribed burning as the most economical way to reduce the risk of wildfires and maintain habitat for fire-dependent plant and animal species. Unfortunately, where there is fire, there is always smoke.

As people move closer to forests, the smoke from controlled burns becomes more problematic. Smoke can cause health problems ranging from irritated eyes and throats to more serious disorders such as asthma, bronchitis, reduced lung function, and even death. At the very least, burning causes a haze that limits visibility and can contribute to poor air quality across the region.

Probably the greatest danger from smoke comes from reduced visibility on roads. Smoke on the road can be hazardous anywhere, but it poses a particular threat in the South, where prescribed burning is done during the winter rainy season when high relative humidity adds to smoke density. When you add in fragmentation from human development, some of the highest road densities in the Nation, and the erratic movement of air across a highly variable terrain, endangering early morning drivers when doing prescribed burning seems almost unavoidable.

"Most smoke-related highway accidents occur just before sunrise when temperatures are coldest and smoke entrapment is maximized," says **Gary Achtemeier**, research meteorologist with the **SRS Center for Forest Disturbance Science** in Athens, GA. "In these conditions, weak drainage winds of even 1 mile per hour can carry smoke over 10 miles during the night—with the density of the road system in the South, there's a good chance smoke or fog will be carried over a road."

With fellow SRS research meteorologists **Scott Goodrick** and **Yongqiang Liu**, Achtemeier has taken on the task of producing tools managers can use to predict where smoke will drift the day they burn and on into the night and early morning of the next day. The researchers started by developing a computer program that combines high-resolution national weather data with a precise understanding of terrain to predict smoke from fires set at defined coordinates. They tackled the terrain of the Piedmont first, an area where there is significant use of prescribed burning—and where population and road networks are expanding rapidly.

## Night Smoke in the Piedmont

The Piedmont, defined as the region that lies between the Coastal Plain and the Appalachian Mountains, includes parts of Virginia, North and South Carolina, Georgia, and Alabama. The terrain of the area is one of gently rolling hills and valleys bisected by numerous streams and rivers and heavily scored by various sizes of roads. "We took on a very specific task, to write a PC-based program to simulate the movement of ground-level smoke over the complex terrain of the Piedmont at night," says Achtemeier.

Smoke can become a problem at any time during a prescribed burn, but visibility problems occur more frequently in valley bottoms at night. As night falls, air cools rapidly near the ground and wind speeds decline. Smoke begins to accumulate near the ground, especially from smoldering fuels that don't generate much heat. This ground-hugging smoke is carried through the valleys, accumulating at low points and creating hazards where valley drainages cross roads or bridges. Figuring out exactly where smoke goes involves much more than just assuming it will travel down the terrain of the valleys.

"Under certain weather conditions in the Piedmont, smoke can get trapped in shallow layers of air near the ground at night and get carried to unexpected destinations," says Achtemeier. "When it gets confined within valleys, smoke can be slow to disperse. When moist conditions are present—and you know how humid it is in the South—this smoke can easily turn into fog."

Achtemeier stresses that the program he and fellow researchers developed, PB-Piedmont (PB for prescribed burn), is designed strictly to predict the movement of smoke from prescribed burning—not wildfire—

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## *The Southern High-Resolution Modeling Consortium*

In 2001, as part of the National Fire Plan, the Forest Service set up five regional modeling consortia to provide products based on high-resolution weather data. The Southern High-Resolution Modeling Consortium (SHRMC) was set up by the **SRS Southern Smoke Management Team** based in Athens, GA, in collaboration with the University of Georgia Atmospheric Science Program. The SHRMC supplies regional and local weather forecasts to foresters in the Southern Region, which consists of the 13 Southern States from Virginia to Texas. The SHRMC collaborates with other scientists; local, State, and Federal air quality and fire regulators; and other modeling centers as part of various national interagency modeling consortia.

SHRMC provides the physical infrastructure for modeling advances in air quality, fire control, smoke impact, and weather prediction, and for the Internet-based distribution of realtime data to consortium members, natural resource managers, and the public.

**For more information:**
shrmc.ggy.uga.edu/

## Smoke Gets in Your Eyes

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under specific conditions. "PB-Piedmont is a wind and particle movement model that provides the numerical 'eyes' to 'see' where smoke trapped near the ground will go at night. It predicts movement, not concentrations, and addresses problems of complex terrain in areas where ridge and valley height differences are less than 300 feet."

Taking into account the nature of smoke itself—a phenomenon that hasn't been studied extensively—added complexity to the model. "We knew that smoke plumes typically diverge and split into neighboring valleys, and that smoke trapped in a valley gradually 'bleeds' away as air enters the valley, but we had to figure out how to model the process," says Achtemeier. "We designed the smoke model so that particles divide into smaller particles, allowing the model to simulate the bleed out from valleys."

To get at the subtle drift of night smoke, the smoke model was combined with an air flow model developed by Achtemeier that simulates pressure forces that move winds as slow as 4 inches a second. Add to this information about topography and landscape features such as roads, rivers, and streams, then combine it with the most powerful weather data developed so far. What you get is a model that takes up a tremendous amount of computing power and space, much more than a typical natural resource manager would have access to.

### How It Works

PB-Piedmont actually runs on weather data supplied through a high performance computer system set up by the **Southern High-Resolution Modeling Consortium** (SHRMC), a group of State and Federal agencies who joined together to provide the infrastructure needed to run smoke and other models. PB-Piedmont is essentially a "nowcast," updated hourly with surface weather data as it becomes available over the Web. Computing power through the SHRMC makes it possible to run PB-Piedmont predictively out to 72 hours using MM5, the high-resolution weather data developed by a community of scientists and distributed through the National Center for Atmospheric Research.

Achtemeier realized early on that natural resource managers planning prescribed burns would have very specific needs. The model would have to be small enough to fit on a laptop, run faster than real time to make predictions—and still be powerful enough to model smoke on a fine terrain scale. In addition, the model would have to be simple enough to be run by those with no experience with meteorological modeling.

"Keeping the mathematics simple so the model can run rapidly enough to provide timely predictions is a daunting task," says Achtemeier. "That's why we made PB-Piedmont a simplified model designed to run for the specific weather conditions that are associated with smoke entrapment near the ground. You can't apply it to other conditions."

The result is a model easily installed on the user's computer, either from a disk or downloaded from the SHRMC Web site. Two "weather grabbers" are installed with the model: every hour they go to the SHRMC Web site and grab high-resolution weather data. When a manager sits down to plan a burn, the model grabs data for the next 72 hours, plenty of time to track the movement of smoke through critical night and early morning hours—time to decide well in advance whether or not to do the burn.

The movement of smoke predicted by PB-Piedmont has been validated by aircraft video imaging from two experimental night burns, and by nearly 300 ground observations of over 30 prescribed burns. Upgraded several times, the model is now being used to plan prescribed burns by the U.S. Fish and Wildlife Service and the State of South Carolina.

## Superfog Revealed

In March 1997, SRS smoke researchers conducted a 2-night experiment in the Talladega National Forest in western Alabama to validate the PB-Piedmont model. To simulate a prescribed burn, they set afire 50 bales of hay soaked in diesel fuel. Once the hay was burning, they put the fire out with water to create a moisture-laden smolder. They also set off 60 smoke bombs—all of this by the light of the full moon.

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**Smoke models help land managers plan prescribed burns for the least impact.** *(photo by USDA Forest Service, Southern Research Station)*

## Smoke Gets in Your Eyes

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"The only way to observe an entire smoke plume moving along the ground at night is from the air," says Achtemeier. "We knew the patterns smoke makes as it scatters from headlights. We wanted to see if we could observe the whole smoke plume by looking at the moonlight scattered from it."

The site was selected for terrain typical of the Piedmont, safety, and absence of other light sources. The researchers flew over the test fires in a small plane mounted with a light-intensified multispectral video camera, which recorded the formation of smoke on the 2 nights of the experimental burns. Observations from the experiment were nearly identical to results predicted by PB-Piedmont. What the researchers didn't realize at the time was that they had also recorded the formation of superfog on the first night of the experiment.

Superfog occurs when trapped smoke combines with water vapor at just the right temperature and relative humidity to produce zero visibility. Scientists had long suspected the involvement of smoke in the formation of superfog, but they hadn't had many opportunities to observe the phenomenon, which comes on quickly late at night and dissipates just as quickly right before sunrise. Achtemeier saw fog form during the 1997 experiment, but didn't really get the significance of it until he reviewed the video taken that night. He got excited—some would say obsessed—about a phenomenon that some scientists still doubt the existence of.

The various explanations for superfog range from "it's just dense smoke" to the involvement of hygroscopic smoke particles that attract and bond with water molecules, leading to the formation of water droplets that scatter light. Some explanations leave out the smoke particles and attribute superfog simply to the rapid cooling of the moisture coming off smoldering logs and stumps. Achtemeier decided to take a closer look.

In 2002 and 2003, Achtemeier, with systems analyst **Ken Forbus** and electronics technician **Tim Giddens** from the SRS Athens unit, went out to 5 different prescribed burn sites, looking at over 20 individual "smokes" to see if the bulk moisture from smoldering fires alone is enough to trigger superfog. "We'll have to look at the total moisture budget before we can make conclusions, but our preliminary findings indicate that smoldering could add enough moisture to trigger superfog," says Achtemeier. "We did find out that on any one site you can have individual smokes that range from very dry to very moist. Though this may seem intuitive, no one has really tried to document it."

In fall 2003, Achtemeier was out in his backyard raking and burning leaves. He just couldn't stop thinking about smoke and superfog. When he raked over his burning pile, a dense white smoke formed that didn't really disperse, but retained its structure while moving away, eventually breaking into patches and

*(photo courtesy Gary Achtemeier, USDA Forest Service)*

disappearing. Looks like superfog, he thought, so he set up an experiment, using the same instruments to measure relative humidity and temperature he used on the individual smokes out in the field. He started burning some leaves in late evening, when the temperature was relatively low. When he got the fire going, his instrument immediately registered 100 percent humidity. "Turns out I had actually produced superfog in my own backyard. I measured the visibility at less than 4 inches."

Though Achtemeier is convinced that superfog can be caused by smoke—and a very possible result of prescribed burning—others in the scientific community remain unconvinced. But if he's right, his models could prevent road accidents related to prescribed burning. "It may be that there are some very specific conditions in which superfog forms, and if we can isolate these conditions, we might be able to pinpoint within 72 hours the days when prescribed burns should not take place."

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# Air Quality Issues Lead to a New Understanding of Day Smoke

The particulate matter and ozone derivatives produced by both wildfires and prescribed burning have an undeniable effect on air quality. In 1998, the U.S. Environmental Protection Agency (EPA) issued an interim policy to protect public health from the impacts of air pollutants from wildland fires. As part of this policy, the EPA urged the States to develop smoke management programs. Land managers accustomed to planning for smoke hazards needed new tools to look at less visible air quality effects from prescribed fires.

With funding from the 2001 National Fire Plan and the computing power of the Southern High-Resolution Modeling Consortium (SHRMC), the **SRS Smoke Management Team** of **Gary Achtemeier**, **Scott Goodrick**, and **Yongqiang Liu** began developing a research tool, the Southern Smoke Simulation System (SHRMC–4S) to model fire emissions, smoke movement, and air quality effects.

SHRMC–4S integrates the Community Multiscale Air Quality model developed by the EPA with the high-resolution weather prediction data generated by SHRMC with Daysmoke, a program SRS researchers developed to simulate the behavior of smoke plumes from prescribed burning—and to correct assumptions in the prevailing models that might have led to restrictions on an important forest management practice.

"When we started working with the air quality community, we found out that the system being used averaged burns over an entire year, when there are really only 30 days or so in the year that managers can burn on," says Achtemeier. "This greatly exaggerated the air quality effects from prescribed burning. We developed Daysmoke to indicate the exact day and time of burns, and to take into account *how* managers engineer their burns so that smoke sweeps up and away."

And then there is the structure of wildland smoke. EPA particulate models are based on simple smokestack plumes. A prescribed fire incident in spring 2006 caused SRS researchers to change how they look at the structure of smoke from wildland fires—and may change the way particulate concentrations in air are modeled in the future.

In April 2006, smoke from a prescribed burn in Cocke County, TN, jumped over the mountains to find its way into the streets of Asheville, NC. When Achtemeier plugged data from the burn into Daysmoke, the model predicted only a tenth of the particulate concentrations recorded in Asheville. Puzzled, he went to satellite images and ground-level photo images of the event and noticed that what looked like one big plume of smoke on the satellite images was actually made up of many small updraft cores. When he simulated five or six cores in Daysmoke, the model gave a more accurate reading.

"This discovery gave us more answers about why other models were not predicting air quality effects from prescribed burning more accurately," says Achtemeier. "Our next step is to develop an umbrella code that brings all these findings together. When we have that, we'll run a simulation using data from Florida to see how close we are getting to accurately predicting air quality effects."

For Achtemeier, Goodrick, and Liu, even the sky may not be the limit. In the planning stage are products that link short-term and long-term climate data with wildfire, prescribed fire, and smoke management data to look at the effects of climate on wildland fire—as well as the effects of fire in the Southeast on climate.

**For more information:**
Gary Achtemeier at 706–559–4239 or gachtemeier@fs.fed.us.

**SRS researchers developed the Daysmoke program to simulate the behavior of smoke plumes from prescribed burning.** *(photo by Dale Wade, Rx Fire Doctor, www.forestryimages.org)*

# Time to Burn: Getting a Step Ahead of Wildland Arsonists

*by Zoë Hoyle*


Every year, arsonists set over 1.5 million fires in the United States, resulting in over $3 billion in damages. Arson is a leading cause of wildfire in several heavily populated States—Florida, for one. Often set near homes and roads, intentionally set fires cause a disproportionate amount of the damage attributed to wildfire in general.

Research forester **Jeff Prestemon** from the **SRS Economics of Forest Protection and Management unit** in Research Triangle Park, NC, and economist **David Butry,** formerly with the SRS unit and now with the National Institute of Standards and Technology in Gaithersburg, MD, have developed a model to help law enforcement agencies better predict where and when fires might be set in wildland areas—and design strategies to reduce the risk of arson.

## Criminal Dimensions

For other types of crimes, researchers have documented that perpetrators often commit multiple offenses in a short time frame, a "spree" phenomenon described as *temporal clustering*. Individuals committing property or violent crimes also often commit multiple crimes within a certain area, adding a second dimension of *spatial clustering*. In a pair of studies, Prestemon and Butry set out to test whether spatio-temporal clustering could also be observed in wildland arson. They also looked at the relationship between socioeconomic factors and incidences of wildland arson—adding yet another dimension by describing the fire-setting process in the context of the economics of crime.

"Even though the economic damages from wildland arson are often staggering, research into the factors that contribute to it has been limited to a few published studies," says Prestemon. "Models of wildland arson have mostly related fire setting to weather, seasonal trends, and law enforcement, ignoring the socioeconomic variables used to predict other types of crime."

"At the same time, no one had previously identified the spatio-temporal dimensions of wildland arson that we found," says Butry. "Our findings have uncovered a new avenue of fire research, deepened our understanding of arsonist behaviors, and revealing another way in which humans and society interact with the environment."

## Patterns Emerge

Two studies revealed similar spatio-temporal patterns for arson as for other crimes. In one study in Florida, Butry and Prestemon evaluated wildland arson as both an annual and a daily process. Using annual data from all Florida counties for 1995 to 2001, their model revealed the influence of law enforcement, wildland fuels, poverty, and labor conditions on the rates of ignitions recorded for the State.

To measure fine temporal patterns of arson, the researchers parsed the 1995 to 2001 data into daily observations. They focused this fine-scale analysis on nine counties in Florida with high rates of arson. Their model identified temporal clustering that lasted up to 11 days—implying higher risk of repeat arson ignitions for 11 days following the initial fire. This kind of pattern had never before been found in any research into human-ignited wildfires.

In a second study, Butry and Prestemon measured the spatial as well as temporal clustering of arson wildfires using a different set of data—daily information for the six U.S. census tracts in Florida with the greatest arson activity. Their statistical results showed that an arson event in one census tract was related to arson in the neighboring tracts for up to 11 days, and in the same tract for up to 10 days.

"Not only did we confirm our findings from the previous study, but we also showed that arson clusters in both space and time," says Butry. "In other words, you can use arson events in one tract to predict future ignitions in the same or adjacent tracts for several days."

## How to Get Ahead of Wildland Arsonists

"Combining the patterns we found with data on law enforcement led us to conclude that there *are* strategies that law enforcement can use to prevent wildland arson," says Prestemon. "They can closely monitor areas where fires have been set before. They can also increase arson enforcement on days of the year when events are more common, and during droughts."

From their studies, Prestemon and Butry also found that locations with difficult economic conditions—low wages and high poverty rates—have higher rates of wildland arson, a finding consistent with other economic models of crime. They also found that forest management activities are related to wildland arson, with fuel reductions from prescribed burning and other wildfires correlated with lower arson rates.

"This finding is also consistent with an economic model of wildland arson crime, where lower fuels increase the cost of successfully starting fires," says Prestemon.

The next step is to test the model in other locations to see if the statistical results hold true in other States, and even further, to conduct new research on what motivates people to set damaging fires. "We need to direct some of our effort into understanding who arsonists are and what, precisely, makes them behave the way they do," says Butry. "If we could add feedback from convicted wildland arsonists, we could really enhance our understanding of how they choose where and when to set fires. Incorporating this information into the model would raise its predictive value to law enforcement and give more insight into an important social problem."

**For more information:**
Jeff Prestemon at 919–549–4033 or jprestemon@fs.fed.us

David Butry at 301–975–6136 or David.Butry@nist.gov

# Southern Wildfire Risk Assessment

Wildfire is a serious threat to lives, property, and economic and natural resources in the South. To address this threat the Southern Group of State Foresters (SGSF), a nonprofit organization consisting of State foresters from each of the 13 Southern States, contracted with Sanborn, a company which offers photogrammetric (developing maps from photographs) and Geographic Information System mapping services to develop a wildland fire risk assessment for the area covered by the Southern States. Partners in this effort included the Forest Service Southern Region, U.S. Fish and Wildlife Service, and USDI National Park Service, and the Bureau of Indian Affairs.

An ongoing process to assess risks as well as values to be protected, the Southern Wildfire Risk Assessment (SWRA) is a tool that will help fire managers predict and target more precisely those areas that are at high risk for wildfire, and allows agencies and organizations at the national, State, and local levels to obtain a clearer picture of the overall potential for wildland fire and associated problems. Some of the elements included in the assessment are fire occurrence, fire behavior potential, suppression effectiveness, fire effects, and communities at risk.

The **SRS Southern Center for Wildland-Urban Interface Research and Information** has partnered with SGSF to develop *Fire in the South II*, a publication about the top 10 findings of the SWRA. Due for completion in mid-2007, the publication will build on the first *Fire in the South*, which introduces the risk assessment in its early stages, describes characteristics of the South that contribute to the wildland fire problem, and discusses solutions to the wildland fire problems in the South.

**For more information** about SWRA, or to download a copy of *Fire in the South*, go to: dev.sanborn.com/swra/content/deliverables/index.htm.

# Changing Roles: Wildland-Urban Interface Professional Development Program

Natural resource agencies are being called upon to provide solutions to increasingly complex challenges at the wildland-urban interface (WUI). Communities are growing rapidly, landowners' management goals often conflict, residents may not understand the benefits of resource management, and the resulting risks to environmental quality and human quality of life are becoming more apparent. To help meet these needs, the Southern Group of State Foresters led a partnership with the **SRS Center for Wildland-Urban Interface Research and Information**, the University of Florida School of Forest Resources and Conservation, and the U.S. Fish and Wildlife Service to develop a WUI professional development program. This program provides State and Federal natural resource agencies with a set of flexible resources to conduct their own training programs aimed toward building skills and tools to successfully tackle WUI issues.

## Module Topics

Findings from the Forest Service report *Human Influences on Forest Ecosystems: Southern Wildland-Urban Interface Assessment* and discussions with agency leaders were used to form the four modules used to train natural resource professionals working in the WUI:

- Module 1: Interface Issues and Connections—introduces participants to key WUI issues and how they are interconnected.
- Module 2: Managing Interface Forests—provides tools and knowledge for effectively managing fragmented forests in the WUI, including management practices appropriate for the interface; equipment and systems for small forests; managing for wildlife, fire, water, and visual and recreational amenities; enterprise opportunities for landowners; and forest cooperatives.
- Module 3: Land Use Planning and Policy—explains land use decisionmaking tools, and how natural resource professionals can get involved in local decisionmaking and land use planning processes.
- Module 4: Communicating with Interface Residents and Leaders—discusses key tips for effective communication with WUI residents and community leaders.

## Program Features

A number of different materials are provided to allow trainers to select those that best meet their objectives:

- Trainer's guides introduce the topic with key points for training emphasis.
- Exercises provide an interactive opportunity for participants to discuss and apply what they are learning.
- Fact sheets outline important points, strategies, and information for participants and trainers if they want additional background material.
- Presentations in Microsoft PowerPoint® enable trainers to easily present background information to participants.
- A set of case studies provides examples of interface challenges as well as success stories from across the South.
- The video *When Nature Is at Your Doorstep*, produced as part of this project, introduces WUI issues to program participants, and can also be used for public outreach.
- A bibliography of books, articles, Web sites, programs, and other tools pertaining to each module subject matter is provided.

To view and download the WUI Professional Development Program materials, visit: www.interfacesouth.usda.gov/products/training/changing_roles.html.

**For more information contact:**
Annie Hermansen-Báez, at 352–376–3271 or ahermansen@fs.fed.us.

# Wood to Energy: An Outreach Program

The Southern United States produces nearly 60 percent of the Nation's wood; projections show that it will continue to be the leader into the future. Many of these southern forests are located in the wildland-urban interface (WUI). As urban centers spread, large areas of once primarily contiguous forestland are increasingly surrounded by or with urban development; the South already has more cities with forests within 50 miles than any other part of the United States.

## Biomass Sources in the Wildland-Urban Interface

The South is a prime location for using woody biomass to produce energy. The close proximity of forests to urban areas means a continuous source of biomass fuels without excessive transportation costs. Small-diameter trees in many areas need a new market, since the pulp and paper market is moving offshore where fiber can be produced at a lower cost. Biomass energy producers near plantation forests can benefit from forest thinnings and commercial logging residues.

Urban wood waste from yard trimmings, municipal solid waste, utility line clearings, invasive plant removal, native plant restoration, and land clearing for development can also be used as biomass fuels. Providing a source of energy could add incentive for landowners to thin dense or diseased forests to mitigate forest fire risk. Short rotation woody crops are another potential source, as is debris from hurricanes and other natural disasters.

## The "Wood to Energy" Program

In WUI communities where both the necessary technology and adequate supplies of biomass are available, there is still a need to educate concerned citizens, community leaders, and those who can supply and use woody biomass for energy production.

To meet this need, a biomass outreach program titled "Wood to Energy" is being developed through a partnership between SRS, the University of Florida, the Southern Region Cooperative Extension Service, and the Southern States Biobased Alliance of the Southern States Energy Board. The program is funded through the USDOE/USDA Biomass Initiative; its goal is to encourage the use of woody biomass for bioenergy production in communities at the wildland-urban interface in the 13 Southern States and Puerto Rico.

**For more information:**
Annie Hermansen-Báez at
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WOOD to ENERGY

**The South is a prime location for using woody biomass to produce energy.**
*(photo by Lauren McDonell, University of Florida)*

# Landscaping to Reduce Fire Risk

*by Annie Hermansen-Báez*

You probably weren't thinking about wildfire when you landscaped your yard. If you live in a fire-prone area, you might want to think again. The good news is that SRS research can help you plant in a way to reduce the risk of fire reaching your home.

When researchers at the **SRS Southern Center for Wildland-Urban Interface Research and Information** asked fire specialists across the South about their information needs, many responded that they needed to know more about the flammability of the plants and mulches used in southern landscaping. This kind of information is particularly important where homes are close to or within fire-prone natural areas. Although all plants will burn with the right conditions, some species are less flammable than others, making them more desirable for firewise landscaping.

Mulches are another factor that can increase the risk of fire reaching your home. "To make your home safe from fire doesn't mean no landscaping," says **Alan Long**, University of Florida (UF) professor and SRS collaborator. "It means choosing the proper plants and mulches."

## The Right List of Plants

Homeowners interested in landscaping to reduce the risk of fire often look for a list of landscape plants with low flammability to guide their selections. The few lists available are usually based on observation or anecdotal evidence, rather than on research. They may include related species found on firewise plant lists from other parts of the country; even though related, plant species from other regions do not necessarily have the same flammability as species found in the South. There is a real need for accurate lists.

"Extension personnel and fire professionals that I contacted were looking for lists of firewise plants to give to wildland-urban interface residents they're working with," says **Anna Behm Mosozera**, UF researcher on the firewise landscape project. "They saw firewise lists as a key component in helping residents make informed decisions about landscaping in fire-prone areas."

To address this need, SRS researcher **Wayne Zipperer** and collaborators at UF and the National Institute of Standards and Technology (NIST) are conducting a series of studies to evaluate plant flammability. Behm Mosozera led a preliminary study on the flammability of shrubs found in the understory of the pine flatwoods and hardwood hammock ecosystems of the southern Coastal Plain, and came up with four measures that could be used to rank plant flammability: ignitability, sustainability, combustibility, and consumability. The research focused on shrubs because previous postfire assessment studies indicated that the presence of shrubs was a key contributing factor to whether a home was damaged or destroyed by a wildfire.

Based on results from this study, the researchers developed a flammability key that urban foresters, extension agents, and others can use to create firewise plant lists for homeowners in the areas where they work. The step-by-step ranking method is based on easy-to-identify characteristics such as type of plant (tree, palm, shrub, or vine); distance between the ground and branches; texture of the bark or leaves (coarse, medium, or fine); denseness of the plant; and other factors. After completing all of the steps, the

**Landscaping—either by using horizontal separation or by using plants with low flammability—can reduce the risk of fire to houses.** *(photo by Larry Kohrnak, University of Florida)*

resource professional can identify plants as "not firewise," "at-risk firewise," "moderately firewise," or "firewise." Behm Mosozera cautions that though this method is a great way to make your own local plant list, it should also be compared to other sources of information such as local fire experts.

In another study, the same researchers looked specifically at the flammability of 34 noninvasive shrub species commonly used in landscaping across the South. Fire specialists in many Southern States helped determine the shrubs to be tested by filling out a survey. Once the shrub species were selected, comprehensive burn trials were conducted under controlled conditions at the NIST Building and Fire Research Laboratory in Gaithersburg, MD. Flammability measurements were taken, such as: time until ignition, heat release rate, and maximum flame height. From these studies a flammability ranking of the 34 shrubs was generated for use by fire professionals in the South. This information also helped to validate and refine the flammability key. The research team hopes to expand this study to include more species in the future.

## Safe Mulching

Another study is investigating the flammability of four mulches commonly used around homes—pine straw, shredded cypress, and small- and large-chunk pine bark nugget. Many people use these

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**Flammability study on pine-straw mulch.**
*(photo by Wayne Zipperer, USDA Forest Service)*

## The Four Components of Plant Flammability

In the firewise landscaping context, flammability refers to the ability of a plant to ignite and transfer heat and/or flames to surrounding plants or structures. Plants are flammable for different reasons; some plants ignite quickly, but also burn off quickly. Other plants are not easy to ignite, but can burn for a long time once ignited. Flammability is made up of four components:

- **Ignitability**—the length of time until a plant starts burning when exposed to a flame or other heat source
- **Combustibility**—how rapidly or intensely a plant burns: the rate of spread and rate of heat (or energy) given off from a burning plant
- **Sustainability**—the length of time the plant will sustain a fire
- **Consumability**—how completely the plant burns, or the quantity of the plant that is consumed during a fire

## What Do We Mean by "Firewise" Landscaping?

Generally speaking, to be "firewise" is be adequately prepared for the possibility of wildfire. In this sense, firewise consists of many components, including: community design, escape routes and plans, construction materials, and landscaping. Firewise landscaping involves modifying the landscape around the home to create a "defensible space." Within this space, plantings should be separated both vertically and horizontally to break up vegetation and reduce the amount of fuel available for fire spread. Creating defensible space also improves access for firefighters and their equipment. In addition, it is recommended that landscape plants with low- or moderate-flammability characteristics be used in the defensible space.

**For more information:**
www.firewise.org

## Landscaping to Reduce Fire Risk

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mulches directly up to and in contact with their homes, yet little is known about their flammability. "The information we are collecting will help homeowners determine the best mulch type to have around their homes in the event of fire threat," says **Brian Hinton**, UF researcher who is working on the project with SRS researcher Zipperer.

In initial tests burning pine straw and large-chunk pine bark nuggets, temperatures reached 700 to 800 degrees at 4 inches above the mulches. The smaller pine bark chunks reached 400 to 500 degrees, and the shredded cypress reached 300 to 400 degrees. Ignition temperatures for most fuels are usually in the range of 600 degrees. Pine straw tended to flare up immediately, while both sizes of pine bark nuggets tended to smolder and continue to generate heat over a longer period of time.

The ability of mulches to hold moisture was found to be a critical factor influencing their flammability. The study is looking at how fire spreads across mulch and from mulch to plants, and how the arrangement of plants affects how fire spreads to homes. Zipperer cautions that if you live in a fire-prone area, mulches should not be placed immediately adjacent to structures, regardless of mulch type. Final results from this study will be available next year.

Information about plant and mulch flammability will help homeowners to plan their landscapes to reduce fire risk and still retain many of the other landscaping benefits they desire, such as creation of wildlife habitat, conservation of energy and water, and aesthetics. This information will also help improve predictive fire models—and ultimately, develop more firewise communities.

**For more information:**
Annie Hermansen-Báez at
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**To access the flammability key:**

www.interfacesouth.org/products/fact_sheets/Preparing_Firewise_Plant_List.pdf or

www.interfacesouth.org/products/flammability_key.html

**For more information about these flammability studies and other related projects:**

www.interfacesouth.org/products/research.html

*(photo by Larry Kohrnak, University of Florida)*

# Tips for Reducing Wildfire Risk While Achieving Other Landscaping Goals

*by Sara Sillars*

As people continue to move into the wildland-urban interface, firewise landscaping becomes more important for protecting homes and families from wildfires. Firewise landscaping can seem to conflict with other landscaping goals such as creating wildlife habitat or conserving water and energy, but few differences actually exist. In those instances where there are conflicting objectives, small modifications such as the following can be made.

## Avoid flammable plants near your home

Firewise planting discourages planting shrubs and trees near the home; conversely, energy conservation landscaping principles recommend that trees and shrubs be placed close to the home for shading. To resolve this conflict, select shrub and tree species with low flammability. Leave 2 to 3 feet between shrub branches and your home, and trim shrubs to stay 2 feet below the windows. Trim tree branches up to 10 feet.

Well-maintained lawns have low flammability and are often used in firewise landscaping, but lawns are not recommended for creating wildlife habitat or conserving water. A compromise is to keep a well-maintained lawn in high-traffic areas around the house and plant alternative ground covers in low-traffic areas and on the outer edges of the defensible space (defined as an area of modified vegetation extending at least 30 feet from the house in all directions). Some alternative ground covers include stones and organic mulches and plants of low flammability.

## Maintain vertical separation

While firewise landscaping recommends reducing the vertical layering of vegetation, landscaping for wildlife encourages it for cover and habitat. If you live in an area at high risk of fire, you should give priority to firewise landscaping and maintain vertical separation within the defensible space. Beyond the defensible space, islands of vertically layered vegetation can be created as long as they are separated horizontally by areas cleared of dense vegetation.

## Clear dead plant material and organic mulches away from the home

Removing dead plants and brush piles is recommended for firewise landscaping, but those plant materials provide excellent wildlife habitat. If the property is large enough, small isolated brush piles, snags, and other dead plant materials can remain as long as they are more than 60 feet from the home.

Firewise landscaping discourages the use of organic mulches close to the home due to their potential fire hazard; however, mulches are useful in landscaping for water conservation. To reduce potential fire risk, maintain an area 2 to 3 feet out from the home as bare ground or covered by rock or gravel. Choose organic mulches of low flammability.

**For information on selecting plants based on flammability:**

*Selecting and Maintaining Plants for Firewise Landscaping* at www.interfacesouth.org/products/fact_sheets/Selecting_Maintaining_Firewise_Plants_Landscaping.pdf.

**For more information:**
Annie Hermansen-Báez at 352–376–3271 or ahermansen@fs.fed.us.

*Sara Sillars is employed by the University of Florida as a technology transfer intern at the Southern Center for Wildland-Urban Interface Research and Information.*

*(photo by Larry Kohrnak, University of Florida)*

Landowner's TOOLBOX

www.srs.fs.usda.gov

# Three Communities on the Edge

*by Perdita Spriggs*

Combining resources is essential to addressing emerging issues in the South. The **SRS Southern Center for Wildland-Urban Interface Research and Information** (the WUI Center) located in Gainesville, FL, actively partners with a variety of organizations—including local, State, and Federal agencies, universities, and nongovernmental organizations—to ensure that the research it conducts is relevant, and that information reaches communities that can benefit from it.

Locales with wildland-urban interface issues particularly benefit from science-based collaborative efforts that offer solutions to urbanization driven challenges. Three such SRS partnerships—with the University of Georgia (UGA), Auburn University, and American Forests—exemplify the strength of cooperation in solving natural resource issues that have crept over city limits.

## What Works in Tree Canopy Policies

Trees in cities provide shade on those long summer days, but they also ensure important ecological services such as clean water and air, as well as reduce the urban heat island effect from concrete and other hard surfaces. Good tree canopy cover also provides decreased energy bills, increased property values, and urban wildlife habitat.

As cities such as Atlanta, GA, continue to expand at a phenomenal pace, the area covered by tree canopy rapidly decreases. Researchers from UGA, in collaboration with the WUI Center, are studying the impact of county- and city-level land use polices on tree canopy coverage. Determining which government policies help preserve or increase tree canopy should also identify environmentally friendly ordinances.

"We need to understand the role policy plays in urban tree canopy," emphasizes **Ed Macie**, who serves a dual role as team leader for the WUI Center and as regional urban forester for the Forest Service, Southern Region Headquarters in Atlanta. "Our goal is to communicate to local land use decisionmakers the impact of tree canopy on the environment."

The 2-year study encompasses the 10-county metro region around Atlanta and involves digitizing and calculating tree canopy coverage from Geographic Information Systems (GIS) data, then tying it to variables such as income, education, employment, and population growth. An Internet survey will also query planners, natural resource professionals, and environmental organizations to gain an impression of the effectiveness of local tree canopy ordinances. Once the data is complete, researchers will determine the correlation between the

**The SRS WUI Center collaborates with a variety of partners to address wildland-urban interface issues in communities across the South.** *(photo by Larry Kohrnak, University of Florida)*

changes in tree canopy and the local policies in place.

"Right now, we don't know which policies are doing a good job," says **Jeff Dorfman**, professor in UGA's Department of Agricultural and Applied Economics. "Many local governments have tree ordinances that restrict owners and builders. However, no one knows which policies are the most effective."

**For more information:**

Ed Macie at 404–347–1647 or emacie@fs.fed.us.

## Rapid Change Comes to the Florida Panhandle

Florida's population continues to grow at one of the fastest rates in the Nation, with the Florida Panhandle preparing for rapid changes in land ownership over the next few years. Massive development is already following the transition of the St. Joe Company, Florida's largest landowner, from timber company to major land developer. Though development could bring some positive changes—increased jobs, health care services, and educational opportunities—it could also greatly affect the natural systems of the area if not properly done.

Working with Auburn University's Center for Forest Sustainability, the WUI Center initiated predevelopment research on the areas slated for rapid change. These studies will look at ecological, social, and economic issues in the area, their interrelation, and the influence of urban development.

"Normally, studies would come in much later, after the development has occurred," says **Wayne Zipperer**, research forester at the WUI Center. "We have the unique opportunity to sample particular areas before development and compare that data to the postdeveloped state."

The project will use an integrated approach to develop specific land use and cover data, primarily through vegetation analysis, water sampling, and socioeconomic studies. Using forest health monitoring protocols, researchers will monitor changes in forest conditions and compare them to national values.

**Graeme Lockaby**, codirector for the Center for Forest Sustainability at Auburn, agrees that the results will have far-reaching impacts. "We will be able to monitor changes as development occurs, determine which are positive or negative, and provide guidance on making development more compatible with the remaining forests."

The long-term project will also involve participant research by maintaining close connections with residents, developers, and environmentalists as the study progresses, engaging their input in a "living and breathing" research effort.

**For more information:**

Wayne Zipperer at 352–376–4576 or wzipperer@fs.fed.us.

## Post-Katrina Analysis Aids Gulf Coast Recovery Efforts

Hurricane Katrina wrought devastating damage to the Gulf Coast region. The physical composition of tens of thousands of square miles, including forests and streams, was changed, with 100-percent loss of forest canopy cover in some areas and an average of 40 percent loss in most communities. As the recovery process continues, WUI Center researchers and American Forests, the nation's oldest nonprofit citizens' conservation organization, have partnered to analyze hurricane impacts to natural systems, with primary emphasis on wildfire susceptibility and the loss of ecosystem services. Analyses planned include measuring the risk of fire, based on fuels and conditions, to provide data to State foresters

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## Three Communities on the Edge

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for a fire-risk management system. Additionally, researchers will use ecosystem analysis formulas to measure changes in stormwater management, air pollution removal, carbon storage, and carbon sequestration functions. The resulting data will be extremely useful to local decisionmakers during the rebuilding process.

"We want to better understand the impact on ecological services such as air and water quality, and determine the value of what has been lost," explains Macie, who manages the cooperative agreement and is also an advisor to American Forests. "We will also have a better idea of the impact catastrophic events have on our ecosystem, and be able to more clearly communicate the need for emergency support funds to help with recovery efforts."

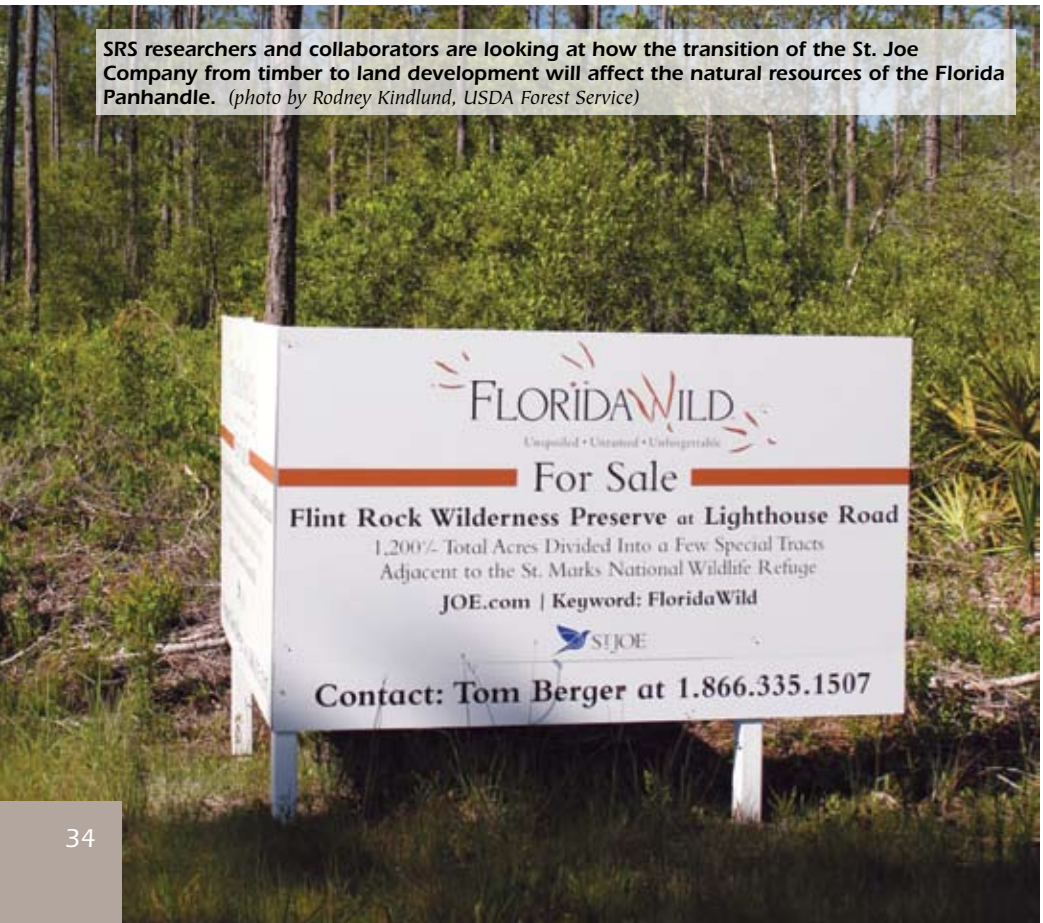
The 2-year project, covering nearly 200 square miles, will use GIS data, satellite imagery, and aerial photos to detect land changes, assess the loss of tree canopy cover, and quantify the value of lost ecological services. GIS files that mirror the shape of a city or county will be used to provide an ecological analysis of existing land features and assist in determining future plans for rebuilding.

"We don't make decisions for the community, although we will run rebuilding scenarios that they request," says **Gary Moll**, vice president of the Urban Forests Center at American Forests. "Ultimately, we provide them with the data, tools, and training to look at areas, determine their ecosystem services, and decide how to mix those into the community."

Local communities will have the training and data, in a usable and simplified desktop format, to rerun analyses with new data as needed. Study results should underscore the importance of local community involvement in restoration activities and provide insight to better plan communities to minimize and mitigate catastrophic events.

**For more information:**

Ed Macie at 404–347–1647 or emacie@fs.fed.us.




**SRS researchers and collaborators are looking at how the transition of the St. Joe Company from timber to land development will affect the natural resources of the Florida Panhandle.** *(photo by Rodney Kindlund, USDA Forest Service)*

# RECOMMENDED READING

Most of the technical reports and articles listed below are available in full text PDF format from the SRS publications database at www.srs.fs.usda.gov/pubs/, or from Treesearch, the USDA Forest Service Research and Development Publications online database, at www.treesearch.fs.fed.us/.

Products of the **SRS Southern Center for Wildland-Urban Interface Research and Information** can be found at www.interfacesouth.usda.gov/.

### Seeing the Houses Through the Trees

Macie, E.A.; Hermansen, L.A., eds. 2002. **Human influences on forest ecosystems: the southern wildland-urban interface assessment.** Gen. Tech. Rep. SRS–55. Asheville, NC: U.S. Department of Agriculture Forest Service, Southern Research Station. 159 p.

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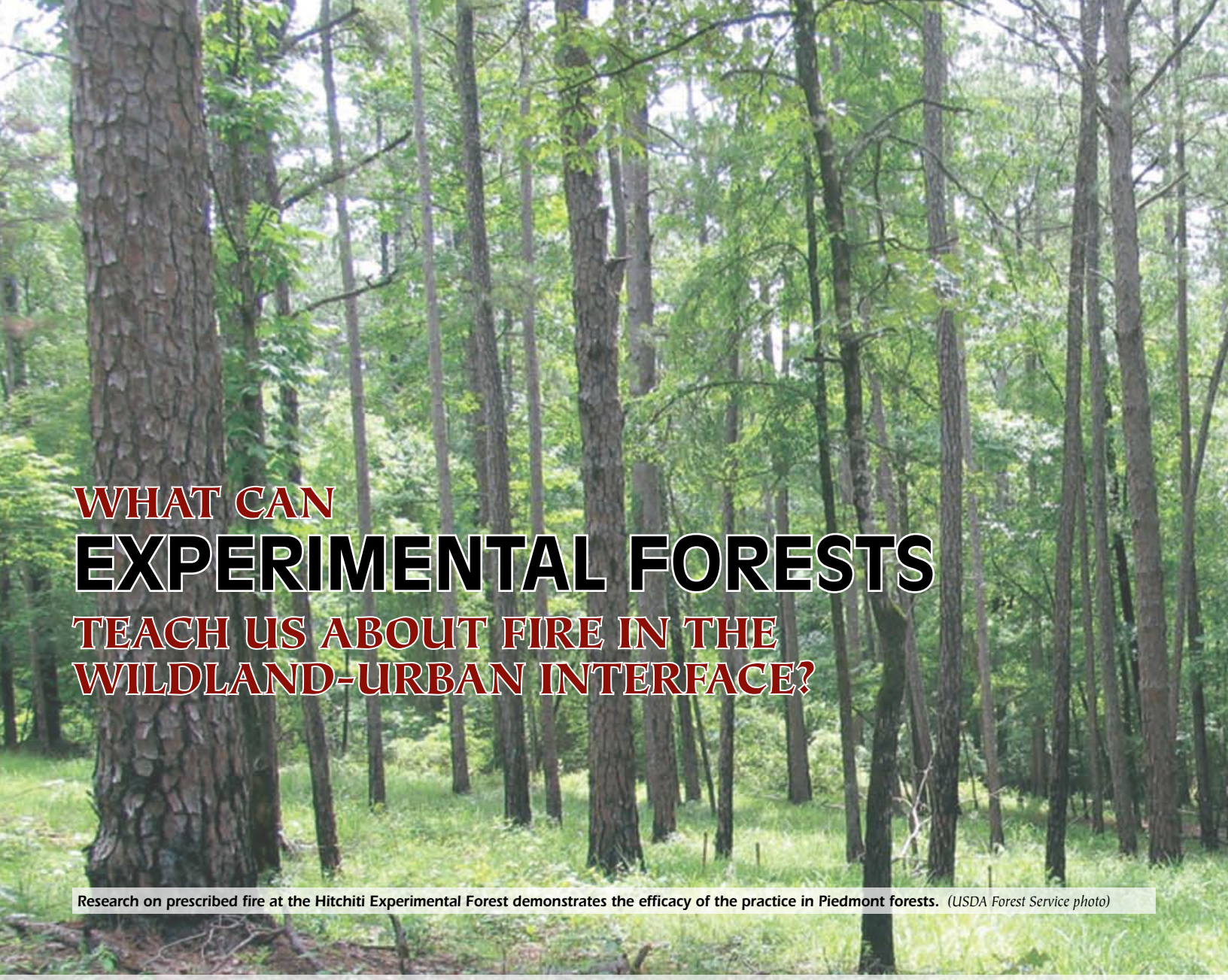

# WHAT CAN EXPERIMENTAL FORESTS TEACH US ABOUT FIRE IN THE WILDLAND-URBAN INTERFACE?

**Research on prescribed fire at the Hitchiti Experimental Forest demonstrates the efficacy of the practice in Piedmont forests.** *(USDA Forest Service photo)*

***Since the 1920s, the USDA Forest Service has maintained a system of experimental forests to test hypotheses and collect long-term data about the ecological effects of fire, grazing, insect infestations, air pollution, and other disturbances. In the South, researchers from Federal agencies and universities use 15 active experimental forests for studies ranging from the practices needed to maintain healthy forests, to the water filtration functions of forests, to habitat restoration for endangered species.***

***Experimental forests are some of the few places in the United States where long-term data are collected about forests and how they change over time. These living laboratories also serve as demonstration sites where cooperators and landowners can see the results of different forest management options.***

Located in the Georgia Piedmont near Juliette, GA, the **Hitchiti Experimental Forest** (Hitchiti) was established by President Franklin D. Roosevelt in 1939 on abandoned farmland purchased by the Federal Government. The 4,735-acre experimental forest has hosted more than 30 years of research on loblolly pine—and more recently, prescribed fire. It is also known as the Brender Demonstration Forest, which was established in 1987 by the SRS, the Georgia Forestry Commission, and the Southern Industrial Forest Research Council to showcase pine management for nonindustrial private landowners.

Prescribed fire may not seem like a wildland-urban interface issue, but with 6 to 8 million acres burned annually, planned burning is an important forest management tool that often runs counter to the needs of the increasing number of homeowners who live near forests in the South. Research on the most efficient methods to conduct and manage prescribed burns allows resource managers to continue this important practice as population grows in the southern region.

The Piedmont, roughly defined as the area between the Appalachian Mountains and the Atlantic Coastal Plain, extends from Maryland to Alabama. In the 1800s, much of the region was cleared for farming, resulting in extensive erosion and in some areas, soil depletion from cotton production. Areas abandoned in the 1900s were recolonized by a mixture of native hardwood and pine trees, with significant acres in loblolly pine—often called old-field pine because it could produce dense seedling stands from a few mature fencerow trees. Today about one-third of Piedmont forestland is covered by stands of loblolly or shortleaf pine. Hardwood-dominated forests, mainly oak and hickory, cover another third of the region; another 20 percent is dominated by a mixture of oak and pine.

## Back to the Burn

Most of the Hitchiti is in second- and third-growth forest, with stands containing loblolly and shortleaf pine mixed with hardwoods. Yellow-poplar and black walnut plantations are also found on the experimental forest. Centuries before, Native Americans maintained the pine-dominated stands of the Georgia Piedmont by frequent burning. Lightning-ignited fires were actually rare, since most of the storms in the area come with significant rainfall. A period of fire suppression followed reestablishment of forests in the 1930s, when pine stands were often replaced by hardwoods or developed dense hardwood understories. Prescribed burning is again being used to restore open pine forests for key species such as the red-cockaded woodpecker and to reduce fuels for wildfire.

Though the use of prescribed fire to maintain the health of southern forests, promote seed production in fire-dependent plants, and benefit wildlife is almost universally accepted, the practice has become increasingly difficult as more people move closer to forests. Prescribed burning does have negative impacts, mostly related to the smoke it produces. Smoke particles can aggravate health problems, lower regional air quality, and reduce visibility on roads and bridges. Though some people question the continued use of burning, stopping or even limiting its use would quickly lead to more of the thick forest undergrowth that feeds destructive wildfire. Scientists from multiple SRS research units work with a wide range of cooperators to find the best and safest ways to use fire to restore and maintain forests.

In 1989, a team of scientists led by SRS researcher **Dale Wade** established a series of plots on the Hitchiti to test burning regimes—using different seasons and frequencies—on fuels and the understory and overstory composition of Piedmont forests. They tested responses to six different treatments in a stand of naturally regenerated loblolly and shortleaf pines that had not been burned in over 50 years, tracking results by periodic measurements and surveys. Each treatment was replicated four times, with the 15-year measurements taken in 2004. **Kenneth Outcalt**, SRS research plant ecologist based in Athens, GA, took over management of the study when Wade retired in January 2003. "There are only a handful of studies like this in the South," says Outcalt. "This is the only one that I am aware of in the Piedmont, or in these mixed pine and hardwood stands."

## Visual Proof of Benefits

Because the plots are located along a major road—and next to the popular Hitchiti Hiking Trail—researchers and foresters use the research plots to demonstrate the effects of prescribed burning to the public, the difference readily apparent between plots where fire has been excluded and those that have been burned frequently at low intensities. A competitive grant from the Joint Fire Science Program was used to fund a permanent outdoor display, individual treatment plot signs, and a fact sheet for a self-guided tour of the prescribed burn study.

The 15-year measurements showed that even infrequent burning will control the hardwood saplings and woody undergrowth that begin to take over forest understories. Burning also increases the herbaceous cover in the understory, often a desirable goal in restoration and wildlife recovery efforts—and it doesn't affect the large pines that house the red-cockaded woodpecker. Though prescribed fire will not reduce a hardwood midstory, the practice gives managers a starting point for other options. "Burning every 3 to 4 years is all managers need to do to keep fuel loads down and reduce wildfire hazard," says Outcalt. "If a manager wants to create red-cockaded woodpecker habitat, they need to thin overstory, remove midstory, and burn on a regular basis."

As a demonstration forest, the Hitchiti has an on-site manager and staff who provide outreach and tours to interested groups. The prescribed burn study is a featured stop on tours conducted for other researchers, land managers, foreign scientists, students, State and Federal employees, and the interested public. The experimental forest also includes an arboretum of native Georgia trees, two interpretive walking trails, and the Hitchiti Natural Area. *–ZH*

**For more information:**
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# around the STATION...


Experimental Forests

| | | |
|---|---|---|
| 1 | Bent Creek | NC |
| 2 | Blue Valley | NC |
| 3 | Coweeta | NC |
| 4 | John C. Calhoun | SC |
| 5 | Santee | SC |
| 6 | Scull Shoals | GA |
| 7 | Hitchiti | GA |
| 8 | Olustee | FL |
| 9 | Chipola | FL |
| 10 | Escambia | AL |
| 11 | Tallahatchee | MS |
| 12 | Delta | MS |
| 13 | Harrison | MS |
| 14 | Palustris | LA |
| 15 | Stephen F. Austin | TX |
| 16 | Crossett | AR |
| 17 | Alum Creek | AR |
| 18 | Sylamore | AR |
| 19 | Henry F. Koen | AR |

## Emerging Issues Along Urban/Rural Interfaces Conference

**April 9–13, 2007, Atlanta, GA**

The pace of urbanization is accelerating in many parts of the world, leading to rapidly changing environmental conditions along urban-rural interfaces. In turn, these changing conditions are creating new ecological and societal challenges and opportunities. This conference, which will take place April 9–13, 2007, in Atlanta, GA, seeks to bring together researchers, practitioners, and policymakers to share current research results and to identify knowledge gaps regarding the interaction between urbanization and natural resources. In particular, approaches that focus on integrating socioeconomic and ecological research will be highlighted. There is funding available to help undergraduate and graduate students attend the conference, and special time will be set aside for personal interaction between keynote speakers and students.

Paper topics include: how ecosystems are being altered by human influences—direct and indirect stressors, restoring and rehabilitating terrestrial and aquatic ecosystems altered by urbanization, how urbanization alters the characteristics of natural disturbances, the relationship(s) between land use policies and ecological processes and disturbances along wildland-urban interfaces, spatial and scale aspects of land use change, and many more.

Sponsors include Auburn University's Center for Forest Sustainability, the SRS Southern Center for Wildland-Urban Interface Research and Information, and the National Science Foundation.

**For more information:**

www.sfws.auburn.edu/urbanruralinterfaces/
or contact David Laband at 334–844–1074 or labandn@business.auburn.edu.

## August Conference Represents Step Forward for Science Delivery

*Report from the Southern Region Conference on Technology Transfer and Extension in Natural Resources held in Hot Springs, AR, August 2–4, 2006*

*by Mike Rauscher*

For the first time in recent memory, specialists in natural resource technology transfer and science delivery from across the Southern United States gathered together at one conference to share experiences and consider new ideas. Southern Regional Extension Forester **Bill Hubbard** served as program chair and master of ceremonies for the conference, which brought together professionals in technology transfer and science delivery from the SRS, Forest Service State and Private Forestry, State forestry agencies, and university extension. Unlike their science program counterparts, professionals in technology transfer and science delivery have rarely held regional meetings of this type. The knowledge exchange that took place over the 3 days was met with enthusiasm by both presenters and participants, with many expressing the desire to continue this

new tradition of sharing professional experiences.

**Ann Bartuska**, Deputy Chief for Research and Development with the Forest Service, gave the first keynote speech. Dr. Bartuska emphasized that the natural resource research community needs to assiduously focus on science that people can use. She pointed to several SRS science application partnerships—the **Southern Center for Urban Forestry**, the **Southern Center for Wildland-Urban Interface Research and Information**, and the **Forest Encyclopedia Network Partnership**—as important cooperative efforts that capture useful scientific knowledge, transform it into understandable packets, and make it immediately and inexpensively accessible to a broad range of audiences. The second keynote speaker, **Martha Monroe**, University of Florida extension specialist, provided a conceptual framework for the full range of technology transfer and science delivery functions. She emphasized that different approaches are required for different audiences, especially audiences who do not know yet that they need our information.

Conference attendees agreed on two concrete decisions: first, to establish a technology transfer/science delivery working group to raise and discuss important issues and opportunities to serve the public in the South better; and second, to perform a systematic assessment of forestry and natural resource target audiences to identify the most effective means of reaching those audiences, especially currently underserved audiences. This audience analysis will also assess how well our scientific knowledge has penetrated into different populations of audiences, again with special attention to underserved audiences. Once target audiences are identified and their needs understood, we can design and implement periodic monitoring and evaluation surveys that create feedback loops between suppliers and consumers of scientific knowledge.

The attendees enjoyed 44 oral presentations and 15 posters covering a wide range of subjects of interest to technology transfer and science delivery professionals. Program details can be found at www.sref.info/2006/techtransfer. Proceedings are being prepared and will be announced on the Web site.

*Mike Rauscher, research forester housed in the SRS science delivery group, is the creative force behind the development and implementation of the Forest Encyclopedia Network, available online at www.forestencyclopedia.net/.*

## SRS Chief's Awards

Two SRS research scientists and a multicultural program manager have received this year's prestigious USDA Forest Service Chief's Awards. **John Stanturf**, **Kenneth Outcalt**, and **Louise K. Wyche** were honored for outstanding individual achievements in areas that recognized cutting edge research as well as multiculturalism throughout the Agency. From a competitive pool of 200 nominees nationally, they were among 35 recipients of awards at a Washington, DC, ceremony early September 2006.

**John Stanturf**, project leader for the **SRS Center for Disturbance Science** based in Athens, GA, received the Chief's Distinguished Scientist Award for his leadership in developing methods for restoration of temperate forests and for developing innovative methods to rehabilitate and restore southern forest ecosystems. For more than 25 years, he has demonstrated leadership in academic, public, and private sector communities, and is recognized internationally as a forest restoration expert. Stanturf has authored numerous scientific publications and is affiliated with a variety of professional and scientific organizations, including the Society of American Foresters and the International Union of Forestry Research Organizations.

**Kenneth Outcalt**, research forester with the **SRS Center for Disturbance Science**, received the Chief's Natural Resource Stewardship Award in recognition of his innovative approaches to stewardship of the unique longleaf pine ecosystem by restoring fire disturbance, and reducing the risk of wildfire while protecting biodiversity on national forest land. A 29-year careerist with SRS, Outcalt's focuses his research efforts on fire and plant ecology and silviculture.

**Louise Wyche**, SRS program manager stationed at Alabama A&M University (AAMU) in Normal, AL, received the Chief's Multicultural Organization Award for exceptional effort, commitment, and support of the Forest Service Multicultural Workforce Strategic Initiative's goal to build and retain a multicultural organization. During her 14 years with SRS, Wyche has worked tirelessly with numerous industries, agencies, and organizations across the country to recruit and train diverse students from AAMU for professional careers throughout the Forest Service.

Each Chief's Award recipient also received an SRS Director's Award earlier this year.

**Jim Barnett** *(USDA Forest Service photo)*

## Barnett Receives Life-Time Achievement Award

**James Barnett**, retired project leader of the **SRS Ecology and Management of Even-Aged Southern Pine Forests** unit in Pineville, LA, received a life-time achievement award from the Southern Forest Nursery Association during their bi-annual meeting in Tyler, TX, July 10–13, 2006. Barnett was recognized for the vision, energy, and leadership he brought to his more than 40 years of Forest Service research—and for his commitment to restoring southern pines to their former range. Through his research, Barnett enhanced seed germination and nursery practices that underlie the success of current efforts to afforest and reforest southern pines. He is recognized as an international authority on nurseries and regeneration.

## Upcoming Conferences 2006–2007

**2006**

**Dec. 18–20** — Soils and Restoration Ecology conference, DePaul University, Chicago, Il.
www.srs.fs.usda.gov/events/sre/

**2007**

**Feb. 26–Mar. 1** — 14th Biennial Southern Silvicultural Research Conference, Athens, GA.
www.srs.fs.usda.gov/bssrc2007/

**Feb. 28–Mar. 2** — "Timberlands in Transition," Coastal Plain Chapter, Society for Ecological Restoration, Apalachicola, FL.
www.ser.org/cpc/default.asp

**May 14–19** — IUFRO Forest Landscape Restoration Conference, Seoul, South Korea.
www.srs.fs.usda.gov/korea/

**June 6–8** — EastFire II Conference, George Mason University, Fairfax, VA.
eastfire.gmu.edu/temp/eastfirewatch/conference.htm

**Autumn at SRS Headquarters, Asheville, NC** *(photo by Rodney Kindlund, USDA Forest Service)*

# NEW PRODUCTS

## *Natural Resources Inventory and Monitoring*

**1** Bentley, James W.; Cartwright, Walter E. 2006. **Alabama's timber industry—an assessment of timber product output and use, 2003.** Resour. Bull. SRS-107. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 45 p.

In 2003, roundwood output from Alabama's forests totaled 1.08 billion cubic feet. Mill byproducts generated from primary manufacturers amounted to 410 million cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Pulpwood was the leading roundwood product at 521 million cubic feet; saw logs ranked second at 404 million cubic feet; veneer logs were third at 107 million cubic feet. The number of primary processing plants was 178. Total receipts amounted to 1.1 billion cubic feet.

**2** Bentley, J.W.; Howell, M.; Johnson, T.G. 2006. **Florida's timber industry—an assessment of timber product output and use, 2003.** Resour. Bull. SRS-110. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 40 p.

In 2003, volume of roundwood output from Florida's forests totaled 509 million cubic feet, 2 percent more than in 1999. Mill byproducts generated from primary manufacturers decreased to 151 million cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Pulpwood was the leading roundwood product at 271 million cubic feet; saw logs ranked second at 171 million cubic feet; veneer logs were third at 32 million cubic feet. Total receipts declined 2 percent to 484 million cubic feet. The number of primary processing plants declined from 93 in 1999 to 92 in 2003.

# *from the Southern Research Station...*

**3** Bentley, James W.; Johnson, T.G. 2006. **North Carolina harvest and utilization study, 2002.** Resour. Bull. SRS-109. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 23 p.

In 2002, a harvest and utilization study was conducted on 108 operations throughout North Carolina. There were 2,926 total trees measured; 1,693, or 58 percent, were softwood, while 1,233, or 42 percent, were hardwood. Results from this study showed that 86 percent of the total softwood volume measured was utilized for a product, and 14 percent was left as logging residue. Seventy-five percent of the total hardwood volume measured was utilized for a product, while 25 percent was left as logging residue.

**4** Howell, Michael; Becker, Charles W. 2006. **Virginia's timber industry—an assessment of timber product output and use, 2003.** Resour. Bull. SRS-108. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 44 p.

In 2003, roundwood output from Virginia's forests decreased to 488 million cubic feet. Mill byproducts generated from primary manufacturers totaled 174 million cubic feet, 6 percent less than in 2001. Seventy-five percent of the plant residues were used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 229 million cubic feet; pulpwood ranked second at 186 million cubic feet; composite panels were third at 54 million cubic feet. The number of primary processing plants decreased from 248 in 2001 to 234 in 2003. Total receipts remained stable at 492 million cubic feet.

**5** Howell, M.; New, B.D.; Mann, M.C. 2006. **North Carolina's timber industry—an assessment of timber product output and use, 2003.** Resour. Bull. SRS-112. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 42 p.

In 2003, industrial roundwood output from North Carolina's forests totaled 776 million cubic feet, 2 percent more than in 2001. Mill byproducts generated from primary manufacturers increased four-tenths of 1 percent to 315 million cubic feet. Almost all plant residues were used primarily for fuel and fiber products. Saw logs were the leading roundwood product at 399 million cubic feet; pulpwood ranked second at 267 million cubic feet; veneer logs were third at 57 million cubic feet. The number of primary processing plants declined from 249 in 2001 to 235 in 2003. Total receipts increased 20.7 million cubic feet to 742 million cubic feet.

**6** Johnson, T.G.; Steppleton, C.D. 2006. **Southern pulpwood production, 2004.** Resour. Bull. SRS-111. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 39 p.

In 2004, the South's production of pulpwood increased from 61.3 million cords in 2003 to 63.8 million cords. Roundwood production increased 6 percent to 47.0 million cords and accounted for 74 percent of the total pulpwood production. The use of wood residue declined 1 percent to 16.8 million cords. Alabama led the South in total production at 10.2 million cords. In 2004, 89 mills were operating and drawing wood from the 13 Southern States. Pulping capacity of Southern mills declined from 127,390 tons per day in 2003 to 125,182 tons per day, and still accounts for more than 70 percent of the Nation's pulping capacity.

**7** Oswalt, Sonja N.; Brandeis, Thomas J.; Dimick, Britta P. 2006. **Phytosociology of vascular plants on an international biosphere reserve: Virgin Islands National Park, St. John, U.S. Virgin Islands.** Caribbean Journal of Science. 42(1): 53-66.

The Virgin Islands National Park on the island of St. John, U.S. Virgin Islands, is one of the few protected contiguous tracts of Lesser Antillean dry and moist forest in the Caribbean basin, a biodiversity "hotspot" of internationally recognized importance. We investigated the relationships of vegetation communities to environmental variables and compared the relative contribution of native and introduced species in extant forest communities on St. John using an island-wide forest vegetation inventory and monitoring network of permanent plots.

## *Forest Ecosystem Restoration and Management*

**8** Bragg, Don C. 2005. **Learning the hard way: the beginnings of Forest Service research in Arkansas.** Journal of Forestry. 103(5): 248-254.

People take for granted that forestry, and the research that supports it, has always been around. In reality, the establishment of a research basis to the practices of the Forest Service has been a long-running struggle. In Arkansas, Forest Service staff began assisting landowners just after the turn of the 20th century, and formed the basis of most forest research and extension until other agencies started contributing substantially around 1940. The formation of the Southern Forest Experiment Station in 1921, eventually followed by the establishment of the Crossett and Sylamore experimental forests, further

strengthened the forestry research program in Arkansas, and allowed for the widespread implementation of sustainable, scientifically based forestry.

**9** Lang, Ping; Dane, Fenny; Kubisiak, Thomas L. 2006. **Phylogeny of Castanea (Fagaceae) based on chloroplast trnT-L-F sequence data.** Tree Genetics & Genomes. 2(3): 132-139.

Species within the genus Castanea (the chestnuts and chinkapins) are native to the temperate zones of the Northern Hemisphere, from Asia to Europe and North America. The genus Castanea has been divided into three sections based on bur and cupule characteristics. Chloroplast DNA sequence data suggest that evolutionary interrelationships among the Castanea species may be more appropriately described not by bur and cupule characteristics, but by current geographic distributions. A number of chloroplast DNA markers are now available for hypothesizing the likely maternal lineage of any Castanea tree, an issue of great importance to the breeding efforts aimed at restoring American chestnut to forests of the Eastern United States.

**10** Ma, Siyan; Chen, Jiquan; Butnor, John R. [and others]. 2005. **Biophysical controls on soil respiration in the dominant patch types of an old-growth, mixed-conifer forest.** Forest Science. 51(3): 221-232.

California's Sierra Nevada old-growth, mixed-conifer forests are comprised of several ecological patch types, which cycle carbon in very different ways. These patches are in close proximity and vary from large forest trees (sugar pine, red fir, white fir), to nitrogen-fixing ceanothus shrubs and dry sandy patches with drought-adapted plants. To understand the factors which control seasonal losses of carbon to the atmosphere, we used portable and automated measurement systems to sample soil respiration from snow melt to mid-summer drought. The highest respiration rates were found in the shrub system, followed by the forest and bare soil patches. The soil respiration rate varied with changes in daily temperature, though moisture effects dominated the response. Shortly after snow melt, saturated conditions inhibited respiration, there was a long period in the spring where optimum soil moisture produced the highest flux rates, and then summer drought reduced rates. Using this data we developed an exponential model to calculate the total soil C flux summed by an area-weighted average across all three patch types (660 ± 163 g C m-2) for year 2000.

**11** Roberds, James H.; Strom, Brian L. 2006. **Repeatability estimates for oleoresin yield measurements in three species of the southern pines.** Forest Ecology and Management. 228: 215-224.

The southern pine beetle is the most destructive insect pest of pines inhabiting the Southeastern United States. Individual trees of these species that discharge large quantities of oleoresin upon wounding are considered to be most resistant to attack by this aggressive bark beetle. A tree's capacity to produce oleoresin can be assessed by measuring amounts of this chemical composite that flow from small surface wounds cut into its trunk at breast height. To evaluate the ability of trees to yield oleoresin, investigators need to know how many of these measurements are required per tree for a proper assessment. Answers to this and other related significant questions dealing with variability in tree oleoresin yield can be obtained by studying its repeatability, a measure of trait consistency within individuals. In this paper we report estimates of repeatability for oleoresin yield in three species of the southern pines.

**12** Sword Sayer, Mary Anne; Haywood, James D. 2006. **Fine root production and carbohydrate concentrations of mature longleaf pine (*Pinus palustris* P. Mill.) as affected by season of prescribed fire and drought.** Trees. 20:165-175.

Our goal was to assess how season of prescribed fire affects root growth and carbohydrate concentrations of longleaf pine, and identify the time of year when fire least affects root processes. Root growth was less on July-burned plots than on either March- or May-burned plots; we attribute this to the effect of fire on interaction between root processes and soil environment. Soil moisture and temperature may have been less favorable for root growth on the July-burned plots. We determined that fire would impact tree growth less in November through March. Also, severe drought was associated with a 3-month delay in peak root growth, and prolonged drought coincided with a reduction in root starch storage. We conclude that season of prescribed fire affects root processes, but that severe or prolonged drought may interact with or override these effects.

## *Forest Values, Uses, and Policies*

**13** Behm, Anna L.; Duryea, Mary L. 2003. **Fire in the wildland-urban interface: considering fire in Florida's ecosystems.** Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences; USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information. 14 p. [Editor's note: This publication was funded by the National Fire Plan through the USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information.]

Many Floridians live close to or within natural ecosystems of Florida in an area termed the wildland-urban interface. The wildlands associated with the interface

depend on fire to maintain biodiversity and health. In the absence of fire, vegetation quickly grows, creating fuel for very intense wildfire. In many wildlands, fire in these ecosystems is inevitable because of lightning or human-caused ignitions. With this threat of wildfire, the serenity of living in these environments can be disrupted. Because of the differences in plant species, soils, and water availability, wildfire frequency and intensity vary among the ecosystems which are associated with the wildland-urban interface.

**14** Behm, Anna L.; Long, Alan J.; Monroe, Martha C. [and others]. [Date unknown]. **Fire in the wildland-urban interface: preparing a firewise plant list for WUI residents.** Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences; USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information. 11 p. [Editor's note: Wayne C. Zipperer and L. Annie Hermansen-Báez, Southern Research Station, co-authored this publication.]

This is a guide for making local firewise plant lists that can assist local homeowners with firewise landscaping. It includes a step-by-step method for determining whether or not a particular plant is appropriate for firewise landscaping. Extension agents, nursery personnel, landscape architects, and urban foresters can use this publication for preparing local firewise plant lists.

**15** Clark, Alexander, III; Daniels, Richard F.; Jordan, Lewis. 2005. **Juvenile/mature wood transition in loblolly pine as defined by annual ring specific gravity, proportion of latewood, and microfibril angle.** Wood and Fiber Science. 38(2): 292-299.

Intensively managed southern pines grow rapidly during the early years of rotation, reach merchantable size at a younger age, and contain a significantly high proportion of juvenile wood. Juvenile wood is a cylinder of wood surrounding the pith and extending the length of all trees, and is produced by young cambium in the live active crown. Juvenile wood has lower stiffness and strength and more longitudinal shrinkage than mature wood, and is not as desirable for lumber production. Landowners and lumber manufactures need to understand the effect of forest management practices on juvenile wood formation. This paper evaluates two methods for determining the year of transition when a tree stops producing juvenile wood and starts to produce mature wood 4.5 feet above ground, based on annual ring specific gravity, proportion of latewood, and mircofibril angle.

**16** Doran, J. Douglas; Randall, Cotton K.; Long, Alan J. 2004. **Fire in the wildland-urban interface: selecting and maintaining firewise plants for landscaping.** Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences; USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information. 7 p.

One of the major issues in the southern wildland-urban interface is the loss of homes to wildfire. Selecting landscape plants based on their flammability can be challenging for homeowners and landscapers, as few plant guides list firewise plants or rank plants by their flammability. This publication outlines key plant characteristics that have the greatest effect on flammability, which can help homeowners make informed decisions about which plants to select when creating an area of defensible space, or how to modify existing plants to prevent the spread of wildfire. Plant characteristics are discussed at three levels: plant parts (primarily leaves), whole plants, and groups of plants. Selecting firewise plants can reduce wildfire risk; but during drought conditions, most plants will burn if exposed to enough heat, regardless of their flammability.

*(photo by Larry Kohrnak, University of Florida)*

**17** Eberhardt, Thomas L.; So, Chi-Leung; Herlihy, Amy H.; So, Po-Wah. 2006. **Use of gadolinium chloride as a contrast agent for imaging spruce knots by magnetic resonance.** Wood and Fiber Science. 38(3): 527-234.

Treatments of spruce wood blocks with a paramagnetic salt, gadolinium (III) chloride, in combination with solvent pretreatments, provided the first assessment of contrast agents as a means to enhance the visualization of wood features by magnetic resonance imaging (MRI). Images collected in collaboration with researchers at the MRC Clinical Sciences Centre (Imperial College, London, UK) showed that the incorporated gadolinium ions resulted in an abrupt loss in signal in a zone around each knot. This phenomenon allows the visualization of compression wood known to surround softwood knots. Applications include studies on wood anatomy by MRI and the modeling of wood defects.

**18** Randall, Cotton K. 2003. **Fire in the wildland-urban interface: understanding fire behavior.** Gainesville, FL: University of Florida, Institute of Food and Agricultural Sciences; USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information. 6 p. [Editor's note: This publication was funded by the National Fire Plan through the USDA Forest Service, Southern Research Station, Southern Center for Wildland-Urban Interface Research and Information.]

Wildland fires pose a serious threat to human life and property when homes are built in fire-prone ecosystems. Developing a basic understanding of the factors that determine wildfire movement and intensity (collectively called fire behavior) will allow homeowners and builders to assess fire hazard on their property and determine what they can do to minimize risk. Research has shown that the most important factors influencing building survival during a wildfire are fire intensity, vegetation characteristics, and building materials (especially roofing). Strategies for protecting homes from wildfires have been developed with these factors in mind. This Extension fact sheet examines factors that affect fire behavior, strategies to reduce fire risk, and examples of risk reduction.

**19** Shupe, Todd F.; Groom, Leslie H.; Eberhardt, Thomas L. [and others]. 2006. **Mechanical and physical properties of composite panels manufactured from Chinese tallow tree furnish.** Forest Products Journal. 56(6): 64-67.

Chinese tallow tree is a noxious, invasive plant in the Southeastern United States. It is generally considered a nuisance and has no current commercial use. The objective of this research was to determine the technical feasibility of using the stem wood of this species for particleboard, fiberboard, and structural flakeboard. Due to its rapid growth, Chinese tallow tree could be a leading raw material for bio-based composite panels. This preliminary study indicated that Chinese tallow tree can be successfully used for all three composite panel types to produce panels meeting various American National Standards Institute grades based on modulus of rupture, modulus of elasticity, and internal bond.

## *Threats to Forest Health*

**20** Fraedrich, Stephen W.; Cram, Michelle M.; Zarnoch, Stanley J. 2005. **The effect of fallow on *Longidorus americanus*, a nematode associated with stunting of loblolly pine seedlings in Georgia (USA).** Nematology 7 (4): 487-493.

Basic information about soil-borne pests that occur in forest tree nurseries is essential to development of integrated pest management programs. *Longidorus americanus* is a plant-parasitic nematode that causes severe stunting of loblolly

*(photo by Rodney Kindlund, USDA Forest Service)*

pine seedlings. Field and growth chamber studies determined that population densities of this nematode decreased rapidly in fallow soil in 3 to 4 months, and were not detectible after 9 to 12 months. *Longidorus americanus* does not survive well in the absence of a host, and the use of fallow may be an acceptable alternative to pesticides for the control of this nematode.

**21** Fraedrich, Stephen W.; Dwinell, L. David. 2005. **Effects of dazomet, metam sodium, and oxamyl on *Longidorus* populations and loblolly pine seedling production.** Southern Journal of Applied Forestry. 29(3): 117-122.

Soil fumigation with methyl bromide has been a standard practice for control of soil-borne pest problems in forest tree nurseries. The use of methyl bromide is currently being phased out worldwide because the chemical has been implicated in the depletion of stratospheric ozone. We found that alternative fumigants, dazomet and metam sodium, were effective for reducing population densities of a plant-parasitic nematode responsible for stunting loblolly pine seedlings. Pine seedlings produced in nursery beds with the fumigants were significantly larger than those produced in nonfumigated beds. Although fumigation was effective for control of the nematode during the first seedling crop, production of a second crop without additional treatment would be inadvisable because of increases in nematode populations by the end of the first growing season.

**22** Riitters, Kurt H.; Wickham, James D.; Wade, Timothy G. 2006. **Evaluating ecoregions for sampling and mapping land-cover patterns.** Photogrammetric Engineering & Remote Sensing. 72(7): 781-788.

An ecoregion is an area defined by biophysical parameters such as climate and topography that contains a distinct assemblage of natural communities. Ecological assessments use ecoregions, like counties and watersheds, as geographic units for sampling and mapping environmental conditions. This research evaluated the use of ecoregions for monitoring forest fragmentation and other land-cover patterns across the lower 48 States. Ecoregions proved effective for explaining the gross regional distribution of dominant land-cover types, but were no more effective than counties or watersheds for explaining the geographic distribution of forest fragmentation or other land-cover patterns.

**23** Zurlini, G.; Riitters, K.; Zaccarelli, N. [and others]. 2006. **Disturbance patterns in a socio-ecological system at multiple scales.** Ecological Complexity. 3: 119-128.

Complexity theory offers potential to understand the dynamics of land use in relation to ecological health in human-dominated landscapes, but field tests are required to develop tools and techniques for analysis. This research explored the use of remote sensing to characterize disturbance patterns representing land use changes, and the use of complexity theory to interpret the results. The results indicate that the likelihood and pattern of disturbance have characteristic spatial scales, which, in turn, suggests that the concepts of "scale domains" and "attractors" from complexity theory will help to understand, model, and evaluate the importance of landscape changes over time.

## *Forest Watershed Science*

**24** Adams, Susan B.; Warren, Melvin L., Jr. 2005. **Recolonization by warmwater fishes and crayfishes after severe drought in upper Coastal Plain hill streams.** Transactions of American Fisheries Society. 134: 1173-1192.

An extreme drought in 2000 dried numerous small, normally perennial streams in northern Mississippi. We studied 12 stream reaches where we had predrought data, and sampled the fish and crayfish for one year after the drought. Seven of the reaches had dried during the drought, whereas five remained flowing. Flows resumed in late autumn 2000, and recolonization was slow over the winter. Recolonization increased considerably during early spring 2001; by June, fish abundance, species composition, and species richness and crayfish density in dry sites were similar to predrought values. Although in general the fauna recovered quickly, some lingering effects on fish and crayfish assemblages persisted after one year. The results are useful for understanding and predicting effects of disturbance and habitat fragmentation on stream communities.

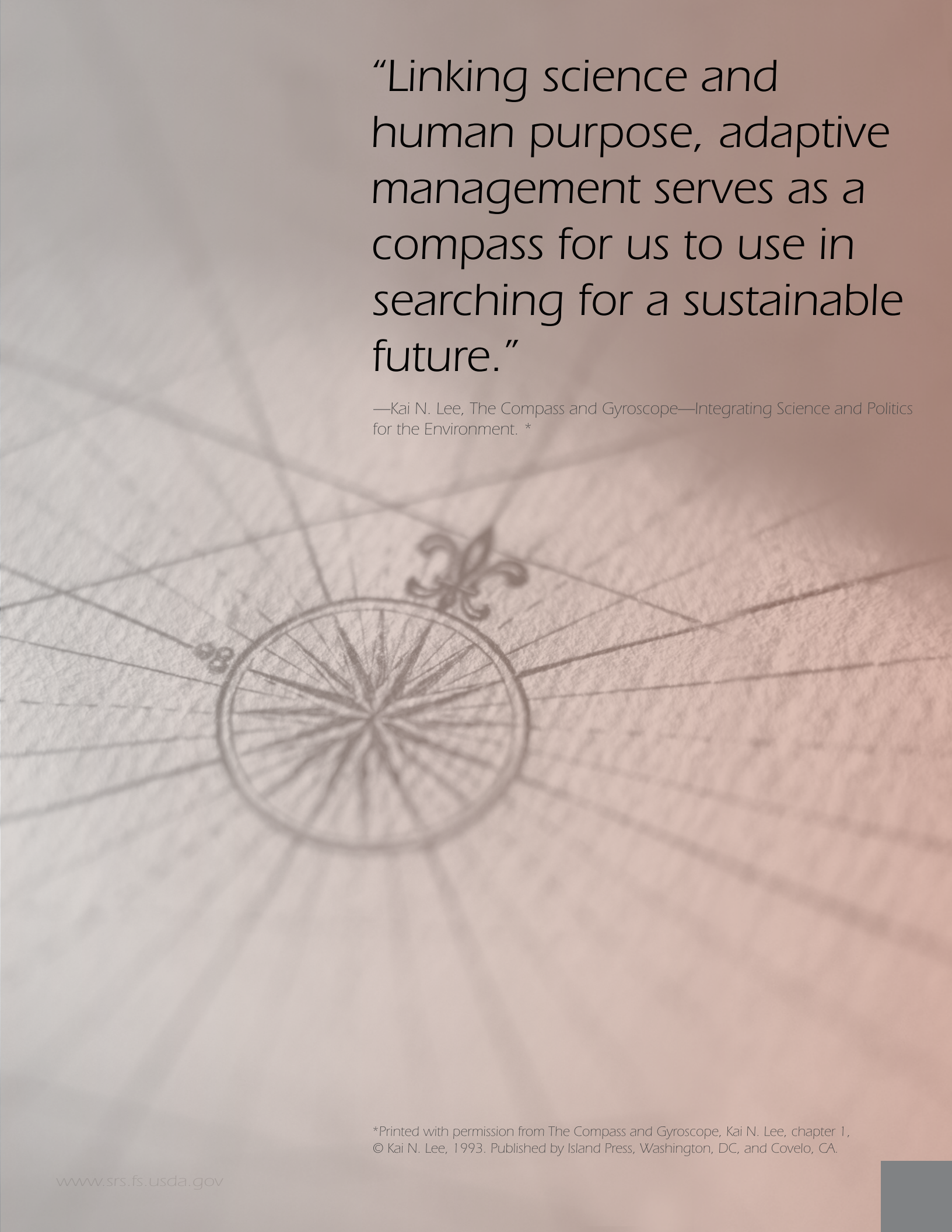
**25** Sanchez, Felipe Garza; Leggett, Zakiya Holmes; Sankar, Sabapathy. 2005. **Analyzing water soluble soil organics as trifluoroacetyl derivatives by liquid state proton nuclear magnetic resonance.** Communications in Soil Science and Plant Analysis. 36: 2793-2805.

Water soluble organic compounds are important in forests because they provide a food source for soil microbes, assist in cycling nutrients, and help build up carbon in the soil. These organic compounds come primarily from live and dead roots, and decomposing leaves. In order to examine how land management affects carbon and nutrient cycling, we need to be able to determine how the amount and composition of the water soluble organics have been altered. We describe a method by which we can detect amounts as low as a few millionths of a gram and yet maintain the ability to determine the chemical composition of the material.

(photo by Rodney Kindlund, USDA Forest Service)

# Research Work Units

| Location & Project Leader | Name & Web Site | Phone |
|---|---|---|
| **Forest Ecosystem Restoration and Management** | | |
| Asheville, NC<br>David Loftis | Upland Hardwood Ecology & Management<br>www.srs.fs.usda.gov/bentcreek | 828-667-5261 |
| Auburn, AL<br>Kris Connor | Restoring Longleaf Pine Ecosystems<br>www.srs.fs.usda.gov/4111 | 334-826-8700 |
| Monticello, AR<br>James Guldin | Southern Pine Ecology<br>www.srs.fs.usda.gov/4106 | 870-367-3464 |
| Saucier, MS<br>Dana Nelson | Genetics and Foundations of Productivity<br>www.srs.fs.usda.gov/organization/unit/mississippi.htm#SRS-4153 | 228-832-2747 |
| **Forest Values, Uses, and Policies** | | |
| Athens, GA<br>Ken Cordell, acting | Urban and Social Influences<br>www.srs.fs.usda.gov/trends | 706-559-4263 |
| Auburn, AL<br>Bob Rummer | Forest Operations<br>www.srs.fs.usda.gov/forestops/ | 334-826-8700 |
| Pineville, LA<br>Les Groom | Characterization and Properties of Wood<br>www.srs.fs.usda.gov/4701 | 318-473-7268 |
| Research Triangle Park, NC<br>David Wear | Forest Economics and Policy<br>www.srs.fs.usda.gov/econ | 919-549-4093 |
| **Threats to Forest Health** | | |
| Asheville, NC<br>Danny Lee | Eastern Forest Environmental Threat Assessment Center<br>www.srs.fs.usda.gov/cc/threatassessment.htm | 828-257-4854 |
| Athens, GA<br>John Stanturf | Disturbance Ecology<br>http://srs.fs.usda.gov/disturbance | 706-559-4316 |
| Pineville, LA<br>Kier Klepzig | Insects, Diseases, and Invasive Plants of Southern Forests<br>www.srs.fs.usda.gov/4501 | 318-473-7232 |
| **Forest Watershed Science** | | |
| Franklin, NC<br>Jim Vose | Forest Watershed Science<br>www.srs.fs.usda.gov/coweeta | 828-524-2128 |
| Lincoln, NE<br>Michele Schoeneberger | National Agroforestry Center<br>www.nac.gov | 402-437-5178 |
| Stoneville, MS<br>Ted Leininger | Bottomland Hardwoods<br>www.srs.fs.usda.gov/cbhr | 662-686-3154 |
| **Natural Resources Inventory and Monitoring** | | |
| Knoxville, TN<br>Bill Burkman | Forest Inventory and Analysis<br>www.srsfia2.fs.fed.us | 865-862-2000 |



*"Linking science and human purpose, adaptive management serves as a compass for us to use in searching for a sustainable future."*

—Kai N. Lee, The Compass and Gyroscope—Integrating Science and Politics for the Environment. *

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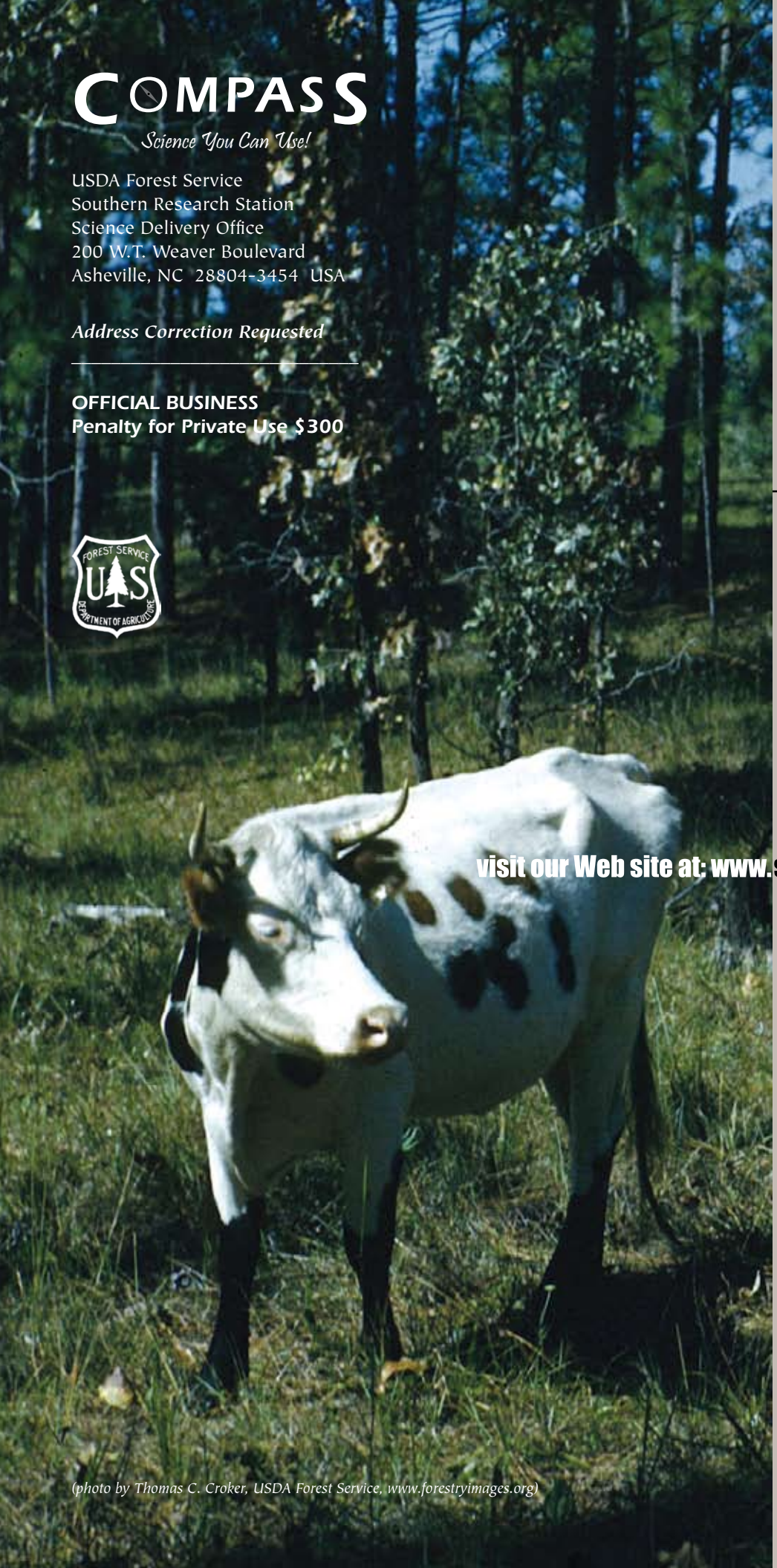

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***In the next issue of Compass, we will look at a wide range of practices developed by SRS research to "clean up" the environment. These practices range from using fast-growing trees to establish buffers and clean toxic waste from soil to constructing and restoring wetlands.***

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